

4. Store detention doors and frames under cover at building site. Place units in a vertical position with heads up, spaced by blocking, on minimum **4-inch- (102-mm-)** high wood blocking. Avoid using nonvented plastic or canvas shelters that could create a humidity chamber.
 - a. Provide minimum **1/4-inch (6-mm)** space between each stacked unit to permit air circulation.

H. Maintenance Tools

1. Tool Kit: Provide six sets of tools for use with security fasteners, each packaged in a compartmented kit configured for easy handling and storage.

1.2 PRODUCTS

A. Materials

1. Hot-Rolled Steel Sheet: ASTM A 1011/A 1011M, CS (Commercial Steel), Type B; free of scale, pitting, or surface defects; pickled and oiled.
2. Cold-Rolled Steel Sheet: ASTM A 1008/A 1008M, CS (Commercial Steel), Type B.
3. Metallic-Coated Steel Sheet: ASTM A 653/A 653M, CS (Commercial Steel), Type B; with **G60 (Z180)** zinc (galvanized) or **A60 (ZF180)** zinc-iron-alloy (galvannealed) coating designation.
4. Stainless-Steel Sheet: ASTM A 240/A 240M, austenitic stainless steel, Type 304.
5. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.
6. Concealed Bolts: ASTM A 307, Grade A unless otherwise indicated.
7. Masonry Anchors: Fabricated from same steel sheet as door face.
8. Embedded Anchors: Fabricated from mild steel shapes and plates, hot-dip galvanized according to ASTM A 153/A 153M.
9. Postinstalled Expansion Anchors: With capability to sustain, without failure, a load equal to 4 times the load imposed, as determined by testing per ASTM E 488, conducted by a qualified independent testing agency.
 - a. Corrosion Protection: Carbon-steel components zinc plated to comply with ASTM B 633, Class Fe/Zn 5 (0.005 mm) for Class SC 1 service condition (mild).
 - b. Corrosion Protection: Stainless-steel components complying with **ASTM F 593 and ASTM F 594, Alloy Group 1 or 2 (ASTM F 738M and ASTM F 836M, Alloy Group 1 or 4)** for bolts and nuts; ASTM A 276 or ASTM A 666, Type 304 or 316, for anchors.
 - c. Corrosion Protection: Components fabricated from nickel-copper-alloy rods complying with ASTM B 164 for UNS No. N04400 alloy.
10. Welding Rods and Bare Electrodes: Select according to AWS specifications for metal alloy welded.
11. Glazing: Comply with Division 08 Section "Security Glazing".
12. Grout: Comply with ASTM C 476, with a slump of not more than **4 inches (102 mm)** as measured according to ASTM C 143/C 143M.
13. Insulation: Slag-wool-fiber/rock-wool-fiber or glass-fiber blanket insulation. ASTM C 665, Type I (unfaced); with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively; passing ASTM E 136 for combustion characteristics. Minimum **1.5-lb/cu. ft. (24-kg/cu. m)** density.
14. Bituminous Coating: Cold-applied asphalt mastic, SSPC-Paint 12, compounded for **15-mil (0.4-mm)** dry film thickness per coat. Provide inert-type noncorrosive compound free of asbestos fibers, sulfur components, and other deleterious impurities.

B. Detention Doors

1. General: Provide flush-design detention doors of seamless hollow construction, **2 inches (51 mm)** thick unless otherwise indicated. Construct detention doors with smooth, flush surfaces without visible joints or seams on exposed faces or stile edges.
 - a. For single-acting swinging detention doors, bevel both vertical edges **1/8 inch in 2 inches (3 mm in 51 mm)**.
 - b. For sliding detention doors, square both vertical edges.
2. Core Construction: Provide the following core construction of same material as detention door face sheets, welded to both detention door faces:

- a. Steel-Stiffened Core: **0.042-inch- (1.0-mm-)** thick, steel vertical stiffeners extending full-door height, with vertical webs spaced not more than **4 inches (102 mm)** apart, spot welded to face sheets a maximum of **3 inches (76 mm)** o.c. Fill spaces between stiffeners with insulation.
 - b. Truss-Stiffened Core: **0.013-inch- (0.3-mm-)** thick, steel, truncated triangular stiffeners extending between face sheets and for full height and width of door; with stiffeners welded to face sheets not more than **3 inches (76 mm)** o.c. vertically and **2-3/4 inches (70 mm)** horizontally. Fill spaces between stiffeners with insulation.
3. Vertical Edge Channels: **0.123-inch- (3.1-mm-)** thick, continuous channel of same material as detention door face sheets, extending full-door height at each vertical edge; welded to top and bottom channels to create a fully welded perimeter channel. Noncontiguous channel is permitted to accommodate lock-edge hardware only if lock reinforcement is welded to and made integral with channel.
4. Top and Bottom Channels: **0.123-inch- (3.1-mm-)** thick metal channel of same material as detention door face sheets, spot welded, not more than **4 inches (102 mm)** o.c., to face sheets.
 - a. Reinforce top edge of detention door with **0.053-inch- (1.3-mm-)** thick closing channel, inverted and nesting in top channel; welded so channel web is flush with top door edges.
5. Hardware Reinforcement: Fabricate reinforcing plates from same material as detention door face sheets to comply with the following minimum thicknesses:
 - a. Full-Mortise Hinges and Pivots: **0.187 inch (4.7 mm)** thick.
 - b. Maximum-Security Surface Hinges: **0.250 inch (6.3 mm)** thick.
 - c. Strike Reinforcements: **0.187 inch (4.7 mm)** thick.
 - d. Slide-Device Hanger Attachments: As recommended by device manufacturer.
 - e. Lock Fronts, Concealed Holders, and Surface-Mounted Closers: **0.093 inch (2.3 mm)** thick.
 - f. All Other Surface-Mounted Hardware: **0.093 inch (2.3 mm)** thick.
 - g. Lock Pockets: **0.123 inch (3.1 mm)** thick at non-inmate side, welded to face sheet.
6. Hardware Enclosures: Provide enclosures and junction boxes for electrically operated detention door hardware of same material as detention door face sheets, interconnected with UL-approved, **1/2-inch- (13-mm-)** diameter conduit and connectors.
 - a. Where indicated for installation of wiring, provide access plates to junction boxes, fabricated from same material and thickness as face sheet and fastened with at least 4 security fasteners spaced not more than **6 inches (152 mm)** o.c.
7. Interior Detention Door Face Sheets: Fabricated from cold-rolled steel sheets **OR** metallic-coated steel sheets **OR** stainless-steel sheets, **as directed**.
 - a. Security Grade 1: **0.093-inch- (2.3-mm-)** minimum-thickness steel **OR 0.109-inch (2.8-mm)** nominal-thickness stainless steel, **as directed**.
 - b. Security Grade 2: **0.093-inch- (2.3-mm-)** minimum-thickness steel **OR 0.109-inch (2.8-mm)** nominal-thickness stainless steel, **as directed**.
 - c. Security Grade 3: **0.067-inch- (1.7-mm-)** minimum-thickness steel **OR 0.078-inch (2.0-mm)** nominal-thickness stainless steel, **as directed**.
 - d. Security Grade 4: **0.067-inch- (1.7-mm-)** minimum-thickness steel **OR 0.078-inch (2.0-mm)** nominal-thickness stainless steel, **as directed**.
8. Exterior Detention Door Face Sheets: Fabricated from metallic-coated steel sheets **OR** stainless-steel sheets, **as directed**.
 - a. Security Grade 1: **0.093-inch- (2.3-mm-)** minimum-thickness steel **OR 0.109-inch (2.8-mm)** nominal-thickness stainless steel, **as directed**.
 - b. Security Grade 2: **0.093-inch- (2.3-mm-)** minimum-thickness steel **OR 0.109-inch (2.8-mm)** nominal-thickness stainless steel, **as directed**.
 - c. Security Grade 3: **0.067-inch- (1.7-mm-)** minimum-thickness steel **OR 0.078-inch (2.0-mm)** nominal-thickness stainless steel, **as directed**.
 - d. Security Grade 4: **0.067-inch- (1.7-mm-)** minimum-thickness steel **OR 0.078-inch (2.0-mm)** nominal-thickness stainless steel, **as directed**.

C. Detention Panels

1. Provide fixed detention panels of same materials, construction, and finish as specified for adjoining detention frame.

D. Detention Frames

1. General: Provide fully welded detention frames with integral stops, of seamless construction without visible joints or seams. Fabricate detention frames with contact edges closed tight and corners mitered, reinforced, and continuously welded full depth and width of detention frame.
2. Provide two temporary steel spreaders spot welded to bottom of jambs to act as bracing during shipping and storage. Remove prior to installation.
3. Stop Height: Provide minimum stop height of **0.625 inch (16 mm) OR 0.750 inch (19 mm), as directed**, for detention door openings and minimum stop height of **1-1/4 inches (32 mm)** in security glazing or detention panel openings unless otherwise indicated.
4. Interior Detention Frames: Fabricated from cold-rolled steel sheets **OR** metallic-coated steel sheets where indicated **OR** stainless-steel sheets for stainless-steel detention doors, **as directed**.
 - a. Security Grade 1: **0.093-inch- (2.3-mm-) minimum-thickness steel OR 0.109-inch (2.8-mm) nominal-thickness stainless steel, as directed.**
 - b. Security Grade 2: **0.093-inch- (2.3-mm-) minimum-thickness steel OR 0.109-inch (2.8-mm) nominal-thickness stainless steel, as directed.**
 - c. Security Grade 3: **0.067-inch- (1.7-mm-) minimum-thickness steel OR 0.078-inch (2.0-mm) nominal-thickness stainless steel, as directed.**
 - d. Security Grade 4: **0.067-inch- (1.7-mm-) minimum-thickness steel OR 0.078-inch (2.0-mm) nominal-thickness stainless steel, as directed.**
5. Exterior Detention Frames: Fabricated from metallic-coated steel sheets **OR** stainless-steel sheets for stainless-steel detention doors, **as directed**.
 - a. Security Grade 1: **0.093-inch- (2.3-mm-) minimum-thickness steel OR 0.109-inch (2.8-mm) nominal-thickness stainless steel, as directed.**
 - b. Security Grade 2: **0.093-inch- (2.3-mm-) minimum-thickness steel OR 0.109-inch (2.8-mm) nominal-thickness stainless steel, as directed.**
 - c. Security Grade 3: **0.067-inch- (1.7-mm-) minimum-thickness steel OR 0.078-inch (2.0-mm) nominal-thickness stainless steel, as directed.**
 - d. Security Grade 4: **0.067-inch- (1.7-mm-) minimum-thickness steel OR 0.078-inch (2.0-mm) nominal-thickness stainless steel, as directed.**
6. Hardware Reinforcement: Fabricate reinforcing plates from same material as detention frame to comply with the following minimum thicknesses:
 - a. Hinges and Pivots: **0.187 inch (4.7 mm) thick by 1-1/2 inches (38 mm) wide by 10 inches (254 mm) long.**
 - b. Strikes, Flush Bolts, and Closers: **0.187 inch (4.7 mm) thick.**
 - c. Surface-Mounted Hardware: **0.093 inch (2.3 mm) thick.**
 - d. Lock Pockets: **0.123 inch (3.1 mm) thick at non-inmate side, welded to face sheet. Provide 0.123-inch- (3.1-mm-) thick, lock protection plate for attachment to lock pocket with security fasteners.**
7. Hardware Enclosures: Provide enclosures and junction boxes for electrically operated detention door hardware, interconnected with UL-approved, **1/2-inch- (13-mm-) diameter conduit and connectors.**
 - a. Where indicated for installation of wiring, provide access plates to junction boxes, fabricated from same material and thickness as face sheet and fastened with at least 4 security fasteners spaced not more than **6 inches (152 mm) o.c.**
8. Mullions and Transom Bars: Provide closed or tubular mullions and transom bars where indicated. Fasten mullions and transom bars at crossings and to jambs by butt welding. Reinforce joints between detention frame members with concealed clip angles or sleeves of same metal and thickness as detention frame.
9. Jamb Anchors: Weld jamb anchors to detention frames near hinges and directly opposite on strike jamb or as required to secure detention frames to adjacent construction.
 - a. Number of Anchors: Provide two anchors per jamb plus the following:
 - 1) Detention Door Frames: One additional anchor for each **18 inches (457 mm), or fraction thereof, above 54 inches (1372 mm) in height.**

- 2) Detention Frames with Security Glazing or Detention Panels: One additional anchor for each **18 inches (457 mm)**, or fraction thereof, above **36 inches (914 mm)** in height.
- b. Masonry Anchors: Adjustable, corrugated or perforated, strap-and-stirrup anchors to suit detention frame size; formed of same material and thickness as detention frame; with strap not less than **2 inches (51 mm)** wide by **10 inches (254 mm)** long.
- c. Embedded Anchors: Provide detention frames with removable faces at jambs where embedded anchors are indicated. Anchors consist of three parts:
 - 1) Embedded Plates: Steel plates, **0.188 inch thick by 4 inches wide by 6 inches (4.7 mm thick by 102 mm wide by 152 mm)** long. Continuously weld 2 steel bars, **1/2 inch (13 mm)** in diameter and **10 inches (254 mm)** long with **2-inch (51-mm)** 90-degree turndown on ends, to the embedded end of each plate. Weld steel angles, **0.188 inch thick by 2 by 2 by 4 inches (4.7 mm thick by 51 by 51 by 102 mm)** long, to the exposed end of each plate. Embed at locations to match frame angles.
 - 2) Frame Angles: Steel angles, **0.188 inch thick by 2 by 2 by 4 inches (4.7 mm thick by 51 by 51 by 102 mm)** long, welded to detention frames with **1-inch- (25-mm-)** long welds at each end of angle.
 - 3) Connector Angles: Steel angles, of size required, to connect frame angles and embedded plates.
- d. Postinstalled Expansion Anchors: Minimum **1/2-inch- (13-mm-)** diameter concealed bolts with expansion shields or inserts. Provide conduit spacer from detention frame to wall, welded to detention frame. Reinforce detention frames at anchor locations.
10. Floor Anchors: Provide floor anchors for each jamb and mullion that extends to floor, formed of same material and thickness as detention frame, and as follows:
 - a. Monolithic Concrete Slabs: Clip anchors, with two holes to receive fasteners, welded to bottom of jambs and mullions with at least four spot welds per anchor.
 - b. Separate Topping Concrete Slabs: Adjustable anchors with extension clips, allowing not less than **2-inch (51-mm)** height adjustment, welded to jambs and mullions with at least 4 spot welds per anchor. Terminate bottom of detention frames at finish floor surface.
11. Rubber Door Silencers: Except on weather-stripped detention doors, drill stops in strike jambs to receive three silencers on single-detention-door frames and drill head jamb stop to receive two silencers on double-detention-door frames. Keep holes clear during construction.
12. Grout Guards: Provide factory-installed grout guards of same material as detention frame, welded to detention frame at back of hardware cutouts, silencers, and glazing-stop screw preparations to close off interior of openings and prevent mortar or other materials from obstructing hardware operation or installation.

E. Moldings And Stops

1. Provide fixed moldings on inmate side of glazed openings and removable stops on non-inmate side.
 - a. Height: As required to provide minimum **1-inch (25-mm)** glass engagement, but not less than **1-1/4 inches (32 mm)**.
 - b. Fixed Moldings: Formed from same material as detention door and frame face sheets, but not less than **0.093-inch- (2.3-mm-)** thick, spot welded to face sheets a maximum of **5 inches (127 mm)** o.c.
 - c. Removable Stops: Formed from **0.123-inch- (3.1-mm-)** thick angle, of same material as detention door face sheets. Secure with button head security fasteners spaced uniformly not more than **9 inches (229 mm)** **OR 6 inches (152 mm)**, **as directed**, o.c. and not more than **2 inches (51 mm)** from each corner, and as necessary to satisfy performance requirements. Form corners with notched or mitered hairline joints.
2. Coordinate rabbet width between fixed and removable stops with type of glass or panel and type of installation indicated.

F. Accessories

1. Pass-Through Openings: Fabricate flush openings using **0.093-inch- (2.3-mm-)** thick interior channels of same material as detention door faces, inverted to be flush with openings, welded to inside of both face sheets and with corners fully welded. Mount shutters on non-inmate side of detention doors. Reinforce for locks and food-pass hinges.
 - a. Inset Shutters: Fabricate from 2 steel plates, **0.123 inch (3.1 mm)** thick, of same material as detention door face sheets, spot welded together and sized to inset inside opening and to prevent inmate tampering of lock and hinges.
 - b. Overlapping Shutters: For surface application on non-inmate side of door. Fabricate from a single steel plate, of same material as detention door face sheets, **0.187 inch (4.7 mm)** thick, sized to overlap food-pass openings **1/2 inch (13 mm)**.
 2. Detention Door Louvers: Fabricate flush louver openings using **0.093-inch- (2.3-mm-)** thick, interior steel channels of same material as detention door faces, welded to inside of both detention door face sheets and with corners fully welded. Provide welded, inverted V- or Y-shaped vanes allowing specified airflow, fabricated from same material as detention door face sheets, **0.093 inch (2.3 mm)** thick, and spaced so no rigid flat instrument can pass through.
 - a. Reinforcement: Reinforce louvers that exceed **18 inches (457 mm)** in height at louver midpoint with **1/4-by-1-1/2-inch- (6.3-by-38-mm-)** square, vertical rectangular steel bar or **3/4-inch- (19-mm-)** diameter, vertical steel bar.
 - b. Airflow: Airflow and static-pressure loss **as directed**.
 - c. Exterior Detention Door Insect Screens: Fabricated from **12-by-12 (2.1-by-2.1-mm)** mesh of **0.028-inch- (0.71-mm-)** diameter, stainless-steel wire or from perforated metal of same material and thickness as detention door face sheet with **1/8-inch- (3-mm-)** diameter holes spaced **1 inch (25 mm)** o.c.; where indicated.
 3. Speaking Apertures: Consisting of a rectangular pattern of holes, minimum **1 inch high by 4 inches wide (25 mm high by 102 mm wide)**, with holes **1/4 inch (6 mm)** in diameter. Locate holes in both face sheets directly across from each other and spaced not more than **1 inch (25 mm)** o.c. vertically and horizontally. Provide **0.067-inch- (1.7-mm-)** thick, pressed-steel baffles in interior of detention door between hole patterns to prevent passage of objects.
 4. Gun Ports: Fabricate units to comply with UL 752 and to resist same security level as detention doors in which they are installed.
- G. Security Fasteners
1. Security Fasteners: Operable only by tools produced for use on specific type of fastener by fastener manufacturer or other licensed fabricator.
 2. Drive-System Type, Head Style, Material, and Protective Coating: Provide as required for assembly, installation, and strength, and as follows:
 - a. Drive-System Types: Pinned Torx-Plus **OR** Pinned Torx, **as directed**.
 - b. Fastener Strength: **Grade 8 (Class 10.9)**.
 - c. Socket Button Head Fasteners:
 - 1) Heat-treated alloy steel, **ASTM F 835 (ASTM F 835M)**.
 - 2) Stainless steel, **ASTM F 879 (ASTM F 879M)**, Group 1 CW.
 - d. Socket Flat Countersunk Head Fasteners:
 - 1) Heat-treated alloy steel, **ASTM F 835 (ASTM F 835M)**.
 - 2) Stainless steel, **ASTM F 879 (ASTM F 879M)**, Group 1 CW.
 - e. Socket Head Cap Fasteners:
 - 1) Heat-treated alloy steel, **ASTM A 574 (ASTM A 574M)**.
 - 2) Stainless steel, **ASTM F 837 (ASTM F 837M)**, Group 1 CW.
 - f. Protective Coatings for Heat-Treated Alloy Steel:
 - 1) Zinc and clear trivalent chromium, for exterior applications and interior applications where indicated.
 - 2) Zinc phosphate with oil, ASTM F 1137, Grade I, or black oxide unless otherwise indicated.
- H. Fabrication
1. Fabricate detention doors and frames rigid, neat in appearance, and free of defects, warp, or buckle. Accurately form metal to required sizes and profiles, with minimum radius for thickness of

metal. Weld exposed joints continuously; grind, fill, dress, and make smooth, flush, and invisible. Where practical, fit and assemble units in manufacturer's plant. To ensure proper assembly at Project site, clearly identify work that cannot be permanently factory assembled before shipment.

2. Tolerances: Fabricate detention doors and frames to comply with manufacturing tolerances indicated in HMMA 863.
3. Fabricate multiple-opening detention frames with mullions that have closed tubular shapes and with no visible seams or joints.
4. Exterior Detention Doors: Provide weep-hole openings in bottom of detention doors to permit entrapped moisture to escape. Seal joints in top edges of detention doors against water penetration.
5. Hardware Preparation: Factory prepare detention doors and frames to receive mortised hardware, including cutouts, reinforcement, mortising, drilling, and tapping, according to final door hardware schedule and templates provided by detention door hardware supplier.
 - a. Reinforce detention doors and frames to receive surface-mounted door hardware. Drilling and tapping may be done at Project site.
 - b. Locate door hardware as indicated or, if not indicated, according to HMMA 831.
6. Factory cut openings in detention doors.
7. Weld components to comply with referenced AWS standard. Weld before finishing components to greatest extent possible. Remove weld spatter and welding oxides from exposed surfaces by descaling or grinding.

I. General Finish Requirements

1. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
2. Finish detention doors and frames after assembly.

J. Metallic-Coated Steel Sheet Finishes

1. Surface Preparation: Clean surfaces with nonpetroleum solvent so surfaces are free of oil and other contaminants. After cleaning, apply a conversion coating suited to the organic coating to be applied over it. Clean welds, mechanical connections, and abraded areas and apply galvanizing repair paint, complying with SPPC-Paint 20, to comply with ASTM A 780.
2. Factory Priming for Field-Painted Finish: Apply shop primer specified below immediately after surface preparation and pretreatment. Apply a smooth coat of even consistency to provide a uniform dry film thickness of not less than **0.7 mils (0.02 mm)**.
 - a. Shop Primer: Manufacturer's or fabricator's standard, fast-curing, lead- and chromate-free primer complying with ANSI A250.10 acceptance criteria; recommended by primer manufacturer for zinc-coated steel; compatible with substrate and field-applied finish paint system indicated; and providing a sound foundation for field-applied topcoats despite prolonged exposure.

K. Steel Sheet Finishes

1. Surface Preparation: Clean surfaces to comply with SSPC-SP 1, "Solvent Cleaning"; remove dirt, oil, grease, or other contaminants that could impair paint bond. Remove mill scale and rust, if present, from uncoated steel, complying with SSPC-SP 3, "Power Tool Cleaning," or SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
2. Factory Priming for Field-Painted Finish: Apply shop primer specified below immediately after surface preparation and pretreatment. Apply a smooth coat of even consistency to provide a uniform dry film thickness of not less than **0.7 mils (0.02 mm)**.
 - a. Shop Primer: Manufacturer's or fabricator's standard, fast-curing, corrosion-inhibiting, lead- and chromate-free, universal primer complying with ANSI A250.10 acceptance criteria; compatible with substrate and field-applied finish paint system indicated; and providing a sound foundation for field-applied topcoats despite prolonged exposure.

L. Stainless-Steel Finishes

1. Surface Preparation: Remove tool and die marks and stretch lines, or blend into finish.

2. Polished Finishes: Grind and polish surfaces to produce uniform finish, free of cross scratches.
 - a. Run grain of directional finishes with long dimension of each piece.
 - b. When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.
 - c. Directional Satin Finish: No. 4.

1.3 EXECUTION

A. Preparation

1. Remove welded-in shipping spreaders installed at factory.
2. Prior to installation and with shipping spreaders removed, adjust detention frames for squareness, alignment, twist, and plumbness to the following tolerances:
 - a. Squareness: Plus or minus **1/16 inch (1.6 mm)**, measured at door rabbet on a line 90 degrees from jamb and perpendicular to frame head.
 - b. Alignment: Plus or minus **1/16 inch (1.6 mm)**, measured at jambs on a horizontal line parallel to plane of face.
 - c. Twist: Plus or minus **1/16 inch (1.6 mm)**, measured at opposite face corners of jambs on parallel lines, and perpendicular to plane of door rabbet.
 - d. Plumbness: Plus or minus **1/16 inch (1.6 mm)**, measured at jambs on a perpendicular line from head to floor.

B. Installation

1. General: Install detention doors and frames plumb, rigid, properly aligned, and securely fastened in place, complying with Drawings, schedules, and manufacturer's written recommendations.
2. Anchorage: Set detention frame anchorage devices according to details on Shop Drawings and per anchorage device manufacturer's written instructions.
 - a. Masonry Anchors: Coordinate installation of frames to allow for solidly filling space between frames and masonry with grout.
 - b. Embedded Anchors: Install embedded plates in wall surrounding frame openings to match frame angle locations.
 - c. Postinstalled Expansion Anchors: Drill holes in existing construction at locations to match bolt locations and install bolt expansion shields or inserts.
3. Assemble detention frames fabricated in sections. Install angle splices at each corner, of same material and thickness as detention frame, and extend at least **4 inches (102 mm)** on both sides of joint.
 - a. Field splice only at approved locations. Weld, grind, and finish as required to conceal evidence of splicing on exposed faces.
 - b. Continuously weld and finish smooth joints between faces of abutted, multiple-opening, detention frame members.
 - c. Field Welding: Comply with the following requirements:
 - 1) Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
 - 2) Obtain fusion without undercut or overlap.
 - 3) Remove welding flux immediately.
 - 4) At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.
4. Apply bituminous coating to backs of frames prior to filling with grout.
5. Placing Detention Frames: Install detention frames of sizes and profiles indicated. Set detention frames accurately in position; plumb, aligned, and braced securely until permanent anchors are set. After wall construction is complete, remove temporary braces and spreaders, leaving surfaces smooth and undamaged.
 - a. Embedded Anchors: Remove jamb faces from detention frames and set detention frames into opening. Weld steel connector angle to frame angle and to embedded plate with **1-**

- inch- (25-mm-)** long welds at each end of connector angle to form a rigid frame assembly solidly anchored. Reinstall jamb faces using security fasteners.
- b. Postinstalled Expansion Anchors: Install bolt. After bolt is tightened, weld bolt head to provide nonremovable condition. Grind, dress, and finish smooth welded bolt head.
 - c. At fire-rated openings, install detention frames according to NFPA 80.
 - d. Install detention frames with removable stops located on non-inmate side of opening.
6. Grout: Fully grout detention frame jambs and heads. Completely fill space between frames and adjacent substrates. Hand trowel grout and take other precautions, including bracing detention frames, to ensure that frames are not deformed or damaged by grout forces.
 7. Swinging Detention Doors: Fit non-fire-rated detention doors accurately in their frames, with the following clearances:
 - a. Between Doors and Frames at Jambs and Head: **1/8 inch (3.2 mm)**.
 - b. Between Edges of Pairs of Doors: **1/8 inch (3.2 mm)**.
 - c. At Door Sills with Threshold: **3/8 inch (9.5 mm)**.
 - d. At Door Sills without Threshold: **3/4 inch (19.1 mm)**.
 - e. Between Door Bottom and Nominal Surface of Floor Covering: **1/2 inch (12.7 mm)**.
 8. Sliding Detention Doors: Fit sliding detention doors in their frames according to manufacturer's written instructions and as required to allow doors to slide without binding.
 9. Fire-Rated Detention Doors: Install with clearances as specified in NFPA 80.
 10. Smoke-Control Detention Doors: Install according to NFPA 105.
 11. Installation Tolerances: Comply with installation tolerances indicated in HMMA 863.
 12. Glazing: Comply with installation requirements in Division 08 Section "Security Glazing", unless otherwise indicated.
- C. Field Quality Control
1. Inspect installed products to verify compliance with requirements. Prepare inspection reports and indicate compliance with and deviations from the Contract Documents.
 2. Remove and replace detention work where inspections indicate that work does not comply with specified requirements.
 3. Perform additional inspections to determine compliance of replaced or additional work. Prepare inspection reports.
 4. Prepare field quality-control certification that states installed products and their installation comply with requirements in the Contract Documents.
 5. Select one detention door at random from detention doors delivered to Project and have it cut in half or otherwise taken apart for verification that construction complies with requirements.
 6. Test Method: Verify weld strength by prying or chiseling door apart at edge seams, end channels, or stiffeners. Not more than five percent of welds may fail test.
 - a. If tested door fails, replace or rework all detention doors to bring them into compliance at Contractor's expense.
 - b. If tested door passes, replace tested door at Contractor's expense.
- D. Adjusting And Cleaning
1. Final Adjustments: Check and readjust operating hardware items immediately before final inspection. Leave work in complete and proper operating condition. Remove and replace defective work, including detention doors and frames that are warped, bowed, or otherwise unacceptable.
 2. Clean grout and other bonding material off detention doors and frames immediately after installation.
 3. Prime-Coat Touchup: Immediately after erection, sand smooth rusted or damaged areas of prime coat and apply touchup of compatible air-drying primer.
 - a. After finishing smooth field welds, apply air-drying primer.
 4. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A 780.
 5. Stainless-Steel Surfaces: Clean surfaces according to manufacturer's written instructions.



END OF SECTION 08 34 53 00

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SECTION 08 34 53 00a - SECURITY GRILLES

DESCRIPTION OF WORK

This specification covers the furnishing and installation of materials for security grilles. Products shall be as directed by the Owner. Installation procedures shall be in accordance with the product manufacturer's recommendations. Demolition and removal of materials shall be as required to support the work.

GENERAL

System Description

1. Performance Requirements: Comply with following:
 - a. Performance Tests: Conducted by accredited independent testing laboratory in accordance with specified requirements in this Section.
 - 1) Source Quality Control Performance Tests: Conducted in shop or laboratory by accredited independent laboratory.
 - 2) Field Quality Performance Tests: Conducted in field.
 - b. Test Grilles: Completely assembled grille, including hardware, mounted vertically in accordance with manufacturer's recommendations.
 - 1) Test Grille Size: 914 mm (36 inches) wide by 1 219 mm (48 inches) high.
2. Bar Type Security Grilles:
 - a. Impact Test: Test Grille: Withstand impact force of 111 N (25 foot-pounds) with no breaking of welds or bar separation exceeding 127 mm (5 inches).
 - b. Bar Separation Test: Test Grille: Withstand bar separation test force of 227 kg (500 pounds) with no breaking of welds or bar separation exceeding 127 mm (5 inches).
 - c. Sag Test: If grille is equipped with side (jamb) hinges, Test Grille in Fully Extended Position: Withstand sag load of 34 kg (75 pounds) with permanent set after load removal not exceeding 1.6 mm (0.063 inch).
 - d. Forced Entry Resistance Test: If grille is equipped with side (jamb) hinges, test in closed position. Grille shall withstand forced entry loads and shall not be rendered openable throughout test.
3. Window Type Security Grilles:
 - a. Operating Force: Operating Panels: Operate with force exceeding 16 kg (35 pounds) after panel is in motion.
 - b. Impact Test: Test Grille: Withstand impact force of 111 N (25 foot-pounds). Sheet of double strength glass placed 76 mm (3 inches) behind grille material shall remain uncracked or unbroken after impact. No damage occurs that would allow entry through grille.
 - c. Forced Entry Resistance Test: If grille is operable, test grille in closed position. Grille shall withstand forced entry loads and shall not be rendered openable throughout test.
4. Child Guard Security Grilles:
 - a. Impact Test: Test Grille: Withstand impact force of 67 N (15 foot- pounds) with no weld or fastener breakage or bar separation exceeding 127 mm (5 inches).
 - b. Bar Separation Test: Withstand bar separation test force of 23 kg (50 pounds) with no weld or fastener breakage or bar separation exceeding 127 mm (5 inches).
5. Security Guard Security Grilles:
 - a. Impact Test: Test Grille in Fully Extended Position: Withstand impact force of 111 N (25 foot-pounds) with no weld or fastener breakage or bar separation exceeding 127 mm (5 inches).
 - b. Bar Separation Test: Withstand bar separation test force of 23 kg (50 pounds) with no breaking of welds or bar separation exceeding 127 mm (5 inches).

- c. Sag Test: If grille is operable and equipped with side (jamb) hinges, test grille in fully extended position. Grille shall withstand sag load of 34 kg (75 pounds) with permanent set after load removal not exceeding 1.6 mm (0.063 inch).
- d. Forced Entry Resistance Test: If grille is operable, test grille in closed position. Grille shall withstand forced entry loads and shall not be rendered openable throughout test.

Submittals

- 6. Product Data:
- 7. Shop Drawings:
 - a. Include standard details showing recommendations for installation.
 - b. Include size of fasteners, maximum spacing from each end, center-to-center spacing on all four sides, minimum penetration of fasteners into load-bearing material and maximum clearance between frame and rough opening.
- 8. Samples: Submit full set of finish color samples for color selection.
- 9. Quality Assurance/Control Submittals:
 - a. Test Reports: Results of testing by accredited independent laboratory demonstrating compliance of security grilles with specified performance requirements.
 - b. Certificates: Manufacturer's written certification that security grilles meet or exceed specified performance requirements.
- 10. Closeout Submittals:
 - a. Special warranty.

Quality Assurance

- 11. Certifications: Comply with ANSI Z34.2.
- 12. Regulatory Requirements:
 - a. Egress Requirements and Fireman Access: Comply with applicable codes and regulations.
 - 1) Accessibility: Architectural Barriers Act of 1968 as amended (42 USC 4152-4157) and HUD implementing regulations (24 CFR Part 40).
 - a) Uniform Federal Accessibility Standards (UFAS).
 - 2) Section 504 of the Rehabilitation Act of 1973 as amended (29 USC 794) and HUD implementing regulations 24 CFR Part 8.
 - 3) Fair Housing Accessibility Guidelines (24 CFR Chapter 1).
 - 4) Americans with Disabilities Act of 1990 (ADA) (28 CFR Part 35).
- 13. Mock-ups: For Supply and Install Contract: Install one full size mock-up of each type of security grille with specified finish for acceptance.
 - a. Locations: As directed.
 - b. Approved Mock-ups: Standard for rest of work.
 - c. Approved Mock-ups: May remain part of completed project.

Delivery, Storage, And Handling

- 14. Packing, Shipping, Handling, and Unloading: Pack materials at manufacturing plant to prevent damage during shipping.
- 15. Acceptance at Site: Inspect security grilles upon delivery. Replace damaged or defective materials before installation.
- 16. Storage and Protection: Store security grilles in manner to protect from weather and other damage.

Project Conditions

- 17. Field Measurements: Field measure openings for security grilles before start of fabrication.

Scheduling And Sequencing

- 18. Scheduling and Completion: Comply with requirements of Detailed Scope of Work.

Warranty

- 19. Special Warranty: Provide one year written covering materials and installation for security grilles.

- a. Warranty: Include coverage of hardware.
- b. Contractor: Agrees to supply and install, free of charge, any required replacement parts or complete replacement security grille.

PRODUCTS

Security Grilles: KANE Screens, or approved equivalent.

- 20. General: Type(s) and size(s) indicated, specified, or scheduled with necessary hardware, anchors and equipment.
 - a. Egress Requirements and Fireman Access: Comply with applicable codes and regulations.
- 21. Materials:
 - a. Aluminum: ASTM B 221 commercial quality and of proper alloy for grille construction, free from defects impairing strength and/or durability.
 - 1) Zinc Limit: 3.0 percent in order to assure that cladding is anodic to core.
 - 2) Aluminum Extrusions: Minimum ultimate tensile strength of 151 600 kPa (22,000 PSI) and maximum yield strength of 110 300 kPa (16,000 PSI).
 - b. Steel :
 - 1) Shapes, Plates and Bars: ASTM A 36 or ASTM A 569.
 - 2) Steel Pipe: ASTM A 53.

Accessories

- 22. Hardware: Designed to perform functions for which it is intended and securely attached to grille.
 - a. Operable Grilles: Equipped with locks capable of meeting specified forced-entry requirements.
 - b. Locks: Releasable from interior but properly guarded to prevent access from exterior when window is open.
- 23. Anchoring Devices Used in Erection of Grilles: Nonmagnetic stainless steel or other noncorrosive material compatible with grille.
 - a. Anchors Exposed when Grille is Closed and Locked: Non-removable security type.
- 24. Fasteners:
 - a. Screws, Nuts, Washers, Bolts, Rivets, and Other Miscellaneous Fastening Devices Incorporated in Grilles: Nonmagnetic stainless steel or other corrosion resistant materials compatible with security grille and of sufficient strength to perform functions for which they are used.
 - b. Fasteners Concealed when Grille is installed and Closed: Magnetic stainless steel having chromium content of not less than 16 percent.
 - c. Fasteners Concealed when Grille is installed and Open: ASTM B 766 cadmium plated steel, ASTM B 633 zinc plated steel, or ASTM B 456 nickel or chrome plated steel.

Fabrication

- 25. Security Grilles: Fabricated of aluminum or steel and assembled in secure and workmanlike manner to perform as specified and to assure neat construction.
 - a. Welding or Brazing Flux: Completely removed immediately upon completion of welding or brazing operation.
 - b. Grilles: Constructed to reject passage of 102 mm (4 inch) diameter sphere at every space and interval when installed.
 - c. Grille Swing Width for Side Mounting: Maximum of 900 mm (3 feet). For opening in excess of 900 mm (3 feet), provide combination of fixed and operable grilles.
 - d. Grilles: Meet or exceed specified performance requirements in this Section.
 - e. Grilles: Comply with applicable fire codes.
- 26. Bar Type Security Grilles: Constructed of rigid aluminum or steel bars and of construction to meet or exceed specified performance requirements in this Section.
 - a. Fixed and Operable Bar Type Security Grilles: May be jamb or side hinged for egress.
- 27. Window Type Security Grilles: Constructed of aluminum or steel frame with two movable vent frames.

- a. Vent Frames: Glazed with vinyl coated expanded carbon steel, No. 9 - 38 mm (1-1/2 inch) diamond pattern or equal.
- b. Grilles: Constructed in manner to meet or exceed specified performance requirements in this Section.
- 28. Child Guard Security Grilles: Constructed of aluminum or steel bar or tubes and constructed to adjust and mount to exterior track of existing double or single hung windows.
 - a. Grilles: Constructed in manner to meet or exceed specified performance requirements in this Section.
- 29. Security Guard Security Grilles: Constructed of aluminum or steel bars or tubes and constructed to adjust and mount to exterior of existing double or single hung window.
 - a. Fixed and Operable Window Guard Security Grilles: May be jamb or side hinged, or top hinged, for egress.
 - b. Grilles: Constructed in manner to meet or exceed specified performance requirements in this Section.

Finishes

- 30. Grilles: Factory applied baked on enamel painted finish.
 - a. Exposed Surfaces: Clean and free from serious surface blemishes.
 - b. Dress and finish exposed welded joints.
 - c. Steel: Rust resistive primer under baked on enamel.
 - d. Color: As selected from manufacturer's standard colors.

Source Quality Control

- 31. Testing: Performed by accredited independent testing laboratory. Use following HUD test procedures to determine if security grilles comply with specified performance requirements in this Section:
- 32. Sag Test for Side Mounted Grilles: Mount test grille into rigid frame to prevent movement of grille frame during loading.
 - a. Fully Assembled Grille: Opened to 90 degrees or to its open stop.
 - b. Test Load: Applied vertically at point 760mm (30 inches) from face of frame on operating portion of grille.
 - c. Load: Maintained for period of 3 minutes.
 - d. After removal of load, measure permanent sag at point of load application.
- 33. Impact Test: Mount test grille into rigid frame per manufacturer's recommendations.
 - a. One Impact: Made at center of grille or point deemed most susceptible to impact by testing agency.
 - b. Application of Impact Load: Made using 275 mm (11 inch) diameter sphere on free-swinging pendulum.
 - c. Impact: Made at bottom of pendulum arc.
 - d. Impact for Window Type Grille: Made at center of interior sash.
- 34. Bar Separation Test: Subject test grille to separation test at its weakest point of resistance.
 - a. Separation Load: Applied by means of pneumatic or hydraulic cylinder with adequate controls to apply load slowly to avoid quick impact.
 - b. Load: Maintained for period of 10 seconds before release.
- 35. Forced Entry Resistance Test: Mount test grille into rigid frame to prevent movement of grille during test.
 - a. Test Loads: Applied at point within 150 mm (6 inches) of locking mechanism in direction tending to open grille.
 - b. Load A of 34 kg (75 pounds) and Load B of 68 kg (150 pounds): Applied simultaneously, held for 10 seconds and released.
 - c. Load A of 34 kg (75 pounds): Applied vertically upward.
 - d. Load B of 68 kg (150 pounds): Applied perpendicular to face of grille in opening direction.
 - e. Load C of 34 kg (75 pounds): Applied horizontally from load point toward jamb opposite load.

EXECUTION

Examination

36. Site Verification of Conditions:
- Field Measurements: Verify field measurements are as indicated on Shop Drawings.
 - Existing Conditions: Examine openings before beginning installation.
 - Do not proceed with installation until conditions are satisfactory.

Preparation

37. Protection: Protect adjacent elements from damage and disfiguration in accordance with Detailed Scope of Work.
- Contractor: Responsible for damage to grounds, plantings, buildings and any other facilities or property caused by construction operations.
 - Repair or replace damaged elements in accordance with Detailed Scope of Work.
38. Existing Security Grilles: Remove existing grilles and debris from site in accordance with Detailed Scope of Work.
39. Preparation: Prepare openings and existing frames as required to comply with Performance Requirements.

Installation

40. General: Install in accordance with manufacturer's recommendations, Reference Standards, and approved Shop Drawings to comply with Performance Requirements.
- Security Grilles: Securely anchor in place to straight, plumb and level condition, without distortion.
 - Egress Requirements and Fireman Access: Comply with applicable codes and regulations.
41. Dissimilar Materials: Isolate materials from incompatible materials as necessary to prevent deterioration.
- Separate dissimilar metals with bituminous paint, suitable sealant, non-absorptive plastic or elastomeric tape, or gasket between surfaces.
 - Coat aluminum in direct contact with concrete, masonry, steel, or other non-compatible materials with bituminous paint, zinc chromate primer, or other suitable insulating material.

Field Quality Control

42. Field Testing: Contractor shall have field testing of installed security grilles conducted by a testing agency in accordance with performance test described under Performance Requirements in this Section and Source Quality Control in this Section. Tests will be modified as required for field conditions.
- Contractor: Provide incidental labor facilities necessary to facilitate inspections and tests.
 - Costs of Testing:
 - By Contractor: Initial tests with failures and subsequent tests as required because of test failures. Costs shall include costs of Architect/Engineer and other consultants for observations of tests and corrective work.
 - Corrective Measures: Meet standards of quality of specified security grille and subject to acceptance of the Owner.

Adjusting And Cleaning

43. Adjusting: At completion of job, check, adjust, and lubricate hardware as required and leave security grilles and hardware in proper operating condition.
44. Cleaning: Comply with requirements of Detailed Scope of Work.
- Clean security grilles after installation is completed to remove foreign matter and surface blemishes.
 - Scratched or Abraded Surfaces: Touch-up with rust inhibitor primer and enamel paint compatible with factory finish.

Protection

45. Installed Work: Protect security grilles from damage after installation.

END OF SECTION 08 34 53 00a

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Task	Specification	Specification Description
08 34 53 00	08 11 63 13a	Security Window Screens and Doors
08 34 56 00	08 11 63 13a	Security Window Screens and Doors
08 34 56 00	08 34 53 00	Detention Doors And Frames
08 34 56 00	08 34 53 00a	Security Grilles
08 34 73 13	08 05 13 00	Steel Doors And Frames
08 34 73 13	08 12 13 13	Steel Entry Doors
08 34 73 13	08 12 13 13a	Stainless Steel Doors And Frames

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SECTION 08 34 73 16 - SOUND CONTROL DOORS

1.1 GENERAL

A. Description Of Work

1. This specification covers the furnishing and installation of material for sound-control door assemblies. Products shall be as follows or as directed by the Owner. Installation procedures shall be in accordance with the products manufacturer's recommendations. Demolition and removal of materials shall be as required to support the work.

B. Summary

1. Section Includes:
 - a. Steel sound-control doors.
 - b. Wood sound-control doors.
 - c. Steel frames and sound-control seals.

C. Submittals

1. Product Data: For each type of product indicated. Include sound ratings, construction details, material descriptions, core descriptions, fire-resistance rating, temperature-rise ratings, and finishes.
2. LEED Submittals:
 - a. Certificates for Credit MR 7: Chain-of-custody certificates certifying that wood doors comply with forest certification requirements. Include evidence that manufacturer is certified for chain of custody by an FSC-accredited certification body, **as directed**.
 - b. Product Data for Credit EQ 4.4: For adhesives and composite wood products, indicating that product contains no urea formaldehyde.
3. Shop Drawings: Include the following:
 - a. Elevations of each door design.
 - b. Details of sound-control seals, door bottoms, and thresholds.
 - c. Details of doors, including vertical and horizontal edge details and metal thicknesses.
 - d. Frame details for each frame type, including dimensioned profiles and metal thicknesses.
 - e. Locations of reinforcement and preparations for hardware.
 - f. Details of each different wall opening condition.
 - g. Details of anchorages, joints, field splices, and connections.
 - h. Details of accessories.
 - i. Details of moldings, removable stops, and glazing.
 - j. Details of conduit and preparations for power, signal, and control systems.
4. Samples:
 - a. Finishes: For each type of exposed finish required, prepared on Samples of not less than **3 by 5 inches (75 by 125 mm)**.
 - b. Doors: Include section of vertical-edge, top, and bottom construction; automatic door bottom or gasket; core construction; glazing; and hinge and other applied hardware reinforcement.
 - c. Frames: Include profile, corner joint, floor and wall anchors, and seals. Include separate section showing fixed sound panels if applicable.
5. Schedule: Provide a schedule of sound-control door assemblies prepared by or under the supervision of supplier, using same reference numbers for details and openings as those on Drawings. Coordinate with the Door Hardware Schedule.
6. Qualification Data: For qualified Installer, manufacturer, and acoustical testing agency.
7. Product Certificates: For each type of sound-control door assembly, from manufacturer.
8. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for each type of sound-control door assembly.
9. Field quality-control reports.
10. Maintenance Data: For sound-control door assemblies to include in maintenance manuals.

11. Warranty: Samples of special warranty.

D. Quality Assurance

1. Manufacturer Qualifications: A qualified manufacturer that is certified for chain of custody by an FSC-accredited certification body.
2. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for installation of units required for this Project.
3. Acoustical Testing Agency Qualifications: An independent agency accredited as an acoustical laboratory according to the National Voluntary Laboratory Accreditation Program of NIST.
4. Source Limitations: Obtain sound-control door assemblies, including doors, frames, sound-control seals, hinges (when integral for sound control), thresholds, and other items essential for sound control, from single source from single manufacturer.
5. Sound Rating: Provide sound-control door assemblies identical to those of assemblies tested as sound-retardant units by an acoustical testing agency, and have the following minimum rating:
 - a. STC Rating: As indicated on Drawings **OR** As indicated in the Door Schedule, **as directed**, as determined by ASTM E 413 when tested in an operable condition according to ASTM E 90 and ASTM E 1408.
6. Forest Certification: Provide doors made with cores **OR** veneers **OR** not less than 70 percent of wood products **OR** all wood products, **as directed**, obtained from forests certified by an FSC-accredited certification body to comply with FSC STD-01-001, "FSC Principles and Criteria for Forest Stewardship."
7. Fire-Rated Door Assemblies: Assemblies listed and labeled by a qualified testing agency, for fire-protection ratings indicated, based on testing at positive pressure according to NFPA 252 or UL 10C.
 - a. Oversize Fire-Rated Door Assemblies: For units exceeding sizes of tested assemblies, provide certification by a qualified testing agency that doors comply with standard construction requirements for tested and labeled fire-rated door assemblies except for size.
8. Smoke- and Draft-Control Door Assemblies: Where indicated **OR** At corridors, smoke barriers, and smoke partitions, **as directed**, provide assemblies tested according to UL 1784.
 - a. Air-Leakage Rate: Maximum air leakage of **0.3 cfm/sq. ft. (3 cu. m/m x sq. m)** at the tested pressure differential of **0.3-inch wg (75 Pa)** of water.
9. Preinstallation Conference: Conduct conference at Project site.

E. Delivery, Storage, And Handling

1. Deliver doors and frames palletized, wrapped, or crated to provide protection during transit and Project-site storage. Do not use nonvented plastic.
 - a. Provide additional protection to prevent damage to finish of factory-finished wood doors.
2. Shipping Spreaders: Deliver welded frames with two removable spreader bars across bottom of frames, tack welded or mechanically attached to jambs and mullions.
3. Store doors and frames under cover at Project site. Place units in a vertical position with heads up, spaced by blocking, on minimum **4-inch- (100-mm-)** high, wood blocking. Avoid using nonvented plastic or canvas shelters that could create a humidity chamber.
 - a. If wrappers on doors become wet, remove cartons immediately. Provide a minimum of **1/4-inch (6-mm)** space between each stacked door to permit air circulation.

F. Project Conditions

1. Environmental Limitations: Do not deliver or install wood sound-control wood doors until spaces are enclosed and weatherproof, wet work in spaces is complete and dry, and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.
2. Field Measurements: Verify actual dimensions of openings by field measurements before fabrication.

G. Coordination

1. Coordinate installation of anchorages for sound-control door assemblies. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, inserts, anchor bolts, and items with integral anchors. Deliver such items to Project site in time for installation.

H. Warranty

1. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of sound-control door assemblies that fail in materials or workmanship within specified warranty period.
 - a. Failures include, but are not limited to, the following:
 - 1) Failure to meet sound rating requirements.
 - 2) Faulty operation of sound seals.
 - 3) Deterioration of metals, metal finishes, and other materials beyond normal use or weathering.
 - 4) Wood doors that are warped (bow, cup, or twist) more than **1/4 inch (6 mm)** in a **42-by-84-inch (1067-by-2134-mm)** section, or show telegraphing of core construction in face veneers exceeding **0.01 inch in a 3-inch (0.25 mm in a 75-mm)** span.
 - b. Warranty Period for Steel Doors: Five years from date of Final Completion.
 - c. Warranty Period for Wood Doors: Two years from date of Final Completion.

1.2 PRODUCTS

A. Steel Sound-Control Doors

1. Description: Provide flush-design sound-control doors, **1-3/4 inches (44 mm)** thick, of seamless construction; with manufacturer's standard sound-retardant core as required to provide STC **OR** STC and fire, **as directed**, rating indicated. Construct doors with smooth, flush surfaces without visible joints or seams on exposed faces or stile edges. Fabricate according to ANSI/NAAMM-HMMA 865.
 - a. Exterior Doors: Fabricate from metallic-coated steel sheet **0.052-inch (1.32-mm)** nominal thickness, or thicker as required to provide STC rating indicated.
 - b. Interior Doors: Fabricate from cold-rolled steel sheet unless otherwise indicated, **0.048-inch (1.21-mm)** nominal thickness, or thicker as required to achieve STC rating indicated.
 - c. Loose Stops for Glazed Lites in Doors: Same material as face sheets.
 - d. Top and Bottom Channels: Closed with continuous channels of same material as face sheets, spot welded to face sheets not more than **6 inches (150 mm)** o.c.
 - e. Hardware Reinforcement: Same material as face sheets.
2. Materials:
 - a. Cold-Rolled Steel Sheet: ASTM A 1008/A 1008M, Commercial Steel (CS), Type B, suitable for exposed applications.
 - b. Hot-Rolled Steel Sheet: ASTM A 1011/A 1011M, Commercial Steel (CS), Type B; free of scale, pitting, or surface defects; pickled and oiled.
 - c. Metallic-Coated Steel Sheet: ASTM A 653/A 653M, Commercial Steel (CS), Type B, with **G60 (Z180)** zinc (galvanized) or **A40 (ZF120)** zinc-iron-alloy (galvannealed) coating designation.
 - d. Glazing: As required by sound-control door assembly manufacturer to comply with sound-control **OR** sound-control and fire-rated-door labeling, **as directed**, requirements.
3. Finishes:
 - a. Prime Finish: Apply manufacturer's standard primer immediately after cleaning and pretreating.
 - 1) Shop Primer: Manufacturer's standard, fast-curing, lead- and chromate-free primer complying with ANSI/SDI A250.10 acceptance criteria; recommended by primer manufacturer for substrate; compatible with substrate and field-applied coatings despite prolonged exposure.
 - b. Factory-Applied Paint Finish: Manufacturer's standard primer and finish coats, complying with ANSI/SDI A250.3 for performance and acceptance criteria.

- 1) Color and Gloss: As indicated by manufacturer's designations **OR** As selected from manufacturer's full range, **as directed**.

B. Wood Sound-Control Doors

1. Description: Provide flush-design sound-control doors, **1-3/4 inches (44 mm)** thick; with manufacturer's standard sound-retardant core as required to provide **STC OR** **STC** and fire, **as directed**, rating indicated. Fabricate according to WDMA 1.S.1-A.
2. Materials: Comply with Division 08 Section(s) "Flush Wood Doors" OR "Stile And Rail Wood Doors", **as directed**, for grade, faces, veneer matching, fabrication, finishing, and other requirements unless otherwise indicated.
 - a. Glazing: As required by sound-control door assembly manufacturer to comply with sound-control **OR** sound-control and fire-rated-door labeling, **as directed**, requirements.
3. Finishes:
 - a. Factory finish sound-control wood doors to match doors specified in Division 08 Section(s) "Flush Wood Doors" OR "Stile And Rail Wood Doors", **as directed**.

C. Sound-Control Panels

1. Provide sound-control panels of same materials, construction, sound rating, and finish as specified for adjoining sound-control steel **OR** wood, **as directed**, doors.

D. Sound-Control Frames

1. Description: Fabricate sound-control door frames with corners mitered, reinforced, and continuously welded full depth and width of frame. Fabricate according to ANSI/NAAMM-HMMA 865.
 - a. Weld frames according to NAAMM-HMMA 820.
 - b. Exterior Frames: Fabricate from metallic-coated steel sheet **0.079-inch (2.01-mm)** nominal thickness, or thicker as required to provide STC rating indicated.
 - c. Interior Frames: Fabricate from cold-rolled steel sheet unless otherwise indicated, **0.075-inch (1.90-mm)** nominal thickness, or thicker as required to provide STC rating indicated.
 - d. Sound-Control Panel Stops: Formed integral with frames, a minimum of **5/8 inch (16 mm)** high, unless otherwise indicated.
 - e. Hardware Reinforcement: Fabricate according to ANSI/NAAMM-HMMA 865 of same material as face sheets.
 - f. Head Reinforcement: Reinforce frames with metallic-coated steel channel or angle stiffener, **0.108-inch (2.74-mm)** nominal thickness, welded to head.
 - g. Jamb Anchors:
 - 1) Masonry Type: Adjustable strap-and-stirrup or T-shaped anchors to suit frame size, not less than **0.064-inch (1.63-mm)** nominal thickness metallic-coated steel with corrugated or perforated straps not less than **2 inches (50 mm)** wide by **10 inches (250 mm)** long; or wire anchors not less than **0.156 inch (4.0 mm)** thick.
 - 2) Stud-Wall Type: Designed to engage stud, welded to back of frames; not less than **0.048-inch (1.21-mm)** nominal thickness uncoated steel unless otherwise indicated.
 - 3) Postinstalled Expansion Type for In-Place Concrete or Masonry: Minimum **3/8-inch- (9.5-mm-)** diameter, metallic-coated steel bolts with expansion shields or inserts. Provide pipe spacer from frame to wall, with throat reinforcement plate, welded to frame at each anchor location.
 - h. Floor Anchors: Not less than **0.079-inch (2.01-mm)** nominal thickness metallic-coated steel, and as follows:
 - 1) Monolithic Concrete Slabs: Clip-type anchors, with two holes to receive fasteners.
 - 2) Separate Topping Concrete Slabs: Adjustable-type anchors with extension clips, allowing not less than **2-inch (50-mm)** height adjustment. Terminate bottom of frames at finish floor surface.
 - i. Ceiling Struts: Minimum **3/8-inch-thick by 2-inch- (9.5-mm-thick by 50-mm-)** wide uncoated steel unless otherwise indicated.
 - j. Plaster Guards: Metallic-coated steel sheet, not less than **0.026 inch (0.6 mm)** thick.

2. Materials:
 - a. Cold-Rolled Steel Sheet: ASTM A 1008/A 1008M, Commercial Steel (CS), Type B, suitable for exposed applications.
 - b. Hot-Rolled Steel Sheet: ASTM A 1011/A 1011M, Commercial Steel (CS), Type B; free of scale, pitting, or surface defects; pickled and oiled.
 - c. Metallic-Coated Steel Sheet: ASTM A 653/A 653M, Commercial Steel (CS), Type B, with **G60 (Z180)** zinc (galvanized) or **A40 (ZF120)** zinc-iron-alloy (galvannealed) coating designation.
 - d. Supports and Anchors: After fabricating, galvanize units to be built into exterior walls according to ASTM A 153/A 153M, Class B.
 - e. Inserts, Bolts, and Fasteners: Provide items to be built into exterior walls, hot-dip galvanized according to ASTM A 153/A 153M or ASTM F 2329.
 - f. Powder-Actuated Fasteners in Concrete: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with clips or other accessory devices for attaching sound-control door frames of type indicated.
 - g. Mineral-Fiber Insulation: Insulation composed of rock-wool fibers, slag-wool fibers, or glass fibers.
3. Finishes:
 - a. Prime Finish: Apply manufacturer's standard primer immediately after cleaning and pretreating.
 - 1) Shop Primer: Manufacturer's standard, fast-curing, lead- and chromate-free primer complying with ANSI/SDI A250.10 acceptance criteria; recommended by primer manufacturer for substrate; compatible with substrate and field-applied coatings despite prolonged exposure.
 - b. Factory-Applied Paint Finish: Manufacturer's standard primer and finish coats, complying with ANSI/SDI A250.3 for performance and acceptance criteria.
 - 1) Color and Gloss: As indicated by manufacturer's designations **OR** As selected from manufacturer's full range, **as directed**.

E. Sound-Control Hardware

1. Description: Provide manufacturer's standard sound-control system, including head and jamb seals, door bottoms, cam-lift hinges, and thresholds, as required by testing to achieve STC **OR** STC and fire, **as directed**, rating indicated.
 - a. Compression Seals: One-piece units; consisting of closed-cell sponge neoprene seal held in place by metal retainer; with retainer cover of same material as door frame; attached to door frame with concealed screws.
OR
Magnetic Seals: One-piece units; consisting of closed-cell sponge neoprene seal and resiliently mounted magnet held in place by metal retainer; with retainer cover of same material as door frame; attached to door frame with concealed screws.
 - b. Automatic Door Bottoms: Neoprene or silicone gasket, held in place by metal housing, that automatically drops to form seal when door is closed; mounted to bottom edge of door with screws.
 - 1) Mounting: Mortised or semimortised into bottom of door or surface mounted on face of door as required by testing to achieve STC rating indicated.
OR
Door Bottoms: Neoprene or silicone gasket held in place by metal housing; mortised into bottom edge of door.
 - c. Cam-Lift Hinges: Full-mortise template type that raises door **1/2 inch (13 mm)** when door is fully open; with hardened pin; fabricated from stainless steel.
 - d. Thresholds: Flat, smooth, unfluted type as recommended by manufacturer; fabricated from aluminum **OR** stainless steel **OR** solid wood matching wood door faces, **as directed**.
 - 1) Finish: Clear **OR** Color, **as directed**, anodic finish.
 - 2) Color: Light bronze **OR** Medium bronze **OR** Dark bronze **OR** Black **OR** As selected from full range of industry colors and color densities, **as directed**.
2. Other Hardware: Comply with requirements in Division 08 Section "Door Hardware".

F. Sound-Control Accessories

1. Glazing: Comply with requirements in Division 08 Section "Glazing"
2. Grout: Comply with ASTM C 476, with a slump of not more than **4 inches (102 mm)** as measured according to ASTM C 143/C 143M.
3. Corrosion-Resistant Coating: Cold-applied asphalt mastic, compounded for **15-mil (0.4-mm)** dry film thickness per coat. Provide inert-type noncorrosive compound free of asbestos fibers, sulfur components, and other deleterious impurities.

G. Fabrication

1. Sound-Control Steel Door Fabrication: Sound-control doors to be rigid and free of defects, warp, or buckle. Accurately form metal to required sizes and profiles, with minimum radius for thickness of metal.
 - a. Seamless Edge Construction: Fabricate doors with faces joined at vertical edges by welding; welds shall be ground, filled, and dressed to make them invisible and to provide a smooth, flush surface.
 - b. Exterior Doors: Close top edges flush and seal joints against water penetration. Provide weep-hole openings in bottom of exterior doors to permit moisture to escape.
 - c. Glazed Lites: Factory install glazed lites according to requirements of tested assembly to achieve STC rating indicated. Provide fixed stops and moldings welded on secure side of door.
 - d. Hardware Preparation: Factory prepare sound-control doors to receive templated mortised hardware; include cutouts, reinforcement, mortising, drilling, and tapping, according to the Door Hardware Schedule and templates furnished as specified in "Door Hardware".
 - 1) Reinforce doors to receive nontemplated mortised and surface-mounted door hardware.
 - 2) Locate door hardware as indicated, or if not indicated, according to NAAMM-HMMA 831, "Recommended Hardware Locations for Custom Hollow Metal Doors and Frames."
 - e. Tolerances: Fabricate doors to tolerances indicated in ANSI/NAAMM-HMMA 865.
2. Sound-Control Wood Door Fabrication: Factory fit doors to suit frame-opening sizes indicated, with uniform clearances and bevels according to referenced quality standard, unless otherwise indicated. Comply with final door hardware schedules and hardware templates.
 - a. Comply with clearance requirements in NFPA 80 for fire-rated doors.
 - b. Locate door hardware as indicated, or if not indicated, according to DHI WDHS.3, "Recommended Locations for Architectural Hardware for Wood Flush Doors."
 - 1) Coordinate measurements of hardware mortises in steel frames to verify dimensions and alignment before factory machining.
3. Sound-Control Frame Fabrication: Fabricate sound-control frames to be rigid and free of defects, warp, or buckle. Accurately form metal to required sizes and profiles, with minimum radius for thickness of metal. Where practical, fit and assemble units in manufacturer's plant. To ensure proper assembly at Project site, clearly identify work that cannot be permanently factory assembled before shipment.
 - a. Weld flush face joints continuously; grind, fill, dress, and make smooth, flush, and invisible. Where frames are fabricated in sections due to shipping or handling limitations, provide alignment plates or angles at each joint, fabricated from same thickness metal as frames.
 - b. Provide countersunk, flat- or oval-head exposed screws and bolts for exposed fasteners unless otherwise indicated.
 - c. Floor Anchors: Weld anchors to bottom of jambs and mullions with at least four spot welds per anchor.
 - d. Jamb Anchors: Provide number and spacing of anchors as follows:
 - 1) Masonry Type: Locate anchors not more than **18 inches (457 mm)** from top and bottom of frame. Space anchors not more than **32 inches (813 mm)** o.c. and as follows:
 - a) Two anchors per jamb up to **60 inches (1524 mm)** in height.
 - b) Three anchors per jamb from **60 to 90 inches (1524 to 2286 mm)** in height.

- c) Four anchors per jamb from 90 to 96 inches (2286 to 2438 mm) in height.
- d) Four anchors per jamb plus one additional anchor per jamb for each 24 inches (610 mm) or fraction thereof more than 96 inches (2438 mm) in height.
- 2) Stud Wall Type: Locate anchors not more than 18 inches (457 mm) from top and bottom of frame. Space anchors not more than 32 inches (813 mm) o.c. and as follows:
 - a) Three anchors per jamb up to 60 inches (1524 mm) in height.
 - b) Four anchors per jamb from 60 to 90 inches (1524 to 2286 mm) in height.
 - c) Five anchors per jamb from 90 to 96 inches (2286 to 2438 mm) in height.
 - d) Five anchors per jamb plus one additional anchor per jamb for each 24 inches (610 mm) or fraction thereof more than 96 inches (2438 mm) in height.
 - e) Two anchors per head for frames more than 42 inches (1066 mm) wide and mounted in metal stud partitions.
- 3) Postinstalled Expansion Type: Locate anchors not more than 6 inches (152 mm) from top and bottom of frame. Space anchors not more than 26 inches (660 mm) o.c.
- e. Head Reinforcement: For frames more than 48 inches (1219 mm) wide, provide continuous head reinforcement for full width of opening, welded to back of frame at head.
- f. Hardware Preparation: Factory prepare sound-control frames to receive templated mortised hardware; include cutouts, reinforcement, mortising, drilling, and tapping, according to the Door Hardware Schedule and templates furnished as specified in Division 08 Section "Door Hardware".
 - 1) Reinforce frames to receive nontemplated mortised and surface-mounted door hardware.
 - 2) Locate hardware as indicated, or if not indicated, according to NAAMM-HMMA 831, "Recommended Hardware Locations for Custom Hollow Metal Doors and Frames."
- g. Plaster Guards: Weld guards to frame at back of hardware cutouts and glazing-stop screw and sound-control seal preparations to close off interior of openings in frames to be grouted.
- h. Tolerances: Fabricate frames to tolerances indicated in ANSI/NAAMM-HMMA 865.

1.3 EXECUTION

A. Examination

- 1. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of sound-control door assemblies.
- 2. Examine roughing-in for embedded and built-in anchors to verify actual locations of sound-control door frame connections before frame installation.
- 3. Proceed with installation only after unsatisfactory conditions have been corrected.

B. Preparation

- 1. Remove welded-in shipping spreaders installed at factory. Restore exposed finish by grinding, filling, and dressing, as required to make repaired area smooth, flush, and invisible on exposed faces.
- 2. Prior to installation and with installation spreaders in place, adjust and securely brace sound-control door frames to the following tolerances:
 - a. Squareness: Plus or minus 1/16 inch (1.6 mm), measured at door rabbet on a line 90 degrees from jamb perpendicular to frame head.
 - b. Alignment: Plus or minus 1/16 inch (1.6 mm), measured at jambs on a horizontal line parallel to plane of wall.
 - c. Twist: Plus or minus 1/16 inch (1.6 mm), measured at opposite face corners of jambs on parallel lines, and perpendicular to plane of wall.
 - d. Plumbness: Plus or minus 1/16 inch (1.6 mm), measured at jambs on a perpendicular line from head to floor.

3. Drill and tap doors and frames to receive nontemplated mortised and surface-mounted door hardware.

C. Installation

1. General: Install sound-control door assemblies plumb, rigid, properly aligned, and securely fastened in place; comply with manufacturer's written instructions.
2. Frames: Install sound-control door frames in sizes and profiles indicated.
 - a. Set frames accurately in position; plumbed, aligned, and braced securely until permanent anchors are set. After wall construction is complete, remove temporary braces, leaving surfaces smooth and undamaged.
 - 1) At fire-rated openings, install frames according to NFPA 80.
 - 2) At openings requiring smoke and draft control, install frames according to NFPA 105.
 - 3) Where frames are fabricated in sections due to shipping or handling limitations, field splice at approved locations by welding face joint continuously; grind, fill, and dress; make splice smooth, flush, and invisible on exposed faces.
 - 4) Install sound-control frames with removable glazing stops located on secure side of opening.
 - 5) Remove temporary braces only after frames or bucks have been properly set and secured.
 - 6) Check squareness, twist, and plumbness of frames as walls are constructed. Shim as necessary to comply with installation tolerances.
 - 7) Apply corrosion-resistant coatings coating to backs of frames to be filled with mortar, grout, and plaster containing antifreezing agents.
 - b. Floor Anchors: Provide floor anchors for each jamb and mullion that extends to floor and secure with postinstalled expansion anchors.
 - 1) Floor anchors may be set with powder-actuated fasteners instead of postinstalled expansion anchors, if so indicated and approved on Shop Drawings.
 - c. Metal-Stud Partitions: Solidly pack mineral-fiber insulation behind frames.
 - d. In-Place Concrete or Masonry Construction: Secure frames in place with postinstalled expansion anchors. Countersink anchors, and fill and make smooth, flush, and invisible on exposed faces.
 - e. In-Place Gypsum Board Partitions: Secure frames in place with postinstalled expansion anchors through floor anchors at each jamb. Countersink anchors, and fill and make smooth, flush, and invisible on exposed faces.
 - f. Ceiling Struts: Extend struts vertically from top of frame at each jamb to supporting construction above, unless frame is anchored to masonry or to other structural support at each jamb. Bend top of struts to provide flush contact for securing to supporting construction above. Provide adjustable wedged or bolted anchorage to frame jamb members.
 - g. Grouted Frames: Solidly fill space between frames and substrate with grout. Take precautions, including bracing frames, to ensure that frames are not deformed or damaged by grout forces.
 - h. Installation Tolerances: Adjust sound-control door frames for squareness, alignment, twist, and plumbness to the following tolerances:
 - 1) Squareness: Plus or minus **1/16 inch (1.6 mm)**, measured at door rabbet on a line 90 degrees from jamb perpendicular to frame head.
 - 2) Alignment: Plus or minus **1/16 inch (1.6 mm)**, measured at jambs on a horizontal line parallel to plane of wall.
 - 3) Twist: Plus or minus **1/16 inch (1.6 mm)**, measured at opposite face corners of jambs on parallel lines, and perpendicular to plane of wall.
 - 4) Plumbness: Plus or minus **1/16 inch (1.6 mm)**, measured at jambs on a perpendicular line from head to floor.
3. Doors: Fit sound-control doors accurately in frames, within clearances indicated below. Shim as necessary.

- a. Non-Fire-Rated Doors: Fit non-fire-rated doors accurately in frames with the following clearances:
 - 1) Jambs: 1/8 inch (3 mm).
 - 2) Head with Butt Hinges: 1/8 inch (3 mm).
 - 3) Head with Cam-Lift Hinges: As required by manufacturer, but not more than 3/8 inch (9.5 mm).
 - 4) Sill: Manufacturer's standard.
 - 5) Between Edges of Pairs of Doors: 1/8 inch (3 mm).
 - b. Fire-Rated Doors: Install fire-rated doors with clearances according to NFPA 80.
 4. Sound-Control Seals: Where seals have been prefitted and preinstalled in the factory and subsequently removed for shipping, reinstall seals and adjust according to manufacturer's written instructions.
 5. Cam-Lift Hinges: Install hinges according to manufacturer's written instructions.
 6. Thresholds: Set thresholds in full bed of sealant complying with requirements in Division 7 Section "Joint Sealants."
 7. Glazing: Comply with installation requirements in Division 08 Section "Glazing" and with sound-control door assembly manufacturer's written instructions.
 - a. Secure stops with countersunk flat- or oval-head machine screws spaced uniformly not more than 9 inches (230 mm) o.c., and not more than 2 inches (50 mm) o.c. from each corner.
- D. Field Quality Control
 1. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
 2. Testing Services: Acoustical testing and inspecting agency shall select one sound-control door at random from sound-control door assemblies that are completely installed and perform testing for verification that assembly complies with STC rating requirements.
 - a. Field tests shall be conducted according to ASTM E 336, with results calculated according to ASTM E 413. Acceptable field STC values shall be within 5 dB of laboratory STC values.
 - b. Inspection Report: Acoustical testing agency shall submit report in writing to the Owner and Contractor within 24 hours after testing.
 - c. If tested door fails, replace or rework all sound-control door assemblies to bring them into compliance at Contractor's expense.
 - 1) Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.
 3. Prepare test and inspection reports.
- E. Adjusting And Cleaning
 1. Final Adjustments: Check and adjust seals, door bottoms, and other sound-control hardware items right before final inspection. Leave work in complete and proper operating condition.
 2. Remove and replace defective work, including defective or damaged sound seals and doors and frames that are warped, bowed, or otherwise unacceptable.
 - a. Adjust gaskets, gasket retainers, and retainer covers to provide contact required to achieve STC rating.
 3. Clean grout off sound-control door frames immediately after installation.
 4. Prime-Coat Touchup: Immediately after erection, sand smooth rusted or damaged areas of prime coat and apply touchup of compatible air-drying primer.
 5. Metallic-Coated Surfaces: Clean abraded areas of doors and repair with galvanizing repair paint according to manufacturer's written instructions.

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SECTION 08 35 13 13 - FOLDING DOORS

1.1 GENERAL

A. Description Of Work

1. This specification covers the furnishing and installation of material for folding doors. Products shall be as follows or as directed by the Owner. Installation procedures shall be in accordance with the products manufacturer's recommendations. Demolition and removal of materials shall be as required to support the work.

B. Summary

1. Section Includes:
 - a. Accordion folding doors.
 - b. Panel folding doors.
 - c. Bifold doors.
 - d. Bifold mirror doors.
 - e. Fire-rated folding doors.

C. Submittals

1. Product Data: For each type of product indicated.
2. Shop Drawings: Include plans, elevations, sections, details, attachments to other work.
 - a. Fire-Release System: Describe system, including testing and resetting instructions.
 - b. Wiring Diagrams: For power, signal, and control wiring.
3. Samples: For each exposed product and for each color and texture specified.
4. Product Schedule: For folding doors. Use same designations indicated on Drawings.
5. Product certificates.
6. Maintenance data.

D. Quality Assurance

1. Surface-Burning Characteristics: As determined by testing identical products according to ASTM E 84 by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
 - a. Flame-Spread Index: 25 or less.
 - b. Smoke-Developed Index: 50 **OR** 450, **as directed**, or less.
2. Fire-Rated Folding Door Assemblies: Assemblies complying with NFPA 80 that are listed and labeled by a qualified testing agency, for fire-protection ratings indicated, based on testing according to NFPA 252 **OR** IBC Standard 716.5 **OR** UL 10B, **as directed**.
 - a. Oversize Fire-Rated Folding Doors: For units exceeding sizes of tested assemblies, provide certification by a qualified testing agency that doors comply with standard construction requirements for tested and labeled fire-rated door assemblies except for size.
3. Project Conditions
 - a. Environmental Limitations: Do not deliver or install folding doors until spaces are enclosed and weathertight, wet work in spaces is complete and dry, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.
 - b. Field Measurements: Verify actual dimensions of openings by field measurements before fabrication

1.2 PRODUCTS

A. Accordion Folding Doors

1. General: Top-supported, horizontal-sliding, manually operated accordion folding doors, with chain controlling the spacing and extension of pantographic or X-type accordion folding frames.

- Inner and outer covers are continuous surface facings that attach to and completely cover the folding frames and are pleated as the door is retracted.
2. Outer Covering: Of type indicated below, complying with indicated surface-burning characteristics; attached to door support frames in a concealed manner at sufficient intervals to prevent sagging and separation and to permit on-site removal and repair, with vertical seams located in valleys and material hemmed at top and bottom.
 - a. Vinyl reinforced with woven backing weighing not less than **20 oz./linear yd. (567 g/m)**.
 - 1) Color, Texture, and Pattern: As selected from manufacturer's full range.
 - b. Fabric weighing not less than **16 oz./linear yd. (496 g/m)**, treated to resist stains.
 - 1) Color, Texture, and Pattern: As selected from manufacturer's full range.
 - c. Manufacturer's standard nonwoven carpet, needle punched with fused fibers to prevent unraveling.
 - 1) Color, Texture, and Pattern: As selected from manufacturer's full range.
 3. Sweep Seals: Manufacturer's standard top and bottom sweep seals on both **OR** one, **as directed**, side(s).
 4. Carriers: Four-wheel carriers at lead post and two-wheel carriers at intermediate spacing, as necessary for size and weight of partition, to ensure secure, easy, and quiet operation.
 - a. Doors **96 Inches (2438 mm)** High or Less: Nylon wheels on steel shafts.
 - b. Doors More Than **96 Inches (2438 mm)** High: Ball-bearing wheels with nylon tread and steel shafts.
 5. Tracks: Manufacturer's standard metal track made of extruded aluminum or formed steel with factory-applied, corrosion-resistant finish. Limit track deflection, independent of structural supporting system, to no more than 80 percent of bottom clearance. Design and fabricate track to support accordion folding doors and enable their operation without damage to track, folding unit, or adjacent surfaces; complying with the following requirements:
 - a. Head Trim: Prefinished wood molding for surface-mounted tracks.
 - b. Center stop for center-opening partitions.
 - c. Galvanized-steel sheet or aluminum subchannel for forming pocket for recessed suspension track.
 - d. Metal ceiling contact guard to protect finished ceiling surface from damage by moving top sweep seals; with finish matching other exposed metal.
 - e. Curved track sections with ceiling clips to accommodate configuration indicated.
 - f. Glide switch to divert door to auxiliary track.
 - g. Pivot switch to change track direction.
 - h. Cross-track switch to allow one door to cross another.
 6. Hardware: Manufacturer's standard heavy-duty, manually operated metal pulls and latches as follows:
 - a. Finish: Clear-anodized aluminum **OR** Satin stainless steel **OR** Dull chromium-finish brass **OR** Dull chromium-finish steel, **as directed**.
 - b. Latch: Operable from both **OR** one, **as directed**, side(s) of closed door with coin-slot release on opposite side, **as directed**.
 - c. Lock: Manufacturer's standard key-operated cylinder lock, operable from both sides **OR** Manufacturer's standard key-operated cylinder lock, operable from one side; privacy lock on other side **OR** Deadlock to receive cylinder, operable from both sides. Refer to Division 08 Section "Door Hardware" for cylinder requirements **OR** Deadlock to receive cylinder, operable from both sides, **as directed**.
 - d. Foot bolts on lead post where indicated. Secure to post to avoid interference with seals.
 7. Jamb Molding: Manufacturer's standard wood or metal molding at closing jamb as required for light-tight jamb closure.
 8. Lead Posts and Jamb Posts: Not less than **0.048-inch- (1.2-mm-)** thick steel **OR** extruded aluminum, **as directed**, formed for rigidity and light seal at supporting construction.
 - a. Nonferrous jamb strip for single-operating partitions to ensure tight closure by engaging rubber bumper on lead post.
 9. Meeting Post: Fixed single jamb for single-stacked doors **OR** Center meeting post for center-opening doors, **as directed**.

10. Stacking: Tiebacks to maintain door in stacked position.
11. Stacking Configuration: Stack single doors at one end of opening **OR** center-opening doors at both ends of opening **OR** doors in pockets with hinged pocket doors, **as directed**.
12. Opening Size: As directed or as indicated on Drawings.

B. Panel Folding Doors

1. General: Top-supported, horizontal-sliding, manually operated panel folding doors, with panels joined by continuous hinge connectors for the full height of panels.
2. Core Material and Thickness: Manufacturer's standard.
3. Panel Width: **4-inch (100-mm) OR 5-inch (125-mm) OR 6-inch (150-mm) OR 8-inch (200-mm), as directed**, nominal width.
4. Panel Facing: Facings that comply with indicated surface-burning characteristics.
 - a. Vinyl Facing: Vinyl not less than **7 mils (0.175 mm)** thick, factory bonded to core.
 - 1) Color and Texture: As selected from manufacturer's full range.
 - b. Vinyl Facing with Woven Backing: Vinyl reinforced with woven backing weighing not less than **12 oz./linear yd. (372 g/m)**, factory bonded to core.
 - 1) Color and Texture: As selected from manufacturer's full range.
 - c. Plastic-Laminate Facing: Grade VGS, high-pressure plastic laminate complying with NEMA LD 3; adhesive applied under pressure to core.
 - 1) Color, Texture, and Pattern: As selected from manufacturer's full range.
 - d. Wood-Veneer Facing: as directed by the Owner, wood veneer, laminated to core, with manufacturer's standard clear **OR** stained, **as directed**, transparent finish.
 - 1) Stain Color: As selected from manufacturer's full range.
5. Carriers: Four-wheel carriers at lead post and two-wheel carriers at intermediate spacing, as necessary for size and weight of partition, to ensure secure, easy, and quiet operation.
 - a. Panels **5 Inches (125 mm)** Wide or Less: Nylon wheels and axles.
 - b. Panels More Than **5 Inches (125 mm)** Wide: Ball-bearing wheels with nylon tread and steel shafts.
6. Tracks: Manufacturer's standard surface-mounted **OR** recessed, **as directed**, extruded-aluminum or steel track with factory-applied, corrosion-resistant finish. Limit track deflection, independent of structural supporting system, to no more than 80 percent of bottom clearance. Design and fabricate track to support operation without damage to track, folding unit, or adjacent surfaces; complying with the following requirements:
 - a. Prefinished ceiling guard/channel for recessed tracks.
 - b. Center stop for biparting partitions.
 - c. Galvanized-steel sheet or aluminum subchannel for forming pocket for recessed suspension track.
 - d. Nonferrous jamb strip for single-operating partitions to ensure tight closure by engaging rubber bumper on lead post.
 - e. Curved track sections to accommodate configuration indicated.
 - f. Glide switch to divert door to auxiliary track.
 - g. Pivot switch to change track direction.
 - h. Cross-track switch to allow one door to cross another.
7. Hinge Connector: Manufacturer's standard extruded-vinyl hinge connector.
 - a. Color: As selected from manufacturer's full range **OR** Match or coordinate with facing color, **as directed**.
8. Hardware: Manufacturer's standard heavy-duty, manually operated metal pulls and latches as follows:
 - a. Finish: Clear-anodized aluminum **OR** Satin stainless steel **OR** Dull chromium-finish brass **OR** Dull chromium-finish steel, **as directed**.
 - b. Latch: Operable from both **OR** one, **as directed**, side(s) of closed door.
 - c. Lock: Manufacturer's standard key-operated cylinder lock, operable from both sides **OR** Manufacturer's standard key-operated cylinder lock, operable from one side; privacy lock on other side **OR** Deadlock to receive cylinder, operable from both sides. Refer to Division 08 Section "Door Hardware" for cylinder requirements **OR** Deadlock to receive cylinder, operable from both sides, **as directed**.

- d. Foot bolts on lead post where indicated. Secure to post to avoid interference with seals.
- 9. Jamb Molding: Manufacturer's standard wood or metal molding at closing jamb as required for light-tight jamb closure.
 - a. Wood: Match species and finish of panel facing.
 - b. Metal: Manufacturer's standard finish.
- 10. Wood Track Molding: Manufacturer's standard wood molding on each side of surface-mounted track to match species and finish of panel facings. Install with tight, hairline joints with all fasteners concealed.
- 11. Meeting Post: Fixed single jamb for single-stacked doors **OR** Center meeting post for biparting doors, **as directed**.
- 12. Stacking: Tiebacks to maintain door in stacked position.

C. Bifold Doors

- 1. General: Metal folding doors hinged together in pairs and supported on pivots at jamb, with floor and overhead track and door guide pins.
- 2. Metal Panels: Sizes as indicated, formed from nominal **0.024-inch- (0.6-mm-)** thick, cold-rolled steel sheet. Channel form vertical edges and weld cross bracing to panel and channel-formed edges.
 - a. Surface Profile: Fully louvered **OR** Flush **OR** Paneled **OR** Louvered and paneled, **as directed**.
 - b. Configuration: Two **OR** Four, **as directed**, -panel bifold.
 - c. Sheet Metal Texture: Smooth **OR** Simulated leather, **as directed**.
 - d. Protective Finish: Hot-dip galvanized coating applied to panels, stiffeners, hinges, and decorative trim.
 - e. Baked Finish: Baked-enamel factory finish in white **OR** ivory **OR** custom color as selected, **as directed**.
- 3. Hardware: Manufacturer's standard felt pads, screws, and pulls in standard finish. Hinges, pivots, and manufacturer's standard wheels factory installed and as follows:
 - a. Hinges: 3 self-aligning hinges.
 - b. Guides and Pivots: Not less than **5/16-inch- (7.9-mm-)** diameter, adjustable screw-type, weight-bearing, zinc-plated pivot rod held in place by nylon rod clamp assemblies; with not less than **1/4-inch- (6.4-mm-)** diameter, spring-loaded, self-aligning, zinc-plated steel guide rods and top pivot rods held in place by nylon sleeves.
 - c. Track: Prefinished rolled steel with baked-enamel paint finish **OR** Aluminum extrusion, Alloy 6063-T5, **0.05 inch (1.3 mm)** thick, with manufacturer's standard metal finish, **as directed**.

D. Bifold Mirror Doors

- 1. General: Folding doors hinged together in pairs and supported on pivots at jamb, with floor and overhead track and door guide pins.
- 2. Steel-Panel Door Construction: Sizes as indicated, flush profile, formed from nominal **0.024-inch- (0.6-mm-)** thick, cold-rolled steel sheet. Channel form vertical edges and weld cross bracing to panel- and channel-formed edges. Attach mirrored glass facing to steel sheet by means of mechanically attached channels at top and bottom and by dual-faced cushion tape.
 - a. Configuration: Two **OR** Four, **as directed**, -panel bifold.
 - b. Protective Finish: Hot-dip galvanized coating applied to panels, stiffeners, hinges, and decorative trim.
 - c. Baked Finish: Baked-enamel factory finish in white **OR** custom color as selected, **as directed**.
- 3. Metal-Framed Door Construction: Aluminum **OR** Steel, **as directed**, stiles and mechanically fitted rails with screw-attached stiffeners and with mirrored-glass facing attached securely to frames.
 - a. Panel Style: Exposed **OR** Concealed, **as directed**, frame.
 - b. Configuration: Two **OR** Four, **as directed**, -panel bifold.

- c. Baked Finish: Electrostatically applied, baked-enamel factory finish in white **OR** custom color as selected, **as directed**.
 - d. Bright, Reflective Metallic Finish: Chrome **OR** Gold **OR** Selected from manufacturer's full range, **as directed**.
 4. Mirror Facing: Smooth **OR** Beveled, **as directed**, -edged, silvered, mirrored, film-backed safety glass complying with 16 CFR 1201 for Category II safety glass; with ASTM C 1036 for Type I (transparent, flat), Class 1 (clear), Quality q2 (mirror) annealed float glass; with the following:
 - a. Glass Thickness: 3 mm thick for doors up to **84 inches (2133 mm)** in height **OR** 4 mm thick for doors with height more than **84 inches (2133 mm)**, **as directed**.
 - b. Edge Protection: Vertical mirror edges protected by metal **OR** Mylar, **as directed**, trim.
 - c. Film-Backed Safety Mirrors: Apply film backing with pressure-sensitive adhesive coating over mirror-backing paint as recommended in writing by film-backing manufacturer to produce a surface free of bubbles, blisters, and other imperfections.
 5. Hardware: Manufacturer's standard felt pads, screws, and pulls in standard finish. Hinges, pivots, and manufacturer's standard wheels factory installed and as follows:
 - a. Hinges: 3 self-aligning hinges.
 - b. Guides and Pivots: Manufacturer's standard.
 - c. Guides and Pivots: Spring-loaded, zinc-plated steel guides and tops, and adjustable bottom pivot pins with nylon bushings and tips.
 - d. Guides and Pivots: Not less than **5/16-inch- (7.9-mm-)** diameter, adjustable screw-type, weight-bearing, zinc-plated pivot rod held in place by nylon rod clamp assemblies; with not less than **1/4-inch- (6.4-mm-)** diameter, spring-loaded, self-aligning, zinc-plated steel guide rods and top pivot rods held in place by nylon sleeves.
 6. Track: Prefinished rolled steel with baked-enamel paint finish **OR** Aluminum extrusion, Alloy 6063-T5, **0.05 inch (1.3 mm)** thick, with manufacturer's standard metal finish, **as directed**.
- E. Fire-Rated Folding Doors
1. General: Electrically **OR** Gravity-, **as directed**, operated, automatic- or self-closing, UL- or ITS-listed, biparting folding fire-rated assembly; top supported from overhead track or dual tracks without floor guides; complete with hardware, seals, track, closing devices, releasing devices, controls, pocket doors, and accessories necessary for intended operation and complying with the following requirements:
 - a. Assembly remains in normal open (stacked) position. Signal from fire-alarm system initiates self-closing operation.
 - b. Controls allow manual operation in either conventional or emergency mode. When opened manually during emergency mode, control mechanism automatically closes assembly.
 2. Fire Rating: **1 OR 1-1/2 OR 3, as directed**, hour(s).
 3. Panel Construction: Formed-steel **OR** Formed stainless-steel, **as directed**, sheet panels connected by formed-steel **OR** formed stainless-steel, **as directed**, hinges.
 4. Fire Insulation:
 - a. Cover interior surface of both series of panels in parallel panel doors with continuous fire-resistant blanket secured to each panel with metal clip system.
 - b. Extend fire insulation from bottom edge of panels to tracks and meet at interior centers of fixed jamb and lead post, forming an effective fire barrier.
 5. Perimeter Seals and Closures: Manufacturer's standard vinyl or neoprene vertical seals, horizontal top and bottom seals, and closures identical to products tested for fire rating indicated, and forming an effective smoke and draft seal.
 6. Track and Trolley System: 1 track or 2 parallel steel tracks on **8-inch (200-mm)** centers, with ball-bearing roller trolleys and adjustable steel hanger rods for overhead support; designed for type of operation, size, and weight of fire-rated folding door indicated. Provide a continuous system of track sections and accessories identical to products tested for fire rating indicated, to accommodate configuration and layout indicated for door operation and storage.
 7. Lead Posts: Formed from not less than **0.026-inch (0.66-mm-)** thick steel **OR** stainless-steel, **as directed**, sheet, connected to door panels by specially adapted panels and equipped with manufacturer's standard handle on each side.
 8. Electric Operators and Controls:

- a. Operators: Factory-assembled power-drive unit consisting of motor, remote-located, **as directed**, control panel, limit switches, torque-limiting devices, clutch, reversing magnetic motor operator, leading-edge obstruction detectors, and key-switch control for conventional operation.
 - 1) Motor: 1/2 hp, controlled by reversing magnetic starter and equipped with overload protection.
 - 2) Limit Switches: To prevent overtravel.
 - 3) Roller Chain or Cable: Connected to lead posts by means of vertical stabilizer bar assembly.
 - 4) Drive Mechanism: Protected by torque limiter and emergency clutch.
 - 5) Travel Speed: **18 inches (450 mm)** per second, maximum; **6 inches (150 mm)** per second, minimum.
- b. In case of fire, closing system is activated by building's fire- and smoke-detection equipment and automatically closes fire-rated folding doors.
- c. Electrical Service: Equip for 120 V, single phase, 60-cycle ac.
- d. Battery: Electrical current connects through relay to battery charger that continuously charges 12-V dc battery and automatically maintains battery at capacity. Automatic audible signal device sounds off if battery falls below or exceeds proper charge, power loss has occurred, or high-ac line voltage has been experienced.
- e. Leading-Edge Obstruction Detector:
 - 1) Equip with pressure-sensitive leading edge that, on contact with an obstruction, causes door to stop and pause before attempting to re-close.
 - 2) Disable leading-edge obstruction detector until fire-rated folding door has opened pocket door.
- f. Fire-rated folding doors can be manually opened at any time by pushing against leading edge.
- g. Audible alarm sounds at automatic closing of door.
9. Accessories:
 - a. Vision panels.
 - b. Exit Hardware: Located on both sides of fire-rated folding door. In emergency mode, slight pressure on hardware causes door to open a minimum of **32 inches (812 mm)**, pause for 3 seconds, and then automatically close. Furnish hardware that can be field programmable to allow automatic opening distances of up to the entire opening width. In conventional mode, hardware is used to operate door and move it back into storage pocket.
10. Finishes:
 - a. Baked-enamel finish for panels and hinges in colors selected from manufacturer's full range.
 - b. Manufacturer's standard finish for handles.
11. Pocket Door:
 - a. Solid-core pocket doors with reverse-action spring **OR** continuous, **as directed**, hinge; 90-degree minimum swing.
 - b. Face Finish: Match adjacent finishes.
 - c. Magnetic Catch: Holding force of no more than **30 lbf (133 N)**.
 - d. Maximum Opening Force: **50 lbf (222 N)**.
 - e. Bumper on interior side of pocket door as required by fire-rated folding door manufacturer to prevent interference with opening or retracting operation of fire-rated folding door.
 - f. Coordinate pocket door sizes with fire-rated folding door manufacturer.

1.3 EXECUTION

A. Preparation

1. For folding doors supported by or anchored to permanent construction, advise installers of specific requirements for placement of anchorage devices. Furnish installers of other work with templates and drawings showing locations of anchorage devices and similar items.
 2. In path of fire-rated folding doors, level floor with header to tolerance of plus or minus **1/16 inch (1.6 mm)** across opening; grind or fill floor as necessary.
- B. Installation
1. General: Install folding doors complying with manufacturer's written installation instructions. Install track in one piece.
 - a. Comply with NFPA 80 for installing fire-rated folding doors.
 2. Standard Floor Clearances: **1/4 to 3/4 inch (6.4 to 19 mm)** maximum (above floor finish).
 - a. Comply with NFPA 80 for clearances required for fire-rated folding doors.
 3. Coordinate provisions for electrical service, sensing devices, and final connections for fire-rated folding doors.
- C. Adjusting
1. Adjust units as necessary to ensure smooth, quiet operation without warping or binding. Adjust hardware to function smoothly. Confirm that latches engage accurately and securely without forcing or binding.
 - a. Fire-Rated Folding Doors: Verify that all operations are functional and comply with requirements of authorities having jurisdiction.
 2. Pocket Doors: Adjust to operate smoothly and easily, without binding or warping. Adjust hardware to function smoothly. Confirm that latches and locks engage accurately and securely without forcing or binding.
- D. Demonstration
1. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain fire-rated folding doors.

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SECTION 08 36 13 00 - SECTIONAL OVERHEAD DOORS

1.1 GENERAL

A. Description Of Work

1. This specification covers the furnishing and installation of material for sectional overhead doors. Products shall be as follows or as directed by the Owner. Installation procedures shall be in accordance with the products manufacturer's recommendations. Demolition and removal of materials shall be as required to support the work.

B. Summary

1. Section includes manually **OR** electrically, **as directed**, operated sectional doors with integral pass doors, **as directed**.

C. Performance Requirements

1. General Performance: Sectional doors shall meet performance requirements specified without failure due to defective manufacture, fabrication, installation, or other defects in construction and without requiring temporary installation of reinforcing components.
2. Delegated Design: Design sectional doors, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.
3. Structural Performance: Exterior sectional doors shall withstand the effects of gravity loads, and the following loads and stresses within limits and under conditions indicated according to ASCE/SEI 7.
 - a. Wind Loads: As indicated on Drawings **OR** Uniform pressure (velocity pressure) of **20 lbf/sq. ft. (960 Pa)**, acting inward and outward, **as directed**.
 - 1) Basic Wind Speed: **85 mph (38 m/s) OR 90 mph (40 m/s) OR 100 mph (44 m/s) OR 110 mph (49 m/s)**, **as directed**.
 - 2) Exposure Category: **A OR B OR C OR D**, **as directed**.
 - b. Deflection Limits: Design sectional doors to withstand design wind loads without evidencing permanent deformation or disengagement of door components. Deflection of door in horizontal position (open) shall not exceed 1/120 of the door width.
4. Air Infiltration: Maximum rate not more than indicated when tested according to ASTM E 283 **OR** DASMA 105, **as directed**.
 - a. Air Infiltration: Maximum rate of **0.08 cfm/sq. ft. (0.406 L/s per sq. m)** at **15 and 25 mph (24.1 and 40.2 km/h)**.
5. Windborne-Debris-Impact-Resistance Performance: Provide sectional doors **OR** glazed sectional doors, **as directed**, that pass large-missile-impact and cyclic-pressure tests when tested according to ASTM E 1886 and ASTM E 1996 **OR** DASMA 115, **as directed**.
6. Seismic Performance: Sectional doors shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.
 - a. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified."
 - b. Seismic Component Importance Factor: **1.5 OR 1.0**, **as directed**.
7. Operation Cycles: Provide sectional door components and operators capable of operating for not less than number of cycles indicated for each door. One operation cycle is complete when a door is opened from the closed position to the fully open position and returned to the closed position.

D. Submittals

1. Product Data: For each type and size of sectional door and accessory.
2. LEED Submittal:
 - a. Certificates for Credit MR 7: Chain-of-custody certificates certifying that flush wood doors comply with forest certification requirements. Include evidence that manufacturer is certified for chain of custody by an FSC-accredited certification body, **as directed**. Include statement indicating costs for each certified wood product.

3. Shop Drawings: For each installation and for special components not dimensioned or detailed in manufacturer's product data. Include plans, elevations, sections, details, and attachments to other work.
 - a. Wiring Diagrams: For power, signal, and control wiring.
4. Samples: For each exposed product and for each color and texture specified.
5. Delegated-Design Submittal: For sectional doors indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
6. Seismic Qualification Certificates: For sectional doors, accessories, and components, from manufacturer.
7. Maintenance data.
8. Warranties: Sample of special warranties.

E. Quality Assurance

1. Wood Door Manufacturer Qualifications: A qualified manufacturer that is certified for chain of custody by an FSC-accredited certification body.
2. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for both installation and maintenance of units required for this Project.
3. Forest Certification: Provide wood doors made with not less than 70 percent of wood products **OR** all wood products, **as directed**, obtained from forests certified by an FSC-accredited certification body to comply with FSC STD-01-001, "FSC Principles and Criteria for Forest Stewardship."
4. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
5. Standard for Sectional Doors: Fabricate sectional doors to comply with DASMA 102 unless otherwise indicated.
6. Regulatory Requirements: Comply with applicable provisions in the U.S. Architectural & Transportation Barriers Compliance Board's "Americans with Disabilities Act (ADA) and Architectural Barriers Act (ABA) Accessibility Guidelines for Buildings and Facilities" and ICC/ANSI A117.1, **as directed**.

F. Warranty

1. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of sectional doors that fail in materials or workmanship within Two **OR** Five, **as directed**, years from date of Final Completion.
2. Special Finish Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components that show evidence of deterioration of factory-applied finishes within 10 years from date of Final Completion.

1.2 PRODUCTS

A. Steel Door Sections

1. Exterior Section Faces and Frames: Fabricate from zinc-coated (galvanized), cold-rolled, commercial steel (CS) sheet, complying with ASTM A 653/A 653M, with indicated zinc coating and thickness.
 - a. Fabricate section faces from single sheets to provide sections not more than **24 inches (610 mm)** high and of indicated thickness. Roll horizontal meeting edges to a continuous, interlocking, keyed, rabbeted, shiplap, or tongue-in-groove weathertight seal, with a reinforcing flange return.
 - b. For insulated doors, provide sections with continuous thermal-break construction, separating the exterior and interior faces of door.
2. Section Ends and Intermediate Stiles: Enclose open ends of sections with channel end stiles formed from galvanized-steel sheet not less than **0.064-inch- (1.63-mm-)** nominal coated thickness and welded to door section. Provide intermediate stiles formed from not less than

- 0.064-inch- (1.63-mm-)** thick galvanized-steel sheet, cut to door section profile, and welded in place. Space stiles not more than **48 inches (1219 mm)** apart.
3. Reinforce bottom section with a continuous channel or angle conforming to bottom-section profile and allowing installation of astragal, **as directed**.
 4. Reinforce sections with continuous horizontal and diagonal reinforcement, as required to stiffen door and for wind loading. Provide galvanized-steel bars, struts, trusses, or strip steel, formed to depth and bolted or welded in place. Ensure that reinforcement does not obstruct vision lites, **as directed**.
 5. Provide reinforcement for hardware attachment.
 6. Board Thermal Insulation: Insulate interior of steel sections with door manufacturer's standard CFC-free polystyrene or polyurethane board insulation, with maximum flame-spread and smoke-developed indexes of 75 and 450, respectively, according to ASTM E 84; or with glass-fiber-board insulation. Secure insulation to exterior face sheet. Enclose insulation completely within steel sections that incorporate the following interior facing material, with no exposed insulation:
 - a. Interior Facing Material:
 - 1) Zinc-coated (galvanized), cold-rolled, commercial steel (CS) sheet, complying with ASTM A 653/A 653M, with indicated thickness.
 - 2) Manufacturer's standard prefinished hardboard panel, **1/8 inch (3 mm)** thick and complying with ANSI A135.5.
 7. Foamed-in-Place Thermal Insulation: Insulate interior of steel sections with door manufacturer's standard CFC-free polyurethane insulation, foamed in place to completely fill interior of section and pressure bonded to face sheets to prevent delamination under wind load, and with maximum flame-spread and smoke-developed indexes of 75 and 450, respectively, according to ASTM E 84. Enclose insulation completely within steel sections that incorporate the following interior facing material, with no exposed insulation:
 - a. Interior Facing Material:
 - 1) Zinc-coated (galvanized), cold-rolled, commercial steel (CS) sheet, complying with ASTM A 653/A 653M, with indicated thickness.
 - 2) Manufacturer's standard prefinished hardboard panel, **1/8 inch (3 mm)** thick and complying with ANSI A135.5.
 8. Fabricate sections so finished door assembly is rigid and aligned, with tight hairline joints and free of warp, twist, and deformation.
- B. Wood Door Sections**
1. Paneled Sections: Fabricate stiles and rails of clear, vertical-grain, straight, kiln-dried Douglas fir, West Coast hemlock, or Sitka spruce, not less than **1-3/4 inches (44 mm)** thick. Form meeting rails to provide rabbeted, weathertight-seal joint.
 - a. Panel Inserts: Tempered hardboard, **1/4 inch (6 mm)** thick, smooth on two sides, complying with ANSI A135.4.
 - b. Glazed Panel Inserts: 6-mm-thick, clear float glass, complying with ASTM C 1036, Type I, Class 1, Quality Q3, with removable glazing stops of same wood as stiles and rails.
 2. Flush Sections: Construct flush wood door sections with top, bottom, and end closures of clear, vertical-grain, straight, kiln-dried Douglas fir, West Coast hemlock, or Sitka spruce. Provide wood blocking to receive hardware, end stiles, and frames for glazing, glued and doweled in place. Form meeting rails to provide rabbeted weathertight-seal joint.
 - a. Core: Manufacturer's standard polystyrene or polyurethane board insulation or honeycomb core complying with maximum flame-spread and smoke-developed indexes of 75 and 450, respectively, according to ASTM E 84. Bond to facing.
 - b. Facing: **1/8-inch- (3-mm-)** thick, tempered hardboard complying with ANSI A135.4 and smooth on one side.
 3. Fabricate sections of mortise-and-tenon construction with waterproof glue and steel dowels, or of rabbeted construction with waterproof glue and steel dowels and pins.
 4. Reinforce sections with continuous horizontal and diagonal galvanized-steel members as required to stiffen door and for wind loading. Ensure that reinforcement does not obstruct vision lites.

5. Treat wood door members after machining with water-repellent preservative formulation according to WDMA I.S. 4.
6. Fabricate sections so finished door assembly is rigid and aligned, with tight hairline joints and free of warp, twist, deformation, and delamination.
7. Factory prime door sections with one coat of exterior primer compatible with field-applied finish, applied at a minimum dry film thickness of **1 mil (0.025 mm)**.

C. Aluminum Door Sections

1. Sections: Construct door sections with stiles and rails formed from extruded-aluminum shapes, complying with **ASTM B 221 (ASTM B 221M)**, alloy and temper recommended by manufacturer for type of use and finish indicated, with wall thickness not less than **0.065 inch (1.7 mm)** for door section **1-3/4 inches (44 mm)** deep. Fabricate sections with stile and rail dimensions and profiles shown on Drawings. Join stiles and rails by welding or with concealed, **1/4-inch- (6-mm-)** minimum diameter, aluminum or nonmagnetic stainless-steel through bolts, full height of door section. Form meeting rails to provide a weathertight-seal joint.
 - a. Reinforce sections with continuous horizontal and diagonal reinforcement, as required to stiffen door and for wind loading. Ensure that reinforcement does not obstruct vision lites.
 - b. Provide reinforcement for hardware attachment.
2. Solid Panels: Fabricate of aluminum sheet, complying with **ASTM B 209 (ASTM B 209M)**, alloy and temper standard with manufacturer for type of use and finish indicated, not less than **0.040 inch (1.02 mm)** thick, set in continuous vinyl channel retained with rigid, snap-in, extruded-vinyl moldings or with rubber or neoprene glazing gasket with aluminum stop.
3. Full-Vision Sections: Manufacturer's standard, tubular, aluminum-framed section fully glazed with 6-mm-thick, clear acrylic glazing set in vinyl, rubber, or neoprene glazing channel and with removable extruded-vinyl or aluminum stops.

D. Translucent Door Sections

1. Construct door sections of not less than **0.063-inch- (1.6-mm-)** thick, extruded-aluminum stiles and rails complying with **ASTM B 221 (ASTM B 221M)** and with alloy and temper recommended by manufacturer for type of use and finish indicated, to provide door sections at least **1-3/4 inches (44 mm)** deep. Fabricate units with overlapped or interlocked weathertight-seal joints at meeting rails. Reinforce or truss each section as required for strength and rigidity. Provide reinforcement for hardware attachment.
2. Provide translucent, ribbed, glass-fiber-reinforced plastic panels, secured and sealed watertight to framing, and reinforced to meet performance requirements.

E. Tracks, Supports, And Accessories

1. Tracks: Manufacturer's standard, galvanized-steel track system of configuration indicated, sized for door size and weight, designed for lift type indicated and clearances shown on Drawings, and complying with ASTM A 653/A 653M for minimum **G60 (Z180)** zinc coating. Provide complete track assembly including brackets, bracing, and reinforcement for rigid support of ball-bearing roller guides for required door type and size. Slot vertical sections of track spaced **2 inches (51 mm)** apart for door-drop safety device. Slope tracks at proper angle from vertical or design tracks to ensure tight closure at jambs when door unit is closed.
2. Track Reinforcement and Supports: Galvanized-steel track reinforcement and support members, complying with ASTM A 36/A 36M and ASTM A 123/A 123M. Secure, reinforce, and support tracks as required for door size and weight to provide strength and rigidity without sag, sway, and vibration during opening and closing of doors.
 - a. Vertical Track Assembly: Track with continuous reinforcing angle attached to track and attached to wall with jamb brackets **OR** wall jamb brackets attached to track and attached to wall, **as directed**.
 - b. Horizontal Track Assembly: Track with continuous reinforcing angle attached to track and supported at points from curve in track to end of track by laterally braced attachments to overhead structural members.

3. Removable Center Posts: Manufacturer's standard carry-away **OR** roll-away **OR** swing-up, **as directed**, type for multiple doors in one opening.
 4. Weatherseals: Replaceable, adjustable, continuous, compressible weather-stripping gaskets of flexible vinyl, rubber, or neoprene fitted to bottom and top of sectional door unless otherwise indicated.
 5. Windows: Manufacturer's standard window units of type and size indicated and in arrangement shown. Set glazing in vinyl, rubber, or neoprene glazing channel for metal-framed doors and elastic glazing compound for wood doors, as required. Provide removable stops of same material as door-section frames.
 6. Pass Doors: Manufacturer's standard pass doors where indicated, complete with glazing, operating hardware, and mortise lock. Construct pass doors of same materials, design, and finish as sectional door assembly.
 - a. Lock Cylinders: Provide cylinders specified in Division 08 Section "Door Hardware" **OR** standard with manufacturer, **as directed**, and keyed to building keying system, **as directed**.
 - b. Keys: Two **OR** Three, **as directed**, for each cylinder.
- F. Hardware
1. General: Provide heavy-duty, corrosion-resistant hardware, with hot-dip galvanized, stainless-steel, or other corrosion-resistant fasteners, to suit door type.
 2. Hinges: Heavy-duty, galvanized-steel hinges of not less than **0.079-inch- (2.01-mm-)** nominal coated thickness at each end stile and at each intermediate stile, according to manufacturer's written recommendations for door size. Attach hinges to door sections through stiles and rails with bolts and lock nuts or lock washers and nuts. Use rivets or self-tapping fasteners where access to nuts is not possible. Provide double-end hinges where required, for doors over **16 feet (4.88 m)** wide unless otherwise recommended by door manufacturer.
 3. Rollers: Heavy-duty rollers with steel ball-bearings in case-hardened steel races, mounted with varying projections to suit slope of track. Extend roller shaft through both hinges where double hinges are required. Provide **3-inch- (76-mm-)** diameter roller tires for **3-inch- (76-mm-)** wide track and **2-inch- (51-mm-)** diameter roller tires for **2-inch- (51-mm-)** wide track.
 4. Push/Pull Handles: For push-up or emergency-operated doors, provide galvanized-steel lifting handles on each side of door.
- G. Locking Devices
1. Slide Bolt: Fabricate with side-locking bolts to engage through slots in tracks for locking by padlock, located on single-jamb side, operable from inside only.
 2. Locking Device Assembly: Fabricate with cylinder lock, spring-loaded deadbolt, operating handle, cam plate, and adjustable locking bars to engage through slots in tracks.
 - a. Lock Cylinders: Provide cylinders specified in Division 08 Section "Door Hardware" **OR** standard with manufacturer, **as directed**, and keyed to building keying system, **as directed**.
 - b. Keys: Two **OR** Three, **as directed**, for each cylinder.
 3. Chain Lock Keeper: Suitable for padlock.
 4. Safety Interlock Switch: Equip power-operated doors with safety interlock switch to disengage power supply when door is locked.
- H. Counterbalance Mechanism
1. Torsion Spring: Counterbalance mechanism consisting of adjustable-tension torsion springs fabricated from steel-spring wire complying with ASTM A 229/A 229M, mounted on torsion shaft made of steel tube or solid steel. Provide springs designed for number of operation cycles indicated.
 2. Weight Counterbalance: Counterbalance mechanism consisting of filled pipe weights that move vertically in a galvanized-steel weight pipe. Connect pipe weights with cable to weight-cable drums mounted on torsion shaft made of steel tube or solid steel.
 3. Cable Drums and Shaft for Doors: Cast-aluminum or gray-iron casting cable drums mounted on torsion shaft and grooved to receive door-lifting cables as door is raised. Mount counterbalance

mechanism with manufacturer's standard ball-bearing brackets at each end of torsion shaft. Provide one additional midpoint bracket for shafts up to **16 feet (4.88 m)** long and two additional brackets at one-third points to support shafts more than **16 feet (4.88 m)** long unless closer spacing is recommended by door manufacturer.

4. Cables: Galvanized-steel lifting cables with cable safety factor of at least 5 **OR 7, as directed**, to 1.
5. Cable Safety Device: Include a spring-loaded steel or spring-loaded bronze cam mounted to bottom door roller assembly on each side and designed to automatically stop door if either lifting cable breaks.
6. Bracket: Provide anchor support bracket as required to connect stationary end of spring to the wall and to level the shaft and prevent sag.
7. Provide a spring bumper at each horizontal track to cushion door at end of opening operation.

I. Manual Door Operators

1. Equip door with manufacturer's recommended manual door operator unless another type of door operator is indicated.
2. Push-up Operation: Lift handles and pull rope for raising and lowering doors, with counterbalance mechanism designed so that required lift or pull for door operation does not exceed **25 lbf (111 N)**.
3. Chain-Hoist Operator: Consisting of endless steel hand chain, chain-pocket wheel and guard, and gear-reduction unit with a maximum **25-lbf (111-N) OR 35-lbf (155-N), as directed**, force for door operation. Provide alloy-steel hand chain with chain holder secured to operator guide.

J. Electric Door Operators

1. General: Electric door operator assembly of size and capacity recommended and provided by door manufacturer for door and "operation cycles" requirement specified, with electric motor and factory-prewired motor controls, starter, gear-reduction unit, solenoid-operated brake, clutch, remote-control stations, control devices, integral gearing for locking door, and accessories required for proper operation.
 - a. Comply with NFPA 70.
 - b. Provide control equipment complying with NEMA ICS 1, NEMA ICS 2, and NEMA ICS 6; with NFPA 70, Class 2 control circuit, maximum 24-V ac or dc.
2. Usage Classification: Electric operator and components capable of operating for not less than number of cycles per hour indicated for each door.
3. Door-Operator Type: Unit consisting of electric motor, gears, pulleys, belts, sprockets, chains, and controls needed to operate door and meet required usage classification.
 - a. Trolley: Trolley operator mounted to ceiling above and to rear of door in raised position and directly connected to door with drawbar.
 - b. Jackshaft, Center Mounted: Jackshaft operator mounted on the inside front wall above door and connected to torsion shaft with an adjustable coupling or drive chain.
 - c. Jackshaft, Side Mounted: Jackshaft operator mounted on the inside front wall on right or left side of door and connected to torsion shaft with an adjustable coupling or drive chain.
4. Electric Motors: Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements specified in Division 11 Section "Common Motor Requirements For Equipment", unless otherwise indicated.
 - a. Electrical Characteristics:
 - 1) Phase: Single phase **OR** Polyphase, **as directed**.
 - 2) Volts: 115 **OR** 208 **OR** 230 **OR** 460, **as directed**, V.
 - 3) Hertz: 60.
 - b. Motor Type and Controller: Reversible motor and controller (disconnect switch) for motor exposure indicated.
 - c. Motor Size: Minimum size as indicated. If not indicated, large enough to start, accelerate, and operate door in either direction from any position, at a speed not less than **8 in./sec. (203 mm/s)** and not more than **12 in./sec. (305 mm/s)**, without exceeding nameplate ratings or service factor.

- d. Operating Controls, Controllers (Disconnect Switches), Wiring Devices, and Wiring: Manufacturer's standard unless otherwise indicated.
 - e. Coordinate wiring requirements and electrical characteristics of motors and other electrical devices with building electrical system and each location where installed.
 - f. Use adjustable motor-mounting bases for belt-driven operators.
 5. Limit Switches: Equip each motorized door with adjustable switches interlocked with motor controls and set to automatically stop door at fully opened and fully closed positions.
 6. Obstruction Detection Device: Equip motorized door with indicated external automatic safety sensor capable of protecting full width of door opening. Activation of device immediately stops and reverses downward door travel.
 - a. Photoelectric Sensor: Manufacturer's standard system designed to detect an obstruction in door opening without contact between door and obstruction.
 - 1) Self-Monitoring Type: Designed to interface with door operator control circuit to detect damage to or disconnection of sensor device. When self-monitoring feature is activated, door closes only with sustained pressure on close button.
 - b. Sensor Edge: Automatic safety sensor edge, located within astragal or weather stripping mounted to bottom bar. Contact with sensor activates device. Connect to control circuit using manufacturer's standard take-up reel or self-coiling cable.
 - 1) Self-Monitoring Type: Four-wire configured device designed to interface with door-operator control circuit to detect damage to or disconnection of sensor edge.
 7. Remote-Control Station: Momentary-contact, three-button control station with push-button controls labeled "Open," "Close," and "Stop."
 - a. Interior units, full-guarded, surface-mounted, heavy-duty type, with general-purpose NEMA ICS 6, Type 1 enclosure.
 - b. Exterior units, full-guarded, standard-duty, surface-mounted, weatherproof type, NEMA ICS 6, Type 4 enclosure, key operated.
 8. Emergency Manual Operation: Equip each electrically powered door with capability for emergency manual operation. Design manual mechanism so required force for door operation does not exceed **25 lbf (111 N) OR 35 lbf (155 N), as directed**.
 9. Emergency Operation Disconnect Device: Equip operator with hand-operated disconnect mechanism for automatically engaging manual operator and releasing brake for emergency manual operation while disconnecting motor without affecting timing of limit switch. Mount mechanism so it is accessible from floor level. Include interlock device to automatically prevent motor from operating when emergency operator is engaged.
 10. Motor Removal: Design operator so motor may be removed without disturbing limit-switch adjustment and without affecting emergency manual operation.
 11. Audible and Visual Signals: Audible alarm and visual indicator lights in compliance with regulatory requirements for accessibility.
 12. Radio-Control System: Consisting of the following:
 - a. Three-channel universal coaxial receiver to open, close, and stop door; one **OR** two, **as directed**, per operator.
OR
Multifunction remote control.
OR
Remote antenna and mounting kit.
- K. Door Assembly
1. Steel **OR** Wood **OR** Aluminum **OR** Full-Vision Aluminum **OR** Translucent, **as directed**, Sectional Door: Sectional door formed with hinged sections.
 2. Operation Cycles: Not less than 10,000 **OR** 20,000 **OR** 50,000 **OR** 100,000, **as directed**.
 3. R-Value **OR** Installed R-Value, **as directed**: **4.5 deg F x h x sq. ft./Btu (0.792 K x sq. m/W) OR 6.0 deg F x h x sq. ft./Btu (1.057 K x sq. m/W) OR 12.0 deg F x h x sq. ft./Btu (2.113 K x sq. m/W) OR 15.0 deg F x h x sq. ft./Btu (2.642 K x sq. m/W) OR 17.5 deg F x h x sq. ft./Btu (3.082 K x sq. m/W), as directed.**
 4. Steel Sections: Zinc-coated (galvanized) steel sheet with **G60 (Z180) OR G90 (Z275), as directed**, zinc coating.

- a. Section Thickness: **1-3/8 inches (35 mm) OR 1-3/4 inches (44 mm) OR 2 inches (51 mm), as directed.**
- b. Exterior-Face, Steel Sheet Thickness: **0.064-inch- (1.63-mm-) OR 0.040-inch- (1.02-mm-) OR 0.028-inch- (0.71-mm-) OR 0.022-inch- (0.56-mm-) OR 0.019-inch- (0.48-mm-), as directed,** nominal coated thickness.
 - 1) Surface:
 - a) Flat.
OR
Manufacturer's standard, grooved **OR** ribbed **OR** paneled **OR** wood-grain embossed, **as directed.**
- c. Insulation: Board **OR** Foamed in place, **as directed.**
- d. Interior Facing Material: Zinc-coated (galvanized) steel sheet of **0.028-inch- (0.71-mm-) OR 0.022-inch- (0.56-mm-) OR 0.019-inch- (0.48-mm-) OR** manufacturer's recommended thickness to meet performance requirements, **as directed,** nominal coated thickness.
- e. Interior Facing Material: Hardboard panel.
5. Wood Sections: Paneled **OR** Flush, **as directed,** and with manufacturer's standard insulation, **as directed.**
6. Aluminum Sections: Solid panels **OR** Full vision, **as directed,** with manufacturer's standard, nonglazed panels across bottom section of door, **as directed.**
7. Translucent Sections: Manufacturer's standard with manufacturer's standard, nonglazed panels across bottom section of door, **as directed.**
8. Track Configuration: Standard-lift **OR** Low-headroom **OR** High-lift **OR** Vertical-lift **OR** Contour, **as directed,** track with removable center post shared with adjacent door, **as directed.**
9. Weatherseals: Fitted to bottom and top and around entire perimeter of door. Provide combination bottom weatherseal and sensor edge, **as directed.**
10. Windows: Approximately **24 by 7 inches (610 by 178 mm) OR 24 by 11 inches (610 by 279 mm), as directed,** with curved corners, **OR** with square corners, **as directed,** and spaced apart the approximate distance as indicated on Drawings; in one row **OR** two rows, **as directed,** at height indicated on Drawings; installed with glazing **OR** insulated glazing, **as directed,** of the following type:
 - a. Clear Float Glass: 3 mm thick and complying with ASTM C 1036, Type I, Class 1, Quality Q3.
 - b. Clear Acrylic Plastic: 3 mm thick, transparent, smooth or polished, and formulated to be UV resistant.
 - c. Clear Polycarbonate Plastic: 3-mm-thick, transparent, fire-retardant, UV-resistant, polycarbonate sheet manufactured by extrusion process.
 - d. Insulating Glass: Manufacturer's standard.
11. Pass Door: As shown.
12. Roller-Tire Material: Case-hardened steel **OR** Neoprene or bronze **OR** Manufacturer's standard, **as directed.**
13. Locking Devices: Equip door with slide bolt for padlock **OR** locking device assembly, **as directed,** and chain lock keeper, **as directed.**
 - a. Locking Device Assembly: Single-jamb side **OR** Cremone type, both jamb sides, **as directed,** locking bars, operable from inside with thumbturn **OR** outside with cylinder **OR** outside only, with cylinder **OR** inside and outside, with cylinders, **as directed.**
14. Counterbalance Type: Torsion spring **OR** Weight counterbalance, **as directed.**
15. Manual Door Operator: Push-up operation **OR** Chain-hoist operator, **as directed.**
16. Electric Door Operator:
 - a. Usage Classification: Heavy duty, 60 to 90 cycles per hour **OR** Standard duty, up to 60 cycles per hour **OR** Medium duty, up to 15 cycles per hour **OR** Light duty, up to 10 cycles per hour, **as directed.**
 - b. Operator Type: Trolley **OR** Jackshaft, center mounted **OR** Jackshaft, side mounted **OR** As shown on Drawings, **as directed.**
 - c. Motor Exposure: Interior, clean, and dry **OR** Exterior, dusty, wet, or humid, **as directed.**
 - d. Emergency Manual Operation: Push-up **OR** Chain, **as directed,** type.

- e. Obstruction-Detection Device: Automatic photoelectric sensor **OR** electric sensor edge on bottom bar **OR** pneumatic sensor edge on bottom bar, **as directed**; self-monitoring type, **as directed**.
 - 1) Sensor Edge Bulb Color: Black **OR** As selected from manufacturer's full range, **as directed**.
- f. Remote-Control Station: Interior **OR** Exterior **OR** Where shown on Drawings, **as directed**.
- g. Other Equipment: Audible and visual signals **OR** Radio-control system, **as directed**.
- 17. Door Finish:
 - a. Aluminum Finish: Clear anodized **OR** Bronze anodized **OR** Anodized color matching sample **OR** Anodized color as selected from manufacturer's full range, **as directed**.
 - b. Baked-Enamel or Powder-Coated Finish: Color and gloss as selected from manufacturer's full range.
 - c. Factory Prime Finish: Manufacturer's standard color.
 - d. Finish of Interior Facing Material: Match finish of exterior section face **OR** Finish as selected from manufacturer's full range, **as directed**.
- L. General Finish Requirements
 - 1. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
 - 2. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.
- M. Aluminum Finishes
 - 1. Clear Anodic Finish: AAMA 611, AA-M12C22A41, Class I, 0.018 mm **OR** AA-M12C22A31, Class II, 0.010 mm, **as directed**, or thicker.
 - 2. Color Anodic Finish: AAMA 611, AA-M12C22A42/A44, Class I, 0.018 mm **OR** AA-M12C22A32/A34, Class II, 0.010 mm, **as directed**, or thicker.
 - 3. Baked-Enamel or Powder-Coat Finish: AAMA 2603. Comply with coating manufacturer's written instructions for cleaning, conversion coating, application, and baking.
- N. Steel And Galvanized-Steel Finishes
 - 1. Factory Prime Finish: Manufacturer's standard primer, compatible with field-applied finish. Comply with coating manufacturer's written instructions for cleaning, pretreatment, application, and minimum dry film thickness.
 - 2. Baked-Enamel or Powder-Coat Finish: Manufacturer's standard baked-on finish consisting of prime coat and thermosetting topcoat. Comply with coating manufacturer's written instructions for cleaning, pretreatment, application, and minimum dry film thickness.
- 1.3 EXECUTION
 - A. Installation
 - 1. Install sectional doors and operating equipment complete with necessary hardware, anchors, inserts, hangers, and equipment supports; according to manufacturer's written instructions and as specified.
 - 2. Tracks:
 - a. Fasten vertical track assembly to opening jambs and framing, spaced not more than **24 inches (610 mm)** apart.
 - b. Hang horizontal track assembly from structural overhead framing with angles or channel hangers attached to framing by welding or bolting, or both. Provide sway bracing, diagonal bracing, and reinforcement as required for rigid installation of track and door-operating equipment.
 - c. Repair galvanized coating on tracks according to ASTM A 780.
 - 3. Accessibility: Install sectional doors, switches, and controls along accessible routes in compliance with regulatory requirements for accessibility.

B. Startup Services

1. Engage a factory-authorized service representative to perform startup service.
 - a. Complete installation and startup checks according to manufacturer's written instructions.
 - b. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

C. Adjusting

1. Adjust hardware and moving parts to function smoothly so that doors operate easily, free of warp, twist, or distortion.
2. Lubricate bearings and sliding parts as recommended by manufacturer.
3. Adjust doors and seals to provide weathertight fit around entire perimeter.
4. Align and adjust motors, pulleys, belts, sprockets, chains, and controls according to manufacturer's written instructions.
5. Touch-up Painting: Immediately after welding galvanized materials, clean welds and abraded galvanized surfaces and repair galvanizing to comply with ASTM A 780.

END OF SECTION 08 36 13 00



Task	Specification	Specification Description
08 36 13 00	08 33 23 11	Overhead Coiling Doors

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SECTION 08 38 13 00 - FLEXIBLE DOORS

1.1 GENERAL

A. Description Of Work

1. This specification covers the furnishing and installation of flexible doors. Products shall be as follows or as directed by the Owner. Installation procedures shall be in accordance with the product manufacturer's recommendations. Demolition and removal of materials shall be as required to support the work.

B. Submittals

1. Product Data: For each type of product indicated.
2. Shop drawings shall be submitted for approval.

1.2 PRODUCTS

- A. General: Each new door unit shall be a complete unit produced by one manufacturer including hardware, accessories, mounting, and installation components.

B. Door Panels: Door panels shall be constructed of the following materials.

1. Heavy-Duty, Abrasive-Resistant Rubber, 60 durometer, roto-cured process, 2,200 psi tensile strength. Panel thickness shall be 1/2- inch. Lower door panel shall be reinforced with additional rubber extrusions bonded horizontally to the door facing on 8 inch centers.
2. Flexible Polycarbonate transparent panels 1/2 inch thick.
3. Flexible Polyvinylchloride (PVC) transparent panels min. 0.196 inch (5mm) thick.
4. Flexible Polyvinylchloride (PVC) opaque panels min. 0.196 inch (5mm) thick.

- C. Door Facings shall be high strength fabric reinforced vinyl bonded to door frame. Facing shall not be mechanically fastened.

- D. The Vision Panels shall be double glazed, damage resistant with optical clarity exceeding 90%. Vision Panels shall be mounted flush.

- E. Door Panels shall be single or double-acting, as required.

- F. Panel Frame: Framing materials to which door panels shall be secured shall be galvanized steel, ASTM A525, 11 gauge. Door panels shall be suspended between L-shaped rolled formed rails and stiles by removable bolt and nut connectors.

G. Hardware shall conform to the requirements of ASTM A 164 or ASTM A 386, as required.

1. Hinges shall be adjustable spring-type gravity self-lubricating hinges.
2. Magnetic Catch shall be provided at door overlap at pair of door panels to give positive closure.
3. Header and Jamb Seals shall be door mounted PVC seals at head and jamb.
4. Bumpers shall be center or bottom bumpers.
5. Jamb Guards shall be formed steel guards to enclose and protect lower hinge hardware and closures.

- H. Door Jamb shall be constructed of steel tube, ASTM A 500, with integral wall anchors, galvanized in compliance with ASTM A 386 or stainless steel bent plate, Type 304, with integral wall anchors, as required.

- I. Finish: All ferrous metal parts shall be finish-coated with polyurethane paint.



- J. Fire Hazard Classification: All door material shall have a fire hazard classification determined by ASTM E 84. Provide materials with the following fire hazard classifications:
 - Flame spread not more than 25.
 - Smoke developed not more than 50.
- K. Vertical PVC Vinyl Strip Doors
 - 1. Door shall consist of overlapping transparent minimum PVC strips with pre-punched galvanized hanger brackets which mate with formed metal arms on the universal hardware.
 - 2. Hardware shall provide full swivel action. A cover plate shall prevent accidental removal.
 - 3. End Strips shall be orange to frame opening. Strips shall have rounded edges and overlap to form a seal.

1.3 EXECUTION

- A. Products shall be installed per manufacturer's written instruction. Products shall be firmly attached to adjacent materials. Products shall be installed level and plumb and shall be demonstrated to operate properly and as intended for a complete installation.

END OF SECTION 08 38 13 00



Task	Specification	Specification Description
08 38 16 00	08 05 13 00	Steel Doors And Frames
08 38 16 00	08 12 13 13	Steel Entry Doors
08 38 16 00	08 12 13 13a	Stainless Steel Doors And Frames
08 38 19 00	08 05 13 00	Steel Doors And Frames
08 38 19 00	08 12 13 13	Steel Entry Doors
08 38 19 00	08 12 13 13a	Stainless Steel Doors And Frames

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SECTION 08 42 13 00 - ALUMINUM-FRAMED ENTRANCES AND STOREFRONTS

1.1 GENERAL

A. Description Of Work

1. This specification covers the furnishing and installation of material for aluminum framed entrances and storefronts. Products shall be as follows or as directed by the Owner. Installation procedures shall be in accordance with the products manufacturer's recommendations. Demolition and removal of materials shall be as required to support the work.

B. Summary

1. Section Includes:
 - a. Exterior and interior storefront framing.
 - b. Storefront framing for window walls.
 - c. Storefront framing for ribbon walls.
 - d. Storefront framing for punched openings.
 - e. Exterior and interior manual-swing entrance doors and door-frame units.

C. Definitions

1. ADA/ABA Accessibility Guidelines: U.S. Architectural & Transportation Barriers Compliance Board's "Americans with Disability Act (ADA) and Architectural Barriers Act (ABA) Accessibility Guidelines for Buildings and Facilities."

D. Performance Requirements

1. General Performance: Aluminum-framed systems shall withstand the effects of the following performance requirements without exceeding performance criteria or failure due to defective manufacture, fabrication, installation, or other defects in construction:
 - a. Movements of supporting structure indicated on Drawings including, but not limited to, story drift and deflection from uniformly distributed and concentrated live loads.
 - b. Dimensional tolerances of building frame and other adjacent construction.
 - c. Failure includes the following:
 - 1) Deflection exceeding specified limits.
 - 2) Thermal stresses transferring to building structure.
 - 3) Framing members transferring stresses, including those caused by thermal and structural movements to glazing.
 - 4) Glazing-to-glazing contact.
 - 5) Noise or vibration created by wind and by thermal and structural movements.
 - 6) Loosening or weakening of fasteners, attachments, and other components.
 - 7) Sealant failure.
 - 8) Failure of operating units.
2. Delegated Design: Design aluminum-framed systems, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.
3. Structural Loads:
 - a. Wind Loads: As indicated on Drawings **OR as directed.**
 - 1) Basic Wind Speed: **85 mph (38 m/s) OR 90 mph (40 m/s) OR 100 mph (44 m/s) OR 110 mph (49 m/s), as directed.**
 - 2) Exposure Category: **A OR B OR C OR D, as directed.**
4. Deflection of Framing Members:
 - a. Deflection Normal to Wall Plane: Limited to edge of glass in a direction perpendicular to glass plane shall not exceed L/175 of the glass edge length for each individual glazing lite **OR 1/175 of clear span for spans up to 13 feet 6 inches (4.1 m) and to 1/240 of clear span plus 1/4 inch (6.35 mm) for spans greater than 13 feet 6 inches (4.1 m), as directed, or an**

- amount that restricts edge deflection of individual glazing lites to **3/4 inch (19 mm)**, whichever is less.
- b. Deflection Parallel to Glazing Plane: Limited to L/360 of clear span or **1/8 inch (3.2 mm)**, whichever is smaller **OR** amount not exceeding that which reduces glazing bite to less than 75 percent of design dimension and that which reduces edge clearance between framing members and glazing or other fixed components directly below them to less than **1/8 inch (3.2 mm)** and clearance between members and operable units directly below them to less than **1/16 inch (1.5 mm)**, **as directed**.
 5. Structural-Test Performance: Provide aluminum-framed systems tested according to ASTM E 330 as follows:
 - a. When tested at positive and negative wind-load design pressures, systems do not evidence deflection exceeding specified limits.
 - b. When tested at 150 percent of positive and negative wind-load design pressures, systems, including anchorage, do not evidence material failures, structural distress, and permanent deformation of main framing members exceeding 0.2 percent of span.
 - c. Test Durations: As required by design wind velocity, but not fewer than 10 seconds.
 6. Windborne-Debris-Impact-Resistance Performance: Provide aluminum-framed systems that pass missile-impact and cyclic-pressure tests when tested according to ASTM E 1886 and testing information in ASTM E 1996 **OR** AAMA 506, **as directed**.
 - a. Large-Missile Impact: For aluminum-framed systems located within **30 feet (9.1 m)** of grade.
 - b. Small-Missile Impact: For aluminum-framed systems located more than **30 feet (9.1 m)** above grade.
 7. Story Drift: Provide aluminum-framed systems that accommodate design displacement of adjacent stories indicated.
 - a. Design Displacement: As indicated on Drawings **OR as directed**.
 - b. Test Performance: Meet criteria for passing, based on building occupancy type, when tested according to AAMA 501.4 at design displacement and 1.5 times design displacement.
 8. Air Infiltration: Provide aluminum-framed systems with maximum air leakage through fixed glazing and framing areas of **0.06 cfm/sq. ft. (0.03 L/s per sq. m)** of fixed wall area when tested according to ASTM E 283 at a minimum static-air-pressure difference of **1.57 lbf/sq. ft. (75 Pa)** **OR 6.24 lbf/sq. ft. (300 Pa)**, **as directed**.
 9. Water Penetration under Static Pressure: Provide aluminum-framed systems that do not evidence water penetration through fixed glazing and framing areas when tested according to ASTM E 331 at a minimum static-air-pressure difference of 20 percent of positive wind-load design pressure, but not less than **6.24 lbf/sq. ft. (300 Pa)**.
 10. Water Penetration under Dynamic Pressure: Provide aluminum-framed systems that do not evidence water leakage through fixed glazing and framing areas when tested according to AAMA 501.1 under dynamic pressure equal to 20 percent of positive wind-load design pressure, but not less than **6.24 lbf/sq. ft. (300 Pa)**.
 - a. Maximum Water Leakage: According to AAMA 501.1 **OR** No uncontrolled water penetrating aluminum-framed systems or water appearing on systems' normally exposed interior surfaces from sources other than condensation, **as directed**. Water leakage does not include water controlled by flashing and gutters that is drained to exterior and water that cannot damage adjacent materials or finishes.
 11. Thermal Movements: Provide aluminum-framed systems that allow for thermal movements resulting from the following maximum change (range) in ambient and surface temperatures. Base engineering calculation on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.
 - a. Temperature Change (Range): **120 deg F (67 deg C)**, ambient; **180 deg F (100 deg C)**, material surfaces.
 - b. Test Performance: No buckling; stress on glass; sealant failure; excess stress on framing, anchors, and fasteners; or reduction of performance when tested according to AAMA 501.5.

- 1) High Exterior Ambient-Air Temperature: That which produces an exterior metal-surface temperature of **180 deg F (82 deg C)**.
 - 2) Low Exterior Ambient-Air Temperature: **0 deg F (minus 18 deg C)**.
 - c. Interior Ambient-Air Temperature: **75 deg F (24 deg C)**.
 12. Condensation Resistance: Provide aluminum-framed systems with fixed glazing and framing areas having condensation-resistance factor (CRF) of not less than 45 **OR** 53, **as directed**, when tested according to AAMA 1503.
 13. Thermal Conductance: Provide aluminum-framed systems with fixed glazing and framing areas having an average U-factor of not more than **0.57 Btu/sq. ft. x h x deg F (3.23 W/sq. m x K) OR 0.69 Btu/sq. ft. x h x deg F (3.92 W/sq. m x K)**, **as directed**, when tested according to AAMA 1503.
 14. Sound Transmission: Provide aluminum-framed systems with fixed glazing and framing areas having the following sound-transmission characteristics:
 - a. Sound Transmission Class (STC): Minimum 26 **OR** 30 **OR** 35, **as directed**, STC when tested for laboratory sound transmission loss according to ASTM E 90 and determined by ASTM E 413.
 - b. Outdoor-Indoor Transmission Class (OITC): Minimum 26 **OR** 30 **OR** 34, **as directed**, OITC when tested for laboratory sound transmission loss according to ASTM E 90 and determined by ASTM E 1332.
 15. Structural Sealant: Capable of withstanding tensile and shear stresses imposed by aluminum-framed systems without failing adhesively or cohesively. When tested for preconstruction adhesion and compatibility, cohesive failure of sealant shall occur before adhesive failure.
 - a. Adhesive failure occurs when sealant pulls away from substrate cleanly, leaving no sealant material behind.
 - b. Cohesive failure occurs when sealant breaks or tears within itself but does not separate from each substrate because sealant-to-substrate bond strength exceeds sealant's internal strength.
 16. Structural-Sealant Joints: Designed to produce tensile or shear stress of less than **20 psi (138 kPa)**.
- E. Submittals
1. Product Data: For each type of product indicated.
 2. LEED Submittal:
 - a. Product Data for Credit EQ 4.1: For adhesives and sealants used inside of the weatherproofing system, including printed statement of VOC content.
 3. Shop Drawings: For aluminum-framed systems. Include plans, elevations, sections, details, and attachments to other work.
 - a. Include details of provisions for system expansion and contraction and for drainage of moisture in the system to the exterior.
 - b. For entrance doors, include hardware schedule and indicate operating hardware types, functions, quantities, and locations.
 4. Samples: For each type of exposed finish required.
 5. Other Action Submittals:
 - a. Entrance Door Hardware Schedule: Prepared by or under the supervision of supplier, detailing fabrication and assembly of entrance door hardware, as well as procedures and diagrams. Coordinate final entrance door hardware schedule with doors, frames, and related work to ensure proper size, thickness, hand, function, and finish of entrance door hardware.
 6. Delegated-Design Submittal: For aluminum-framed systems indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
 7. Seismic Qualification Certificates: For aluminum-framed systems, accessories, and components, from manufacturer.
 - a. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
 8. Welding certificates.

9. Product Test Reports.
10. Quality-Control Program for Structural-Sealant-Glazed System: Include reports.
11. Field quality-control reports.
12. Maintenance Data.
13. Warranties: Sample of special warranties.

F. Quality Assurance

1. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for installation of units required for this Project.
2. Testing Agency Qualifications: Qualified according to ASTM E 699 for testing indicated.
3. Engineering Responsibility: Prepare data for aluminum-framed systems, including Shop Drawings, based on testing and engineering analysis of manufacturer's standard units in systems similar to those indicated for this Project.
4. Quality-Control Program for Structural-Sealant-Glazed System: Develop quality control program specifically for Project. Document quality-control procedures and verify results for aluminum-framed systems. Comply with ASTM C 1401 recommendations including, but not limited to, system material-qualification procedures, preconstruction sealant-testing program, procedures for system fabrication and installation, and intervals of reviews and checks.
5. Product Options: Information on Drawings and in Specifications establishes requirements for systems' aesthetic effects and performance characteristics. Aesthetic effects are indicated by dimensions, arrangements, alignment, and profiles of components and assemblies as they relate to sightlines, to one another, and to adjoining construction. Performance characteristics are indicated by criteria subject to verification by one or more methods including preconstruction testing, field testing, and in-service performance.
 - a. Do not revise intended aesthetic effects, as judged solely by the Owner, except with the Owner's approval. If revisions are proposed, submit comprehensive explanatory data to the Owner for review.
6. Accessible Entrances: Comply with applicable provisions in the U.S. Architectural & Transportation Barriers Compliance Board's ADA-ABA Accessibility Guidelines and ICC/ANSI A117.1, **as directed**.
7. Source Limitations for Aluminum-Framed Systems: Obtain from single source from single manufacturer.
8. Structural-Sealant Glazing: Comply with ASTM C 1401, "Guide for Structural Sealant Glazing" for design and installation of structural-sealant-glazed systems.
9. Structural-Sealant Joints: Design reviewed and approved by structural-sealant manufacturer.
10. Welding Qualifications: Qualify procedures and personnel according to AWS D1.2, "Structural Welding Code - Aluminum."
11. Preinstallation Conference: Conduct conference at Project site.

G. Warranty

1. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of aluminum-framed systems that do not comply with requirements or that fail in materials or workmanship within two **OR** five **OR** 10, **as directed**, years from date of Final Completion.
2. Special Finish Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components on which finishes do not comply with requirements or that fail in materials or workmanship within five **OR** 10 **OR** 20, **as directed**, years from date of Final Completion. Warranty does not include normal weathering.

1.2 PRODUCTS

A. Materials

1. Aluminum: Alloy and temper recommended by manufacturer for type of use and finish indicated.
 - a. Sheet and Plate: **ASTM B 209 (ASTM B 209M)**.

- b. Extruded Bars, Rods, Profiles, and Tubes: **ASTM B 221** (**ASTM B 221M**).
 - c. Extruded Structural Pipe and Tubes: ASTM B 429.
 - d. Structural Profiles: ASTM B 308/B 308M.
 - e. Welding Rods and Bare Electrodes: AWS A5.10/A5.10M.
 2. Steel Reinforcement: Manufacturer's standard zinc-rich, corrosion-resistant primer, complying with SSPC-PS Guide No. 12.00; applied immediately after surface preparation and pretreatment. Select surface preparation methods according to recommendations in SSPC-SP COM and prepare surfaces according to applicable SSPC standard.
 - a. Structural Shapes, Plates, and Bars: ASTM A 36/A 36M.
 - b. Cold-Rolled Sheet and Strip: ASTM A 1008/A 1008M.
 - c. Hot-Rolled Sheet and Strip: ASTM A 1011/A 1011M.
- B. Framing Systems
 1. Framing Members: Manufacturer's standard extruded-aluminum framing members of thickness required and reinforced as required to support imposed loads.
 - a. Construction: Nonthermal **OR** Thermally improved **OR** Thermally broken **OR** Structurally glazed, **as directed**.
 - b. Glazing System: Retained mechanically with gaskets on four sides **OR** Retained by structural sealant at vertical edges and mechanically with gaskets at horizontal edges, **as directed**.
 - c. Glazing Plane: As indicated **OR** Front **OR** Center **OR** Back **OR** Multiplane, **as directed**.
 2. Brackets and Reinforcements: Manufacturer's standard high-strength aluminum with nonstaining, nonferrous shims for aligning system components.
 3. Fasteners and Accessories: Manufacturer's standard corrosion-resistant, nonstaining, nonbleeding fasteners and accessories compatible with adjacent materials.
 - a. Use self-locking devices where fasteners are subject to loosening or turning out from thermal and structural movements, wind loads, or vibration.
 - b. Reinforce members as required to receive fastener threads.
 - c. Use exposed fasteners with countersunk Phillips screw heads, finished to match framing system **OR** fabricated from stainless steel, **as directed**.
 4. Concrete and Masonry Inserts: Hot-dip galvanized cast-iron, malleable-iron, or steel inserts, complying with ASTM A 123/A 123M or ASTM A 153/A 153M.
 5. Concealed Flashing: Manufacturer's standard corrosion-resistant, nonstaining, nonbleeding flashing compatible with adjacent materials **OR** Dead-soft, **0.018-inch- (0.457-mm-)** thick stainless steel, ASTM A 240/A 240M of type recommended by manufacturer, **as directed**.
 6. Framing System Gaskets and Sealants: Manufacturer's standard, recommended by manufacturer for joint type.
 - a. Provide sealants for use inside of the weatherproofing system that have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- C. Glazing Systems
 1. Glazing: As specified in Division 08 Section "Glazing".
 2. Glazing Gaskets: Manufacturer's standard compression types; replaceable, molded or extruded, of profile and hardness required to maintain watertight seal.
 3. Spacers and Setting Blocks: Manufacturer's standard elastomeric type.
 4. Bond-Breaker Tape: Manufacturer's standard TFE-fluorocarbon or polyethylene material to which sealants will not develop adhesion.
 5. Glazing Sealants: For structural-sealant-glazed systems, as recommended by manufacturer for joint type, and as follows:
 - a. Structural Sealant: ASTM C 1184, single-component neutral-curing silicone formulation that is compatible with system components with which it comes in contact, specifically formulated and tested for use as structural sealant and approved by a structural-sealant manufacturer for use in aluminum-framed systems indicated.
 - 1) Provide sealants for use inside of the weatherproofing system that have a VOC content of 100 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

- 2) Color: Black **OR** As selected from manufacturer's full range of colors, **as directed**.
- b. Weatherseal Sealant: ASTM C 920 for Type S, Grade NS, Class 25, Uses NT, G, A, and O; single-component neutral-curing formulation that is compatible with structural sealant and other system components with which it comes in contact; recommended by structural-sealant, weatherseal-sealant, and aluminum-framed-system manufacturers for this use.
 - 1) Provide sealants for use inside of the weatherproofing system that have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 - 2) Color: Matching structural sealant.

D. Entrance Door Systems

1. Entrance Doors: Manufacturer's standard glazed entrance doors for manual-swing operation.
 - a. Door Construction: 1-3/4-inch (44.5-mm) overall thickness, with minimum 0.125-inch (3.2-mm) **OR** 2-inch (50.8-mm) overall thickness, with minimum 0.188-inch (4.8-mm) **OR** 2- to 2-1/4-inch (50.8- to 57.2-mm) overall thickness, with minimum 0.125-inch (3.2-mm-), **as directed**, thick, extruded-aluminum tubular rail and stile members. Mechanically fasten corners with reinforcing brackets that are deeply penetrated and fillet welded or that incorporate concealed tie rods.
 - 1) Thermal Construction: High-performance plastic connectors separate aluminum members exposed to the exterior from members exposed to the interior.
 - b. Door Design: As indicated **OR** Narrow stile; 2-1/8-inch (54-mm) nominal width **OR** Medium stile; 3-1/2-inch (88.9-mm) nominal width **OR** Wide stile; 5-inch (127-mm) nominal width, **as directed**.
 - 1) Accessible Doors: Smooth surfaced for width of door in area within 10 inches (255 mm) above floor or ground plane.
 - c. Glazing Stops and Gaskets: Beveled **OR** Square, **as directed**, snap-on, extruded-aluminum stops and preformed gaskets.
 - 1) Provide nonremovable glazing stops on outside of door.

E. Entrance Door Hardware

1. General: Provide entrance door hardware and entrance door hardware sets indicated in door and frame schedule **OR** and entrance door hardware sets indicated in "Entrance Door Hardware Sets" Article, **as directed**, for each entrance door to comply with requirements in this Section.
 - a. Entrance Door Hardware Sets: Provide quantity, item, size, finish or color indicated, and named manufacturers' products **OR** products equivalent in function and comparable in quality to named products **OR** products complying with BHMA standard referenced, **as directed**.
 - b. Sequence of Operation: Provide electrified door hardware function, sequence of operation, and interface with other building control systems indicated.
 - c. Opening-Force Requirements:
 - 1) Egress Doors: Not more than 15 lbf (67 N) to release the latch and not more than 30 lbf ((133 N)) to set the door in motion and not more than 15 lbf (67 N) to open the door to its minimum required width.
 - 2) Accessible Interior Doors: Not more than 5 lbf (22.2 N) to fully open door.
2. Designations: Requirements for design, grade, function, finish, size, and other distinctive qualities of each type of entrance door hardware are indicated in "Entrance Door Hardware Sets" Article. Products are identified by using entrance door hardware designations as follows:
 - a. References to BHMA Standards: Provide products complying with these standards and requirements for description, quality, and function.
3. Opening-Force Requirements:
 - a. Delayed-Egress Locks: Lock releases within 15 seconds after applying a force of not more than 15 lbf (67 N) for not more than 3 seconds.
 - b. Latches and Exit Devices: Not more than 15 lbf (67 N) required to release latch.
4. Pivot Hinges: BHMA A156.4, Grade 1.
 - a. Offset-Pivot Hinges: Provide top, bottom, and intermediate offset pivots at each door leaf.

5. Butt Hinges: BHMA A156.1, Grade 1, radius corner.
 - a. Nonremovable Pins: Provide set screw in hinge barrel that, when tightened into a groove in hinge pin, prevents removal of pin while entrance door is closed.
 - b. Exterior Hinges: Stainless steel, with stainless-steel pin **OR** Nonferrous, **as directed**.
 - c. Quantities:
 - 1) For doors up to **87 inches (2210 mm)** high, provide 3 hinges per leaf.
 - 2) For doors more than **87 and up to 120 inches (2210 and up to 3048 mm)** high, provide 4 hinges per leaf.
6. Continuous-Gear Hinges: Manufacturer's standard with stainless-steel bearings between knuckles, fabricated to full height of door and frame.
7. Mortise Auxiliary Locks: BHMA A156.5, Grade 1.
8. Manual Flush Bolts: BHMA A156.16, Grade 1.
9. Automatic and Self-Latching Flush Bolts: BHMA A156.3, Grade 1.
10. Panic Exit Devices: BHMA A156.3, Grade 1, listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for panic protection, based on testing according to UL 305.
11. Cylinders: As specified in Division 08 Section "Door Hardware" **OR** BHMA A156.5, Grade 1, **as directed**.
 - a. Keying: No master **OR** Master, **as directed**, key system. Permanently inscribe each key with a visual key control number and include notation "DO NOT DUPLICATE" **OR** to be furnished by Owner, **as directed**.
12. Strikes: Provide strike with black-plastic dust box for each latch or lock bolt; fabricated for aluminum framing.
13. Operating Trim: BHMA A156.6.
14. Removable Mullions: BHMA A156.3, extruded aluminum.
 - a. When used with panic exit devices, provide removable mullions listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for panic protection, based on testing according to UL 305. Use only mullions that have been tested with exit devices to be used.
15. Closers: BHMA A156.4, Grade 1, with accessories required for a complete installation, sized as required by door size, exposure to weather, and anticipated frequency of use; adjustable to meet field conditions and requirements for opening force.
16. Concealed Overhead Holders: BHMA A156.8, Grade 1.
17. Surface-Mounted Holders: BHMA A156.16, Grade 1.
18. Door Stops: BHMA A156.16, Grade 1, floor or wall mounted, as appropriate for door location indicated, with integral rubber bumper.
19. Weather Stripping: Manufacturer's standard replaceable components.
 - a. Compression Type: Made of ASTM D 2000, molded neoprene, or ASTM D 2287, molded PVC.
 - b. Sliding Type: AAMA 701, made of wool, polypropylene, or nylon woven pile with nylon-fabric or aluminum-strip backing.
20. Weather Sweeps: Manufacturer's standard exterior-door bottom sweep with concealed fasteners on mounting strip.
21. Silencers: BHMA A156.16, Grade 1.
22. Thresholds: BHMA A156.21, raised thresholds beveled with a slope of not more than 1:2, with maximum height of **1/2 inch (13 mm)**.
23. Finger Guards: Manufacturer's standard collapsible neoprene or PVC gasket anchored to frame hinge-jamb at center-pivoted doors.

F. Accessory Materials

1. Joint Sealants: For installation at perimeter of aluminum-framed systems, as specified in Division 07 Section "Joint Sealants".
 - a. Provide sealants for use inside of the weatherproofing system that have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2. Bituminous Paint: Cold-applied, asphalt-mastic paint complying with SSPC-Paint 12 requirements except containing no asbestos; formulated for **30-mil (0.762-mm)** thickness per coat.

G. Fabrication

1. Form or extrude aluminum shapes before finishing.
2. Weld in concealed locations to greatest extent possible to minimize distortion or discoloration of finish. Remove weld spatter and welding oxides from exposed surfaces by descaling or grinding.
3. Framing Members, General: Fabricate components that, when assembled, have the following characteristics:
 - a. Profiles that are sharp, straight, and free of defects or deformations.
 - b. Accurately fitted joints with ends coped or mitered.
 - c. Means to drain water passing joints, condensation within framing members, and moisture migrating within the system to exterior.
 - d. Physical and thermal isolation of glazing from framing members.
 - e. Accommodations for thermal and mechanical movements of glazing and framing to maintain required glazing edge clearances.
 - f. Provisions for field replacement of glazing from exterior **OR** interior **OR** interior for vision glass and exterior for spandrel glazing or metal panels, **as directed**.
 - g. Fasteners, anchors, and connection devices that are concealed from view to greatest extent possible.
4. Mechanically Glazed Framing Members: Fabricate for flush glazing without projecting stops.
5. Structural-Sealant-Glazed Framing Members: Include accommodations for using temporary support device to retain glazing in place while structural sealant cures.
6. Storefront Framing: Fabricate components for assembly using shear-block system **OR** screw-spline system **OR** head-and-sill-receptor system with shear blocks at intermediate horizontal members, **as directed**.
7. Entrance Door Frames: Reinforce as required to support loads imposed by door operation and for installing entrance door hardware.
 - a. At exterior doors, provide compression weather stripping at fixed stops.
 - b. At interior doors, provide silencers at stops to prevent metal-to-metal contact. Install three silencers on strike jamb of single-door frames and two silencers on head of frames for pairs of doors.
8. Entrance Doors: Reinforce doors as required for installing entrance door hardware.
 - a. At pairs of exterior doors, provide sliding-type weather stripping retained in adjustable strip and mortised into door edge.
 - b. At exterior doors, provide weather sweeps applied to door bottoms.
9. Entrance Door Hardware Installation: Factory install entrance door hardware to the greatest extent possible. Cut, drill, and tap for factory-installed entrance door hardware before applying finishes.
10. After fabrication, clearly mark components to identify their locations in Project according to Shop Drawings.

H. Aluminum Finishes

1. Clear Anodic Finish: AAMA 611, AA-M12C22A41, Class I, 0.018 mm **OR** AA-M12C22A31, Class II, 0.010 mm, **as directed**, or thicker.
2. Color Anodic Finish: AAMA 611, AA-M12C22A42/A44, Class I, 0.018 mm **OR** AA-M12C22A32/A34, Class II, 0.010 mm, **as directed**, or thicker.
 - a. Color: Light bronze **OR** Medium bronze **OR** Dark bronze **OR** Champagne **OR** Black **OR** Match sample **OR** As selected from full range of industry colors and color densities, **as directed**.
3. Baked-Enamel or Powder-Coat Finish: AAMA 2603 except with a minimum dry film thickness of **1.5 mils (0.04 mm)**. Comply with coating manufacturer's written instructions for cleaning, conversion coating, and applying and baking finish.

- a. Color and Gloss: Match sample **OR** As selected from manufacturer's full range, **as directed**.
- 4. High-Performance Organic Finish:
 - a. 2-coat fluoropolymer finish complying with AAMA 2604 **OR** AAMA 2605, **as directed**, and containing not less than 50 **OR** 70, **as directed**, percent PVDF resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
OR
3-coat **OR** 4-coat, **as directed**, fluoropolymer finish complying with AAMA 2605 and containing not less than 50 **OR** 70, **as directed**, percent PVDF resin by weight in both color coat and clear topcoat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
 - 1) Color and Gloss: Match sample **OR** As selected from manufacturer's full range, **as directed**.

1.3 EXECUTION

A. Installation

- 1. General:
 - a. Comply with manufacturer's written instructions.
 - b. Do not install damaged components.
 - c. Fit joints to produce hairline joints free of burrs and distortion.
 - d. Rigidly secure nonmovement joints.
 - e. Install anchors with separators and isolators to prevent metal corrosion and electrolytic deterioration.
 - f. Seal joints watertight unless otherwise indicated.
- 2. Metal Protection:
 - a. Where aluminum will contact dissimilar metals, protect against galvanic action by painting contact surfaces with primer or applying sealant or tape, or by installing nonconductive spacers as recommended by manufacturer for this purpose.
 - b. Where aluminum will contact concrete or masonry, protect against corrosion by painting contact surfaces with bituminous paint.
- 3. Install components to drain water passing joints, condensation occurring within framing members, and moisture migrating within the system to exterior.
- 4. Set continuous sill members and flashing in full sealant bed as specified in Division 07 Section "Joint Sealants" to produce weathertight installation.
- 5. Install components plumb and true in alignment with established lines and grades, and without warp or rack.
- 6. Install glazing as specified in Division 08 Section "Glazing".
 - a. Structural-Sealant Glazing:
 - 1) Prepare surfaces that will contact structural sealant according to sealant manufacturer's written instructions to ensure compatibility and adhesion. Preparation includes, but is not limited to, cleaning and priming surfaces.
 - 2) Install weatherseal sealant according to Division 07 Section "Joint Sealants" and according to sealant manufacturer's written instructions to produce weatherproof joints. Install joint filler behind sealant as recommended by sealant manufacturer.
- 7. Entrance Doors: Install doors to produce smooth operation and tight fit at contact points.
 - a. Exterior Doors: Install to produce weathertight enclosure and tight fit at weather stripping.
 - b. Field-Installed Entrance Door Hardware: Install surface-mounted entrance door hardware according to entrance door hardware manufacturers' written instructions using concealed fasteners to greatest extent possible.
- 8. Install perimeter joint sealants as specified in Division 07 Section "Joint Sealants" to produce weathertight installation.

B. Erection Tolerances

1. Install aluminum-framed systems to comply with the following maximum erection tolerances:
 - a. Location and Plane: Limit variation from true location and plane to **1/8 inch in 12 feet (3 mm in 3.7 m); 1/4 inch (6 mm)** over total length.
 - b. Alignment:
 - 1) Where surfaces abut in line, limit offset from true alignment to **1/16 inch (1.5 mm)**.
 - 2) Where surfaces meet at corners, limit offset from true alignment to **1/32 inch (0.8 mm)**.
2. Diagonal Measurements: Limit difference between diagonal measurements to **1/8 inch (3 mm)**.

C. Field Quality Control

1. Testing Agency: Engage a qualified independent testing and inspecting agency to perform field tests and inspections.
2. Testing Services: Testing and inspecting of representative areas to determine compliance of installed systems with specified requirements shall take place as follows and in successive phases as indicated on Drawings. Do not proceed with installation of the next area until test results for previously completed areas show compliance with requirements.
 - a. Structural-Sealant Compatibility and Adhesion: Structural sealant shall be tested according to recommendations in ASTM C 1401.
 - 1) Destructive Test Method A, "Hand Pull Tab (Destructive)," in ASTM C 1401, Appendix X2, shall be used.
 - a) A minimum of two **OR** four **OR** six, **as directed**, areas on each building face shall be tested.
 - b) Repair installation areas damaged by testing.
 - b. Structural-Sealant Glazing Inspection: After installation of aluminum-framed systems is complete, structural-sealant glazing shall be inspected and evaluated according to recommendations in ASTM C 1401.
 - c. Air Infiltration: Areas shall be tested for air leakage of 1.5 times the rate specified for laboratory testing under "Performance Requirements" Article, but not more than **0.09 cfm/sq. ft. (0.03 L/s per sq. m)**, of fixed wall area when tested according to ASTM E 783 at a minimum static-air-pressure difference of **1.57 lbf/sq. ft. (75 Pa) OR 6.24 lbf/sq. ft. (300 Pa), as directed**.
 - d. Water Penetration: Areas shall be tested according to ASTM E 1105 at a minimum uniform and cyclic static-air-pressure difference of 0.67 times the static-air-pressure difference specified for laboratory testing under "Performance Requirements" Article, but not less than **4.18 lbf/sq. ft. (200 Pa)**, and shall not evidence water penetration.
 - e. Water Spray Test: Before installation of interior finishes has begun, a minimum area of **75 feet (23 m)** by 1 story of aluminum-framed systems designated by the Owner shall be tested according to AAMA 501.2 and shall not evidence water penetration.
3. Repair or remove work if test results and inspections indicate that it does not comply with specified requirements.
4. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.
5. Aluminum-framed assemblies will be considered defective if they do not pass tests and inspections.
6. Prepare test and inspection reports.

D. Adjusting

1. Adjust operating entrance door hardware to function smoothly as recommended by manufacturer.
 - a. For entrance doors accessible to people with disabilities, adjust closers to provide a 3-second closer sweep period for doors to move from a 70-degree open position to **3 inches (75 mm)** from the latch, measured to the leading door edge.

END OF SECTION 08 42 13 00

SECTION 08 42 26 00 - ALL-GLASS ENTRANCES AND STOREFRONTS

1.1 GENERAL

A. Description Of Work

1. This specification covers the furnishing and installation of material for all-glass entrances and storefronts. Products shall be as follows or as directed by the Owner. Installation procedures shall be in accordance with the products manufacturer's recommendations. Demolition and removal of materials shall be as required to support the work.

B. Summary

1. Section Includes:
 - a. Interior **OR** Exterior **OR** Interior and exterior, **as directed**, manual-swinging **OR** manual-sliding, **as directed**, all-glass entrance doors.
 - b. All-glass sidelights and transoms.
 - c. Interior **OR** Exterior **OR** Interior and exterior, **as directed**, all-glass storefronts.

C. Definitions

1. ADA/ABA Accessibility Guidelines: U.S. Architectural & Transportation Barriers Compliance Board's "Americans with Disability Act (ADA) and Architectural Barriers Act (ABA) Accessibility Guidelines for Buildings and Facilities."

D. Performance Requirements

1. General Performance: All-glass systems shall withstand the effects of the following performance requirements without exceeding performance criteria or failure due to defective manufacture, fabrication, installation, or other defects in construction.
2. Structural Performance: All-glass systems shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated according to SEI/ASCE 7.
 - a. Wind Loads: **As directed**.
 - 1) Basic Wind Speed: **85 mph (38 m/s) OR 90 mph (40 m/s) OR 100 mph (44 m/s) OR 110 mph (49 m/s), as directed.**
 - 2) Importance Factor.
 - 3) Exposure Category: **A OR B OR C OR D, as directed.**
 - b. Seismic Loads: **As directed.**
 - c. Deflection Limits: Deflection normal to glazing plane is limited to **1 inch (25 mm) OR 1/175** of clear span or **3/4 inch (19 mm)**, whichever is smaller, **as directed.**
3. Delegated Design: Design all-glass systems, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.
4. Thermal Movements: Allow for thermal movements resulting from the following ambient and surface temperature changes.
 - a. Temperature Change (Range): **120 deg F (67 deg C)**, ambient; **180 deg F (100 deg C)**, material surfaces.

E. Submittals

1. Product Data: For each type of product indicated.
2. Shop Drawings: Show fabrication and installation details, including the following:
 - a. Plans, elevations, and sections.
 - b. Details of fittings and glazing, including isometric drawings of patch fittings **OR** rail fittings **OR** patch and rail fittings, **as directed.**
 - c. Door hardware locations, mounting heights, and installation requirements.
3. Samples: For each type of exposed finish required

4. Delegated-Design Submittal: For all-glass systems indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
5. Seismic Qualification Certificates
6. Product Test Reports.
7. Field quality-control reports.
8. Maintenance Data.
9. Warranty: Sample of special warranty.

F. Quality Assurance

1. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for installation of units required for this Project.
2. Testing Agency Qualifications: Qualified according to ASTM E 699 for testing indicated.
3. Engineering Responsibility: Prepare data for all-glass systems, including Shop Drawings, based on testing and engineering analysis of manufacturer's standard units in systems similar to those indicated for this Project.
4. Source Limitations: Obtain all-glass systems from single source from single manufacturer.
5. Accessible All-Glass Entrance Doors: Comply with applicable provisions in the U.S. Architectural & Transportation Barriers Compliance Board's ADA-ABA Accessibility Guidelines and ICC/ANSI A117.1.
6. Preinstallation Conference: Conduct conference at Project site.

G. Warranty

1. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of all-glass systems that do not comply with requirements or that fail in materials or workmanship within two years from date of Final Completion

1.2 PRODUCTS

A. Materials

1. Glass: ASTM C 1048, Kind FT (fully tempered), Condition A (uncoated surfaces), Type I (transparent), tested for surface and edge compression per ASTM C 1048 and for impact strength per 16 CFR 1201 for Category II materials.
 - a. Class 1: Clear monolithic.
 - 1) Thickness: **3/8 inch (10 mm) OR 1/2 inch (13 mm) OR 5/8 inch (16 mm) OR 3/4 inch (19 mm), as directed.**
 - 2) Locations: As directed.
 - b. Class 2: Tinted monolithic.
 - 1) Color: Gray **OR** Bronze, **as directed.**
 - 2) Thickness: **3/8 inch (10 mm) OR 1/2 inch (13 mm), as directed.**
 - 3) Locations: As directed.
 - c. Exposed Edges: Machine ground and flat polished.
 - d. Butt Edges: Flat ground.
 - e. Corner Edges: Lap-joint corners with exposed edges polished.
2. Aluminum Extrusions: **ASTM B 221 (ASTM B 221M)**, with strength and durability characteristics of not less than Alloy 6063-T5.
 - a. Bronze Cladding: ASTM B 36/B 36M, alloy matching sample **OR** UNS No. C28000 (muntz metal, 60 percent copper) **OR** UNS No. C22000 (commercial bronze, 90 percent copper) **OR** as standard with manufacturer, **as directed.**
 - b. Brass Cladding: ASTM B 36/B 36M, alloy matching sample **OR** UNS No. C26000 (cartridge brass, 70 percent copper) **OR** UNS No. C28000 (muntz metal, 60 percent copper) **OR** as standard with manufacturer, **as directed.**
 - c. Stainless-Steel Cladding: ASTM A 666, Type 304.

B. Metal Components

1. Fitting Configuration:
 - a. Manual-Swinging, All-Glass Entrance Doors Sidelights and Transoms: Patch fittings at head and sill on pivot side only **OR** Patch fittings at head and sill on pivot side, and for lock at sill of swing side **OR** Patch fitting at top and continuous rail fitting at bottom **OR** Continuous rail fitting at top and bottom, **as directed**.
 - b. Manual-Sliding, All-Glass Entrance Doors Sidelights and Transoms: Continuous rail fitting at top and bottom.
 - c. All-Glass Storefronts: Recessed glazing channel at top and continuous rail fitting at bottom **OR** Recessed glazing channel at top and bottom **OR** Continuous rail fitting at top and bottom, **as directed**.
2. Patch Fittings: Aluminum **OR** Bronze-clad aluminum **OR** Brass-clad aluminum **OR** Stainless-steel-clad aluminum, **as directed**.
3. Rail Fittings:
 - a. Material: Match patch-fitting metal and finish **OR** Aluminum **OR** Bronze-clad aluminum **OR** Brass-clad aluminum **OR** Stainless-steel-clad aluminum, **as directed**.
 - b. Height:
 - 1) Top Rail: 3-1/2 inches (89 mm) **OR** As indicated, **as directed**.
 - 2) Bottom Rail: 3-1/2 inches (89 mm) **OR** 10 inches (255 mm) **OR** As indicated, **as directed**.
 - c. Profile: Tapered **OR** Tapered flat **OR** Tapered at 60 degrees minimum from the horizontal **OR** Square **OR** Curved **OR** As indicated, **as directed**.
 - d. End Caps: Manufacturer's standard precision-fit end caps for rail fittings.
4. Accessory Fittings: Match patch-fitting **OR** rail-fitting **OR** patch- and rail-fitting, **as directed**, metal and finish for the following:
 - a. Overhead doorstop.
 - b. Center-housing lock.
 - c. Glass-support-fin brackets.
5. Anchors and Fastenings: Concealed.
6. Weather Stripping: Pile type; replaceable without removing all-glass entrance doors from pivots.

C. Fabrication

1. Provide holes and cutouts in glass to receive hardware, fittings, and accessory fittings before tempering glass. Do not cut, drill, or make other alterations to glass after tempering.
 - a. Fully temper glass using horizontal (roller-hearth) process, and fabricate so that when glass is installed, roll-wave distortion is parallel with bottom edge of door or lite.
2. Factory assemble components and factory install hardware and fittings to greatest extent possible.

D. Aluminum Finishes

1. Clear Anodic Finish: AAMA 611, AA-M12C22A41, Class I, 0.018 mm **OR** AA-M12C22A31, Class II, 0.010 mm, **as directed**, or thicker.
2. Color Anodic Finish: AAMA 611, AA-M12C22A42/A44, Class I, 0.018 mm **OR** AA-M12C22A32/A34, Class II, 0.010 mm, **as directed**, or thicker.
 - a. Color: Light bronze **OR** Medium bronze **OR** Dark bronze **OR** Black, **as directed**.

E. Stainless-Steel Finishes

1. Surface Preparation: Remove tool and die marks and stretch lines, or blend into finish.
2. Polished Finishes: Grind and polish surfaces to produce uniform finish, free of cross scratches.
 - a. Run grain of directional finishes with long dimension of each piece.
 - b. When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.
 - c. Directional Satin Finish: No. 4.
 - d. Mirrorlike Reflective, Nondirectional Polish: No. 8.

F. Copper-Alloy Finishes

1. Buffed Finish, Lacquered: M21-O6x (Mechanical Finish: buffed, smooth specular; Coating: clear organic, air drying, as specified below).
 - a. Clear, Organic Coating: Lacquer specified for copper alloys, applied by air spray in 2 coats per manufacturer's written instructions, with interim drying, to a total thickness of **1 mil (0.025 mm)**.
2. Hand-Rubbed Finish, Lacquered: M31-M34-O6x (Mechanical Finish: directionally textured, fine satin; Mechanical Finish: directionally textured, hand rubbed; Coating: clear organic, air drying, as specified below).
 - a. Clear, Organic Coating: Lacquer specified for copper alloys, applied by air spray in 2 coats per manufacturer's written instructions, with interim drying, to a total thickness of **1 mil (0.025 mm)**.
3. Statuary Conversion Coating over Satin Finish: M31-C55 (Mechanical Finish: directionally textured, fine satin; Chemical Finish: conversion coating, sulfide).
 - a. Color: Match sample.

1.3 EXECUTION

A. Installation

1. Install all-glass systems and associated components according to manufacturer's written instructions.
2. Set units level, plumb, and true to line, with uniform joints.
3. Maintain uniform clearances between adjacent components.
4. Lubricate hardware and other moving parts according to manufacturer's written instructions.
5. Set, seal, and grout floor closer cases as required to suit hardware and substrate indicated.
6. Install joint sealants as specified in Division 07 Section "Joint Sealants" and to produce weathertight installation.

B. Field Quality Control

1. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
2. After completion of all-glass storefront installation and nominal curing of sealant and glazing compounds, but before installation of interior finishes, test for water leaks according to AAMA 501.2.
3. Perform test for total areas as designated.
4. Work will be considered defective if it does not pass tests and inspections.
5. Prepare test and inspection reports.

C. Adjusting And Cleaning

1. Adjust all-glass entrance doors and hardware to produce smooth operation and tight fit at contact points and weather stripping.
 - a. For all-glass entrance doors accessible to people with disabilities, adjust closers to provide a 3-second closer sweep period for doors to move from a 70-degree open position to **3 inches (75 mm)** from the latch measured to the leading door edge.
2. Remove excess sealant and glazing compounds and dirt from surfaces.

END OF SECTION 08 42 26 00

SECTION 08 42 29 23 - ICU/CCU ENTRANCE DOORS

1.1 GENERAL

A. Description Of Work

1. This specification covers the furnishing and installation of material for ICU/CCU entrance doors. Products shall be as follows or as directed by the Owner. Installation procedures shall be in accordance with the products manufacturer's recommendations. Demolition and removal of materials shall be as required to support the work.

B. Summary

1. Section includes manually operated ICU/CCU entrances.

C. Submittals

1. Product Data: For each type of product indicated.
2. Shop Drawings: For ICU/CCU entrances. Include plans, elevations, sections, details, hardware mounting heights, and attachments to other work.
3. Samples: For each exposed product and for each color and texture specified.
4. Warranties: Sample of special warranties.

D. Quality Assurance

1. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for installation and maintenance of units required for this Project.
2. Preinstallation Conference: Conduct conference at Project site.

E. Warranty

1. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of ICU/CCU entrances that fail in materials or workmanship within two years from date of Final Completion.
2. Special Finish Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components on which finishes fail within 10 **OR** 20, **as directed**, years from date of Final Completion.

1.2 PRODUCTS

A. Materials

1. Aluminum: Alloy and temper recommended by manufacturer for type of use and finish indicated.
 - a. Extruded Bars, Rods, Profiles, and Tubes: **ASTM B 221 (ASTM B 221M)**.
 - b. Sheet and Plate: **ASTM B 209 (ASTM B 209M)**.
2. Stainless-Steel Sheet: ASTM A 240/A 240M or ASTM A 666, Type 304, stretcher-leveled standard of flatness, in entrance manufacturer's standard thickness.
3. Brass Sheet: ASTM B 36/B 36M, Alloy UNS No. C26000 (cartridge brass, 70 percent copper), in entrance manufacturer's standard thickness.
4. Bronze Sheet: ASTM B 36/B 36M, Alloy UNS No. C28000 (muntz metal, 60 percent copper) or Alloy UNS No. C23000 (red brass, 85 percent copper), in entrance manufacturer's standard thickness.
5. Sealants and Joint Fillers: As specified in Division 07 Section "Joint Sealants".
6. Shrinkage-Resistant Grout: Premixed, nonmetallic, noncorrosive, nonstaining grout complying with ASTM C 1107; of consistency suitable for application.
7. Bituminous Coating: Cold-applied asphalt emulsion complying with ASTM D 1187.

B. ICU/CCU Entrance Assemblies

1. General: Provide manufacturer's standard factory-glazed, **as directed**, ICU/CCU entrances including door leaves, sidelites, framing, headers, carrier assemblies, roller tracks, and accessories required for a complete installation.
2. Opening-Force Requirement, Sliding: Not more than **5 lbf (22.2 N)** to fully open door.
3. ICU/CCU Entrance:
 - a. Configuration:
 - 1) Single-sliding two-panel door, with one operable leaf and sidelite; with breakaway capability for sliding leaf only **OR** for sliding leaf and sidelite **OR** as indicated on Drawings, **as directed**.
 - 2) Configuration: Single-sliding three-panel door, with one operable leaf and two sidelites; with breakaway capability for sliding leaf only **OR** for sliding leaf and one sidelite **OR** for sliding leaf and both sidelites **OR** as indicated on Drawings, **as directed**.
 - 3) Configuration: Biparting-sliding four-panel door, with one operable leaf and sidelite on each side; with breakaway capability for sliding leaves only **OR** for sliding leaves and both sidelites **OR** as indicated on Drawings, **as directed**.
 - 4) Configuration: Single-telescoping three-panel door, with two operable leaves and one sidelite; with breakaway capability for sliding leaves only **OR** for sliding leaves and sidelite **OR** as indicated on Drawings, **as directed**.
 - 5) Configuration: Biparting-telescoping six-panel door, with two operable leaves and one sidelite on each side; with breakaway capability for sliding leaves only **OR** for sliding leaves and both sidelites **OR** as indicated on Drawings, **as directed**.
 - b. Mounting: Between jambs **OR** Surface, **as directed**.
 - c. Floor Track Configuration: No track across sliding-door opening and at sidelites (trackless) **OR** recessed, pin-guide track system at sidelites **OR** surface-mounted, roller-guide track system at sidelites, **as directed**.
 - d. Finish: Finish framing, door(s), sidelite(s), and header with Class I, clear anodic finish **OR** Class II, clear anodic finish **OR** Class I, color anodic finish **OR** Class II, color anodic finish **OR** baked-enamel or powder-coat finish **OR** high-performance organic finish (two-coat fluoropolymer) **OR** metal cladding, **as directed**.
 - 1) Color: Light bronze **OR** Dark bronze **OR** Black **OR** As selected from full range of industry colors and color densities, **as directed**.
 - 2) Metal Cladding: No. 4, directional-satin-finish stainless steel **OR** No. 8, mirrorlike reflective, nondirectional-polish-finish stainless steel **OR** Manufacturer's standard satin brass **OR** Manufacturer's standard polished brass **OR** Manufacturer's standard satin bronze, **as directed**.

C. Components

1. Framing and Transom Members: Manufacturer's standard extruded aluminum, minimum **0.125 inch (3.2 mm)** thick and reinforced as required to support imposed loads.
 - a. Nominal Size: **1-3/4 by 4-1/2 inches (45 by 115 mm)** **OR** **1-3/4 by 6 inches (45 by 150 mm)** **OR** As indicated on Drawings, **as directed**.
 - b. Extruded Glazing Stops and Applied Trim: Minimum **0.062-inch (1.6-mm)** wall thickness.
2. Stile and Rail Doors: Manufacturer's standard **1-3/4-inch- (45-mm-)** thick glazed doors with minimum **0.125-inch- (3.2-mm-)** thick, extruded-aluminum tubular stile and rail members. Mechanically fasten corners with reinforcing brackets that are welded, or incorporate concealed tie rods that span full length of top and bottom rails.
 - a. Glazing Stops and Gaskets: Beveled **OR** Square, **as directed**, snap-on, extruded-aluminum stops and preformed gaskets for glazing indicated.
 - b. Stile Design: Narrow stile; **2-1/8-inch (55-mm)** nominal width **OR** Medium stile; **3-1/2-inch (90-mm)** nominal width **OR** Wide stile; more than **4-inch (100-mm)** nominal width **OR** As indicated on Drawings, **as directed**.
 - c. Rail Design: **3-1/2-inch (90-mm)** nominal height **OR** **5-inch (125-mm)** nominal height **OR** As indicated on Drawings, **as directed**.
 - d. Muntin Bars: Horizontal tubular rail member for each door; match stile design.

3. Sidelites: Manufacturer's standard **1-3/4-inch- (45-mm-)** deep sidelites with minimum **0.125-inch- (3.2-mm-)** thick, extruded-aluminum tubular stile and rail members matching door design and finish.
 - a. Glazing Stops and Gaskets: Same materials and design as for stile and rail door.
 - b. Muntin Bars: Horizontal tubular rail member for each sidelite; match stile design.
 4. Glazing: As specified in Division 08 Section "Glazing".
 5. Headers: Fabricated from minimum **0.125-inch- (3.2-mm-)** thick extruded aluminum, and extending full width of ICU/CCU entrance units to conceal carrier assemblies and roller tracks. Provide hinged or removable access panels for service and adjustment. Secure panels to prevent unauthorized access.
 - a. Capacity: Capable of supporting doors up to **100 lb (45 kg)** per leaf over spans up to **14 feet (4.3 m)** without intermediate supports.
 - b. Provide sag rods for spans exceeding **14 feet (4.3 m)**.
 6. Carrier Assemblies and Overhead Roller Tracks: Manufacturer's standard carrier assembly that allows vertical adjustment; consisting of nylon- or delrin-covered, ball-bearing-center steel wheels operating on a continuous roller track or of ball-bearing-center steel wheels operating on a nylon- or delrin-covered, continuous roller track. Support doors from carrier assembly by cantilever and pivot assembly. Provide minimum of two ball-bearing roller wheels and two antirise rollers for each active leaf.
 7. Concealed Bottom Rollers: Manufacturer's standard.
 8. Brackets and Reinforcements: Manufacturer's standard, high-strength aluminum with nonstaining, nonferrous shims for aligning system components.
 9. Fasteners and Accessories: Manufacturer's standard, corrosion-resistant, nonstaining, nonbleeding fasteners and accessories compatible with adjacent materials.
- D. Hardware
1. General: Provide units in sizes and types recommended by ICU/CCU entrance and hardware manufacturers for entrances and uses indicated. Finish exposed parts to match door finish unless otherwise indicated.
 2. Breakaway Hardware: Provide release hardware that allows indicated panels to swing out in direction of egress to full 90 degrees from sliding mode.
 - a. Maximum Force to Open Panel: **50 lbf (222 N)**.
 - b. Release Position: Sliding door fully open **OR** At any point in sliding door travel, **as directed**.
 3. Limit Arm: Provide to control doors in the swing mode.
 4. Pulls: Manufacturer's standard recessed units on both sides of each operable door and surface-mounted, D-shaped pull for each swing-out sidelite.
 5. Manual Flush Bolts: BHMA A156.16, Grade 1, edge mortised, lever-extension type; located at bottom of each swing-out sidelite.
 6. Deadlocks: Manufacturer's standard, operated by exterior cylinder and interior thumb turn.
 - a. Deadbolts: Laminated-steel hook, mortise type, BHMA A156.5, Grade 1.
 - b. Cylinders: BHMA A156.5, Grade 1, six-pin mortise type **OR** As specified in Division 08 Section "Door Hardware", **as directed**.
 - 1) Keying: No master **OR** Integrate into building master, **as directed**, key system, and key all cylinders alike, **as directed**.
 - 2) Keys: Two **OR** Three, **as directed**, for each cylinder.
 7. Weather Stripping: Manufacturer's standard replaceable components.
 - a. Compression Type: ASTM D 2000, molded neoprene, or ASTM D 2287, molded PVC.
 - b. Sliding Type: AAMA 701, wool, polypropylene, or nylon woven pile with nylon-fabric or aluminum-strip backing.
 8. Weather Sweeps: Manufacturer's standard, nylon brush sweep mounted to underside of door bottom.
- E. Fabrication
1. General: Factory fabricate ICU/CCU entrance components to designs, sizes, and thicknesses indicated and to comply with indicated standards.

- a. Fabricate aluminum components before finishing.
 - b. Weld in concealed locations to greatest extent possible to minimize distortion or discoloration of finish. Remove weld spatter and welding oxides from exposed surfaces by descaling or grinding.
 - c. Use concealed fasteners to greatest extent possible. Where exposed fasteners are required, use countersunk Phillips flat-head machine screws, finished to match framing **OR** fabricated from stainless steel, **as directed**.
 - 1) Where fasteners are subject to loosening or turning out from structural movements or vibration, use self-locking devices.
 - 2) Reinforce members as required to receive fastener threads.
 - d. Where aluminum will contact dissimilar metals, protect against galvanic action by painting contact surfaces with primer or by applying sealant or tape recommended by manufacturer for this purpose.
2. Framing: Provide ICU/CCU entrances as prefabricated assemblies. Complete fabrication, assembly, finishing, hardware application, and other work before shipment to Project site.
 - a. Fabricate tubular and channel frame assemblies with manufacturer's standard welded or mechanical joints. Provide subframes and reinforcement as required for a complete system to support required loads.
 - b. Perform fabrication operations in manner that prevents damage to exposed finish surfaces.
 - c. Form profiles that are straight and free of defects or deformations.
 - d. Provide components with concealed fasteners and anchor and connection devices.
 - e. Fabricate components with accurately fitted joints with ends coped or mitered to produce hairline joints free of burrs and distortion.
 - f. Provide anchorage and alignment brackets for concealed support of assembly from the building structure.
 3. Doors: Factory fabricated and assembled in profiles indicated. Reinforce as required to support imposed loads and for installing hardware.
 4. Glazing: Fabricate framing with minimum glazing edge clearances for thickness and type of glazing indicated, according to GANA's "Glazing Manual."
 5. Hardware: Factory install hardware to the greatest extent possible; remove only as required for final finishing operation and for delivery to and installation at Project site. Cut, drill, and tap for factory-installed hardware before applying finishes.
 - a. Provide sliding weather stripping, mortised into door, at perimeter of sliding doors and breakaway sidelites.
 6. Electrical Grounding: Fabricate ICU/CCU entrances to be internally grounded, complying with requirements of authorities having jurisdiction.

F. General Finish Requirements

1. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
2. Apply organic and anodic finishes to formed metal after fabrication unless otherwise indicated.
3. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

G. Aluminum Finishes

1. Clear Anodic Finish: AAMA 611, AA-M12C22A41, Class I, 0.018 mm **OR** AA-M12C22A31, Class II, 0.010 mm, **as directed**, or thicker.
2. Color Anodic Finish: AAMA 611, AA-M12C22A42/A44, Class I, 0.018 mm **OR** AA-M12C22A32/A34, Class II, 0.010 mm, **as directed**, or thicker.
3. Baked-Enamel or Powder-Coat Finish: AAMA 2603. Comply with coating manufacturer's written instructions for cleaning, conversion coating, application, and baking.
4. High-Performance Organic Finish: Two-coat fluoropolymer finish complying with AAMA 2604 **OR** AAMA 2605, **as directed**, and containing not less than 50 **OR** 70, **as directed**, percent PVDF

resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.

1.3 EXECUTION

A. Installation

1. General: Do not install damaged components. Fit frame joints to produce hairline joints free of burrs and distortion. Rigidly secure nonmovement joints. Seal joints watertight.
 - a. Where aluminum will contact dissimilar metals, protect against galvanic action by painting contact surfaces with primer or by applying sealant or tape recommended by manufacturer for this purpose.
 - b. Where aluminum will contact concrete or masonry, protect against corrosion by painting contact surfaces with bituminous coating.
2. Install ICU/CCU entrances plumb and true in alignment with established lines and grades without warp or rack of framing members and doors. Anchor securely in place.
 - a. Install surface-mounted hardware using concealed fasteners to greatest extent possible.
 - b. Set headers, carrier assemblies, tracks, operating brackets, and guides level and true to location with anchorage for permanent support.
 - c. Level recesses for recessed floor tracks using shrinkage-resistant grout.
3. Glazing: Install glazing as specified in Division 08 Section "Glazing".
4. Sealants: Comply with requirements in Division 07 Section "Joint Sealants" for installing sealants, fillers, and gaskets.
 - a. Set framing members, floor tracks, and flashings in full sealant bed.
 - b. Seal perimeter of framing members with sealant.
5. Grounding: Connect ICU/CCU-entrance, electrical grounding systems to building grounding system as specified in Division 26 Section "Grounding And Bonding For Electrical Systems".

B. Adjusting

1. Adjust operating hardware and moving parts for smooth and safe operation; lubricate as recommended by manufacturer.
2. Adjust force to open swing panels.
3. Test grounding system for compliance with requirements of authorities having jurisdiction.

C. Cleaning And Protection

1. Clean glass and metal surfaces promptly after installation. Remove excess glazing and sealant compounds, dirt, and other substances. Repair damaged finish to match original finish.
2. Comply with requirements in Division 08 Section "Glazing" for cleaning and protecting glass.

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Task	Specification	Specification Description
08 42 29 23	08 32 13 00	Sliding Aluminum-Framed Glass Doors

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SECTION 08 42 33 00 - REVOLVING ENTRANCE DOORS

1.1 GENERAL

A. Description Of Work

1. This specification covers the furnishing and installation of material for revolving entrance doors. Products shall be as follows or as directed by the Owner. Installation procedures shall be in accordance with the products manufacturer's recommendations. Demolition and removal of materials shall be as required to support the work.

B. Summary

1. Section Includes:
 - a. Manual revolving door entrances.
 - b. Automatic revolving door entrances.
 - c. Access-control revolving door entrances.

C. Submittals

1. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for revolving door entrances.
2. Shop Drawings: For revolving door entrances. Include plans, elevations, sections, details, and attachments to other work. Indicate enclosures, speed-control units, and other components not in manufacturer's product data.
 - a. Wiring Diagrams: Power, signal, and control wiring.
3. Samples:
 - a. Finishes: For each type of exposed finish required, prepared on Samples of not less than **3 by 5 inches (76 by 127 mm)**.
 - b. Glass Samples: For each type of tinted glass; **12 inches (300 mm)** square.
4. Qualification Data: For qualified Installer, manufacturer and testing agency.
5. Product Test Reports: Based on evaluation of comprehensive tests performed by manufacturer and witnessed by a qualified testing agency, for revolving door entrances.
6. Operation and Maintenance Data: For revolving door entrances to include in operation and maintenance manuals.
7. Warranties: Samples of special warranties.

D. Quality Assurance

1. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for installation of units required for this Project.
2. Regulatory Requirements: Wings shall be capable of collapsing into a book-fold position to provide minimum aggregate parallel width of **36 inches (914 mm)** when breakaway force of no more than **130 lbf (572N) OR 180 lbf (801N)**, as directed, is applied within **3 inches (76 mm)** of outer edges. Set maximum turning speed to comply with requirements of authorities having jurisdiction.
3. Safety Glass: Category II materials complying with testing requirements in 16 CFR 1201.
 - a. Safety-Glass Labeling: Where safety-glass labeling is indicated, permanently mark glass with certification label of the SGCC, another certification agency acceptable to authorities having jurisdiction, or the manufacturer. Label shall indicate manufacturer's name, type of glass, thickness, and safety-glass standard with which glass complies.
4. Revolving Door Entrance Standard: BHMA A156.27.
5. Preinstallation Conference: Conduct conference at Project site.

E. Delivery, Storage, And Handling

1. Deliver revolving door entrance glass, decorative metalwork, and other exposed elements in padded blankets or other approved protective wrapping.

2. Protect finish surfaces from damage during handling and installation.

F. Coordination

1. Recesses: Coordinate size and location of recesses in floor construction for recessed, floor-mounted speed-control units, pivot bearings, foot grilles and recessed mats including anchorages for frames and supports. Furnish setting drawings, templates, and directions for installing anchorages that are to be embedded into concrete. Deliver these items to Project site in time for installation. Concrete, reinforcement, and formwork requirements are specified in Division 31.

G. Warranty

1. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of revolving door entrances that fail in materials or workmanship within specified warranty period.
 - a. Failures include, but are not limited to, the following:
 - 1) Lateral deflection of glass lite edges in excess of 1/175 of their length or **3/4 inch (19 mm)**, whichever is less.
 - 2) Excessive air leakage.
 - 3) Faulty operation of speed-control unit and hardware.
 - 4) Deterioration of metals, metal finishes, and other materials beyond normal weathering.
 - b. Warranty Period for Revolving Door Entrances: Three years from date of Final Completion.
 - c. Warranty Period for Speed-Control Units: Five years from date of Final Completion.
 - d. Warranty Period for Finishes: 20 years from date of Final Completion.

1.2 PRODUCTS

A. Revolving Door Entrances

1. Air Infiltration: Maximum air leakage of **1.25 cfm/sq. ft. (6.4 L/s x sq. m)** of wing area when tested according to ASTM E 283 at a minimum static-air-pressure difference of **1.57 lbf/sq. ft. (75 Pa)**, [equivalent to a 25-mph (40-km/h) wind].
2. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes acting on glass framing members and glazing components.
 - a. Temperature Change: **120 deg F (67 deg C)**, ambient; **180 deg F (100 deg C)**, material surfaces.
3. Windborne-Debris-Impact Resistance: Provide exterior glazing that passes basic **OR** enhanced, **as directed**, protection testing requirements in ASTM E 1996 for Wind Zone 1 **OR** Wind Zone 2 **OR** Wind Zone 3 **OR** Wind Zone 4, **as directed**, when tested using the large-missile test according to ASTM E 1886. Test specimens shall be no smaller in width and length than glazing indicated for use on the Project and shall be installed in same manner as glazing indicated for use on the Project.
4. Seismic Performance: Revolving door entrances shall withstand the effects of gravity loads and loads and stresses within limits and under conditions indicated according to ASCE/SEI 7.

B. Manual Revolving Door Entrances

1. Description: Provide manufacturer's standard two-wing **OR** three-wing **OR** four-wing, **as directed**, manual revolving door entrance, complete with center shaft, speed-control unit, wings, enclosure walls, canopy, hardware, glass and glazing, and accessories as indicated.
 - a. Manual Speed-Control Unit: Mechanical speed regulator that allows free rotation of wings up to a predetermined rate of speed and that engages a clutch-type brake to prevent rapid acceleration of wings.
 - 1) Location: Recessed, floor mounted **OR** Overhead, **as directed**.

- 2) Fold-to-Side Mechanism: Manufacturer's standard overhead carriage, guide support track, pivot mechanism, and other components necessary to permit folded wings to be moved to one side of revolving door entrance enclosure.
- b. Stile-and-Rail Wings: Manufacturer's standard with **1-3/4-inch- (45-mm-)** thick tubular stile-and-rail members.
 - 1) Stile Design: Narrow stile, **2-inch (51-mm)** nominal width **OR** Medium stile, **3-1/2-inch (89-mm)** nominal width **OR** Wide stile, **5-inch (127-mm)** nominal width **OR** As indicated on Drawings, **as directed**.
 - 2) Rail Design: **3-inch (76-mm)** nominal height **OR** **4-inch (102-mm)** nominal height **OR** As indicated on Drawings, **as directed**.
 - 3) Muntin Design: To match stile design.
 - 4) Glass: Clear, fully tempered float glass.
 - a) Thickness: 6 mm **OR** 8 mm **OR** 10 mm, **as directed**.
- c. All-Glass Wings: Manufacturer's standard all-glass wings with tubular metal top and bottom rail members.
 - 1) Glass: Clear, fully tempered float glass.
 - a) Thickness: 12 mm.
- d. Push Bars: Manufacturer's standard push bars, finished to match wings.
 - 1) Shape: Round bars, **1 inch (25 mm)** in diameter **OR** Flat bars, **1/2 inch thick and 1-1/2 inches (13 mm thick and 38 mm)** high **OR** Manufacturer's standard, **as directed**.
- e. Locks: Manufacturer's standard deadbolt locks to receive cylinders; minimum of two for each revolving door entrance.
 - 1) Cylinders: Comply with requirements in Division 08 Section "Door Hardware".
 - 2) Mounting: Surface applied **OR** Mortised, **as directed**.
 - 3) Location: Extend bolt from bottom of wing into floor **OR** top of wing into ceiling **OR** bottom of wing into base of wall enclosure, **as directed**.
- f. Enclosure Walls: Manufacturer's standard, with **1-3/4-inch- (45-mm-)** thick tubular framing members.
 - 1) Configuration: Curved **OR** Segmented, **as directed**.
 - 2) Glass: Clear **OR** Tinted, **as directed**, fully tempered float glass.
 - a) Thickness: 6 mm **OR** 8 mm, **as directed**.
 - b) Tint Color: Blue **OR** Blue-green **OR** Bronze **OR** Green **OR** Gray, **as directed**.
 - 3) Glass: Clear **OR** Tinted, **as directed**, laminated glass with two plies of float glass separated by an interlayer.
 - a) Thickness: Two 3-mm-thick lites **OR** Two 5-mm-thick lites **OR** Two 6-mm-thick lites **OR** Two 8-mm-thick lites **OR** As indicated, **as directed**.
 - b) Tint Color: Blue **OR** Blue-green **OR** Bronze **OR** Green **OR** Gray, **as directed**.
 - 4) Muntin Bars: Horizontal tubular rail member for each enclosure wall; match stile design.
- g. Canopy: Manufacturer's standard ceiling, fascia, roof, **as directed**, and framing with size, layout, materials, and exposed finishes matching enclosure walls unless otherwise indicated.
 - 1) Metal-Clad Plywood: Fabricate from **3/4-inch- (19-mm-)** thick plywood clad with metal sheet. Provide ceiling access panels for repairs to or maintenance of speed-control unit.
OR
Metal: Fabricate from minimum **0.125-inch- (3.18-mm-)** thick, aluminum sheet. Provide ceiling access panels for repairs to or maintenance of speed-control unit.
OR
Glass: Clear **OR** Tinted, **as directed**, laminated glass ceiling with two plies of float glass separated by an interlayer.
 - a) Thickness: Two 6-mm-thick lites **OR** 6-mm-thick top lite and 12-mm-thick bottom lite **OR** As indicated, **as directed**.
 - b) Tint Color: Blue **OR** Blue-green **OR** Bronze **OR** Green **OR** Gray, **as directed**.

- 2) Ceiling Lights: Manufacturer's standard, consisting of two recessed light fixtures within the ceiling of the revolving door entrance enclosure, complete with lamps and translucent lenses.
- 3) Canopy Roof: Manufacturer's standard, of material and finish matching enclosure walls where visible.
- h. Floors: Extend adjacent flooring material specified in a Division 07 into enclosure as indicated on Drawings.
 - 1) Recessed Grilles: Provide grille at entry segment only. Fabricate, using welded joints, from minimum **1/4-inch-wide by 1-inch-tall (6-mm-wide by 25-mm-tall)**, concentrically curved metal bar stock with **1/4-inch (6-mm)** spacing. Finish to match wings.
2. Materials: Extruded aluminum **OR** Stainless-steel-clad, extruded aluminum **OR** Copper-alloy-clad, extruded aluminum, **as directed**.
 - a. Main Extrusions and Tubing: Minimum wall thickness of **0.125 inch (3.2 mm)**.
 - b. Cladding: Minimum **0.04 inch (1.0 mm)** thick.
3. Fabrication: Fabricate revolving door entrance components to designs, sizes, thicknesses, and configurations indicated with profiles that are sharp, straight, and free of defects or deformations. Accurately fit joints with ends coped or mitered to produce hairline joints free of burrs and distortion. Prefit all hardware at the factory. Provide anchorage and alignment brackets for concealed support of assembly from the building structure.
 - a. Wings: Factory fabricated and assembled in profiles indicated. Reinforce as required to support imposed loads and for installing hardware.
 - 1) Glaze wings at the factory. Comply with glazing requirements specified in this Section and in Division 08 Section "Glazing". Provide minimum clearances for thickness and type of glass indicated according to GANA's "Glazing Manual."
 - 2) Provide sliding weather stripping, mortised into stiles and rails of wings, to be adjustable and replaceable without dismantling wings.
 - 3) Welded Construction: Weld reinforcement firmly in place. Weld corners. Grind and polish welds to produce an invisible joint. Mechanically finish exposed surfaces after fabrication to eliminate surface blemishes caused by welding, rolling, bending, and forming.
OR
Mechanically Joined Construction: Joints shall be tightly bolted together. Glass stops shall be snap-in type where possible.
OR
Mechanically Joined Clad Construction: Joints shall be tightly bolted together to produce hairline joints. Finish material before fabrication. Carefully assemble to prevent welds or adhesives from blemishing finished surfaces. Glass stops shall be snap-in type where possible.
 - b. Enclosure Walls and Canopy: Fabricate tubular and channel frame assemblies in configuration indicated, with welded or mechanical joints, according to manufacturer's standards and as specified. Provide subframes as required for a complete system to support required loads.
 - 1) Exterior Framing: Fabricate components to drain water passing joints and condensation and moisture occurring or migrating within the system to the exterior. Provide anchorage and alignment brackets for concealed support of assembly from the building structure. Allow for thermal expansion of exterior units.
4. Aluminum Finishes: Clear anodic **OR** Color anodic **OR** Baked enamel or powder coat **OR** High performance, organic, **as directed**.
 - a. Color: As indicated by manufacturer's designations **OR** As selected from manufacturer's full range, **as directed**.
5. Stainless-Steel Finishes: No. 4 **OR** No. 7 **OR** No. 8, **as directed**.
6. Copper-Alloy Finishes: Buffed finish, lacquered **OR** Hand-rubbed finish, lacquered **OR** Medium-satin finish, lacquered **OR** Statuary conversion coating over satin finish, **as directed**.

C. Automatic Revolving Door Entrances

1. Description: Provide manufacturer's standard two-wing **OR** three-wing **OR** four-wing, **as directed**, automatic revolving door entrance, complete with center shaft **OR** core **OR** core with rotating glazed display case, **as directed**, speed-control unit, wings, enclosure walls, canopy, hardware, glass and glazing, activation devices, safety devices, and accessories as indicated.
 - a. Powered Speed-Control Unit: Provide an electric or electrohydraulic speed regulator to permit automatic rotation of wings. Unit shall allow for manual operation when power is off. Furnish power-operation equipment to suit current characteristics of building electrical service.
 - 1) Location: Recessed, floor mounted **OR** Overhead, **as directed**.
 - 2) Fold-to-Side Mechanism: Manufacturer's standard overhead carriage, guide support track, pivot mechanism, and other components necessary to permit folded wings to be moved to one side of revolving door entrance enclosure.
 - b. Manual-Push Activation: Pushing wing activates unit and maintains rotation of wings for manufacturer's standard preset time.

OR

Continuous Operation: Wings revolve continuously.

OR

Signal Activation: Signal from activation device begins and maintains rotation of wings for manufacturer's standard preset time.

 - 1) Motion Detectors: Self-contained, K-band-frequency, microwave-scanner units with metal or plastic housing; to provide adjustable detection-field sizes, patterns, and functions required by BHMA A156.10. Mount centered on both sides of canopy fascia.
 - 2) Presence Detectors: Self-contained, infrared-scanner units with metal or plastic housing; to provide adjustable detection-field sizes, patterns, and functions required by BHMA A156.10. Detectors shall remain active at all times. Mount recessed in canopy ceiling **OR** on each wing, **as directed**.
 - 3) Combination Motion-Presence Detectors: Self-contained, one-piece units consisting of both motion and presence detectors in a single metal or plastic housing adjustable to provide detection-field sizes, patterns, and functions required by BHMA A156.10. Mount on both sides of canopy fascia.
 - 4) Photoelectric Beams: Pulsed infrared, sender-receiver assembly recessed in canopy ceiling **OR** on each wing, **as directed**.
 - 5) Control Mats: ~~1/2-inch-~~ (13-mm-) thick, synthetic-rubber or flexible-plastic mat in safety-ribbed surface pattern, with extruded-aluminum frame; with pressure switches for low-voltage control wiring; and complying with performance requirements in BHMA A156.10 including Appendix A.
 - a) Color: As indicated by manufacturer's designations **OR** As selected from full range of industry colors, **as directed**.
 - b) Frame: Recessed to fit flush with floor; with concealed anchors **OR** Surface mounted; with tapered safety edge, **as directed**.
 - 6) Push-Plate Switch: Momentary-contact control switch with flat stainless-steel push plate engraved with message "Push to Open" **OR** plastic push-plate engraved with message "Push to Open" in contrasting color, **as directed**.
 - a) Mounting: Recess mounted, semiflush in wall **OR** Surface mounted on wall **OR** Surface mounted on bollard **OR** As indicated on Drawings, **as directed**, on right-hand side of opening.
 - 7) Push-Button Switch: Momentary-contact control switch with one red-button actuator. Provide blue plastic cover engraved with message "Press to Open" in white letters.
 - a) Mounting: Recess mounted, semiflush in wall **OR** Surface mounted on wall **OR** Surface mounted on bollard **OR** As indicated on Drawings, **as directed**, on right-hand side of opening.

- 8) Key Switch: Recess-mounted control switch with key-controlled actuator and enclosed in **2-by-4-inch (50-by-100-mm)** junction box. Provide faceplate engraved with letters indicating switch functions.
 - a) Functions: On-off **OR** On-off, momentary contact, **as directed**.
 - b) Mounting: Recess mounted, semiflush in wall **OR** Surface mounted on wall **OR** Surface mounted on bollard **OR** As indicated on Drawings, **as directed**, on right-hand side of opening.
- c. Stile-and-Rail Wings: Manufacturer's standard with **1-3/4-inch- (45-mm-)** thick tubular stile-and-rail members.
 - 1) Stile Design: Narrow stile, **2-inch (51-mm)** nominal width **OR** Medium stile, **3-1/2-inch (89-mm)** nominal width **OR** Wide stile, **5-inch (127-mm)** nominal width **OR** As indicated on Drawings, **as directed**.
 - 2) Rail Design: **3-inch (76-mm)** nominal height **OR** **4-inch (102-mm)** nominal height **OR** As indicated on Drawings, **as directed**.
 - 3) Muntin Design: To match stile design.
 - 4) Glass: Clear, fully tempered float glass.
 - a) Thickness: 6 mm **OR** 8 mm **OR** 10 mm, **as directed**.
- d. All-Glass Wings: Manufacturer's standard all-glass wings with tubular metal top and bottom rail members.
 - 1) Glass: Clear, fully tempered float glass.
 - a) Thickness: 12 mm.
- e. Push Bars: Manufacturer's standard push bars, finished to match wings.
 - 1) Shape: Round bars, **1 inch (25 mm)** in diameter **OR** Flat bars, **1/2 inch thick and 1-1/2 inches (13 mm thick and 38 mm)** high **OR** Manufacturer's standard, **as directed**.
- f. Locks: Manufacturer's standard deadbolt locks to receive cylinders; minimum of two for each revolving door entrance.
 - 1) Cylinders: Comply with requirements in Division 08 Section "Door Hardware".
 - 2) Mounting: Surface applied **OR** Mortised, **as directed**.
 - 3) Location: Extend bolt from bottom of wing into floor **OR** top of wing into ceiling **OR** bottom of wing into base of wall enclosure, **as directed**.
- g. Enclosure Walls: Manufacturer's standard, with **1-3/4-inch- (45-mm-)** thick tubular framing members.
 - 1) Configuration: Curved **OR** Segmented, **as directed**.
 - 2) Glass: Clear **OR** Tinted, **as directed**, fully tempered float glass.
 - a) Thickness: 6 mm **OR** 8 mm, **as directed**.
 - b) Tint Color: Blue **OR** Blue-green **OR** Bronze **OR** Green **OR** Gray, **as directed**. **OR**
Glass: Clear **OR** Tinted, **as directed**, laminated glass with two plies of float glass separated by an interlayer.
 - a) Thickness: Two 3-mm-thick lites **OR** Two 5-mm-thick lites **OR** Two 6-mm-thick lites **OR** Two 8-mm-thick lites **OR** As indicated, **as directed**.
 - b) Tint Color: Blue **OR** Blue-green **OR** Bronze **OR** Green **OR** Gray, **as directed**.
 - 3) Muntin Bars: Horizontal tubular rail member for each enclosure wall; match stile design.
- h. Canopy: Manufacturer's standard ceiling, fascia, roof, **as directed**, and framing with size, layout, materials, and exposed finishes matching enclosure walls unless otherwise indicated.
 - 1) Metal-Clad Plywood: Fabricate from **3/4-inch- (19-mm-)** thick plywood clad with metal sheet. Provide ceiling access panels for repairs to or maintenance of speed-control units.
 - 2) Metal: Fabricate from minimum **0.125-inch- (3.18-mm-)** thick, aluminum sheet. Provide ceiling access panels for repairs to or maintenance of speed-control units.
 - 3) Glass: Clear **OR** Tinted, **as directed**, laminated glass ceiling with two plies of float glass separated by an interlayer.

- a) Thickness: Two 6-mm-thick lites **OR** 6-mm-thick top lite and 12-mm-thick bottom lite **OR** As indicated, **as directed**.
 - b) Tint Color: Blue **OR** Blue-green **OR** Bronze **OR** Green **OR** Gray, **as directed**.
 - 4) Ceiling Lights: Manufacturer's standard, consisting of two recessed light fixtures within the ceiling of the revolving door entrance enclosure, complete with lamps and translucent lenses.
 - 5) Canopy Roof: Manufacturer's standard, of material and finish matching enclosure walls where visible.
- i. Floors: Extend adjacent flooring material specified in a Division 07 into enclosure as indicated on Drawings.
 - 1) Recessed Grilles: Provide grille at entry quadrant only. Fabricate, using welded joints, from minimum **1/4-inch-wide by 1-inch-tall (6-mm-wide by 25-mm-tall)**, concentrically curved metal bar stock with **1/4-inch (6-mm)** spacing. Finish to match wings.
- j. Rotating Glazed Display Case: Glazed enclosure incorporated into core, with framing matching wings and with panel on one side for access to display area.
- k. Safety Devices: Manufacturer's standard safety devices as required to stop or slow rotation. Provide the following:
 - 1) Emergency Stop Button: Momentary contact, red push-button switch to immediately stop wing rotation and reverse direction to entry position, **as directed**. Provide sign indicating "Emergency Stop."
 - a) Mounting: Recess mounted, semiflush in wall **OR** Surface mounted on wall **OR** Surface mounted on bollard **OR** As indicated on Drawings, **as directed**, on right-hand side of opening.
 - 2) Slow-Speed Operation Button: Momentary contact push-button switch or plate to slow wing rotation by reducing rpm by one half. Include sign indicating operation.
 - a) Mounting: Recess mounted, semiflush in wall **OR** Surface mounted on wall **OR** Surface mounted on bollard **OR** As indicated on Drawings, **as directed**, on right-hand side of opening.
 - 3) Vertical Safety Strip: Compressible safety switch consisting of an impact-pressure-activated, internal-contact switch plate encapsulated in a flexible housing. Mount on enclosure walls at vertical edge of entry.
 - 4) Horizontal Safety Strip: Compressible safety switch consisting of an impact-pressure-activated, internal-contact switch plate encapsulated in a flexible housing. Mount at bottom edge of each wing.
2. Materials: Extruded aluminum **OR** Stainless-steel-clad, extruded aluminum **OR** Copper-alloy-clad, extruded aluminum, **as directed**.
 - a. Main Extrusions and Tubing: Minimum wall thickness of **0.125 inch (3.2 mm)**.
 - b. Cladding: Minimum **0.04 inch (1.0 mm)** thick.
3. Fabrication: Fabricate revolving door entrance components to designs, sizes, thicknesses, and configurations indicated with profiles that are sharp, straight, and free of defects or deformations. Accurately fit joints with ends coped or mitered to produce hairline joints free of burrs and distortion. Prefit all hardware at the factory. Provide anchorage and alignment brackets for concealed support of assembly from the building structure.
 - a. Wings: Factory fabricated and assembled in profiles indicated. Reinforce as required to support imposed loads and for installing hardware.
 - 1) Glaze wings at the factory. Comply with glazing requirements specified in this Section and in Division 08 Section "Glazing". Provide minimum clearances for thickness and type of glass indicated according to GANA's "Glazing Manual."
 - 2) Provide sliding weather stripping, mortised into stiles and rails of wings, to be adjustable and replaceable without dismantling wings.
 - 3) Welded Construction: Weld reinforcement firmly in place. Weld corners. Grind and polish welds to produce an invisible joint. Mechanically finish exposed surfaces after fabrication to eliminate surface blemishes caused by welding, rolling, bending, and forming.

OR

Mechanically Joined Construction: Joints shall be tightly bolted together. Glass stops shall be snap-in type where possible.

OR

Mechanically Joined Clad Construction: Joints shall be tightly bolted together to produce hairline joints. Finish material before fabrication. Carefully assemble to prevent welds or adhesives from blemishing finished surfaces. Glass stops shall be snap-in type where possible.

- b. Enclosure Walls and Ceilings: Fabricate tubular and channel frame assemblies in configuration indicated, with welded or mechanical joints, according to manufacturer's standards and as specified. Provide subframes as required for a complete system to support required loads.
 - 1) Exterior Framing: Fabricate components to drain water passing joints and condensation and moisture occurring or migrating within the system to the exterior. Provide anchorage and alignment brackets for concealed support of assembly from the building structure. Allow for thermal expansion of exterior units.
4. Aluminum Finishes: Clear anodic **OR** Color anodic **OR** Baked enamel or powder coat **OR** High performance, organic, **as directed**.
 - a. Color: As indicated by manufacturer's designations **OR** As selected from manufacturer's full range, **as directed**.
5. Stainless-Steel Finishes: No. 4 **OR** No. 7 **OR** No. 8, **as directed**.
6. Copper-Alloy Finishes: Buffed finish, lacquered **OR** Hand-rubbed finish, lacquered **OR** Medium-satin finish, lacquered **OR** Statuary conversion coating over satin finish **as directed**.

D. Access-Control Revolving Door Entrances

1. Description: Provide manufacturer's standard four-wing **OR** three-wing, **as directed**, access-control revolving door entrance, complete with center shaft **OR** core, **as directed**, speed-control unit, wings, enclosure walls, canopy, hardware, glass and glazing, activation devices, safety devices, and accessories as indicated.
 - a. Powered Speed-Control Unit: Provide an electric or electrohydraulic speed regulator to permit automatic rotation of wings. Unit shall allow for manual operation when power is off. Furnish power-operation equipment to suit current characteristics of building electrical service.
 - 1) Location: Recessed, floor mounted **OR** Overhead, **as directed**.
 - 2) Fold-to-Side Mechanism: Manufacturer's standard overhead carriage, guide support track, pivot mechanism, and other components necessary to permit folded wings to be moved to one side of revolving door entrance enclosure.
 - b. Activation Devices: Keypads **OR** Card readers **OR** Biometric identity verification equipment, **as directed**, as specified in Division 28 Section "Access Control".
 - 1) Mounting: Recess mounted, semiflush in wall **OR** Surface mounted on wall **OR** Surface mounted on bollard **OR** As indicated on Drawings, **as directed**, on right-hand side of opening.
 - c. Stile-and-Rail Wings: Manufacturer's standard with 1-3/4-inch- (45-mm-) thick tubular stile-and-rail members.
 - 1) Stile Design: Narrow stile, 2-inch (51-mm) nominal width **OR** Medium stile, 3-1/2-inch (89-mm) nominal width **OR** Wide stile, 5-inch (127-mm) nominal width **OR** As indicated on Drawings, **as directed**.
 - 2) Rail Design: 3-inch (76-mm) nominal height **OR** 4-inch (102-mm) nominal height **OR** As indicated on Drawings, **as directed**.
 - 3) Muntin Design: To match stile design.
 - 4) Glass: Clear, fully tempered float glass.
 - a) Thickness: 6 mm **OR** 8 mm **OR** 10 mm, **as directed**.
 - d. Locks: Manufacturer's standard deadbolt locks to receive cylinders; minimum of two for each revolving door entrance.
 - 1) Cylinders: Comply with requirements in Division 08 Section "Door Hardware".
 - 2) Mounting: Surface applied **OR** Mortised, **as directed**.

- 3) Location: Extend bolt from bottom of wing into floor **OR** top of wing into ceiling **OR** bottom of wing into base of wall enclosure, **as directed**.
- e. Enclosure Walls: Manufacturer's standard, with **1-3/4-inch- (45-mm-)** thick tubular framing members.
 - 1) Configuration: Curved **OR** Segmented.
 - 2) Glass: Clear **OR** Tinted, **as directed**, fully tempered float glass.
 - a) Thickness: 6 mm **OR** 8 mm, **as directed**.
 - b) Tint Color: Blue **OR** Blue-green **OR** Bronze **OR** Green **OR** Gray, **as directed**.
 - OR**
Glass: Clear **OR** Tinted, **as directed**, laminated glass with two plies of float glass separated by an interlayer.
 - a) Thickness: Two 3-mm-thick lites **OR** Two 5-mm-thick lites **OR** Two 6-mm-thick lites **OR** Two 8-mm-thick lites **OR** As indicated, **as directed**.
 - b) Tint Color: Blue **OR** Blue-green **OR** Bronze **OR** Green **OR** Gray, **as directed**.
 - 3) Muntin Bars: Horizontal tubular rail member for each enclosure wall; match stile design.
- f. Canopy: Manufacturer's standard ceiling, fascia, roof, **as directed**, and framing with size, layout, materials, and exposed finishes matching enclosure walls unless otherwise indicated.
 - 1) Metal-Clad Plywood: Fabricate from **3/4-inch- (19-mm-)** thick plywood clad with metal sheet. Provide ceiling access panels for repairs to or maintenance of speed-control units.
 - 2) Metal: Fabricate from minimum **0.125-inch- (3.18-mm-)** thick, aluminum sheet. Provide ceiling access panels for repairs to or maintenance of speed-control units.
 - 3) Ceiling Lights: Manufacturer's standard, consisting of two recessed light fixtures within the ceiling of the revolving door entrance enclosure, complete with lamps and translucent lenses.
 - 4) Canopy Roof: Manufacturer's standard, of material and finish matching enclosure walls where visible.
- g. Floors: Extend adjacent flooring material specified in a Division 07 into enclosure as indicated on Drawings.
 - 1) Recessed Grilles: Provide grille at entry quadrant only. Fabricate, using welded joints, from minimum **1/4-inch-wide by 1-inch-tall (6-mm-wide by 25-mm-tall)**, concentrically curved metal bar stock with **1/4-inch (6-mm)** spacing. Finish to match wings.
- h. Safety Devices: Manufacturer's standard safety devices as required to stop or slow rotation. Provide the following:
 - 1) Emergency Stop Button: Momentary contact, red push-button switch to immediately stop wing rotation and reverse direction to entry position, **as directed**. Provide sign indicating "Emergency Stop."
 - a) Mounting: Recess mounted, semiflush in wall **OR** Surface mounted on wall **OR** Surface mounted on bollard **OR** As indicated on Drawings, **as directed**, on right-hand side of opening.
 - 2) Slow-Speed Operation Button: Momentary contact push-button switch or plate to slow wing rotation by reducing rpm by one half. Include sign indicating operation.
 - a) Mounting: Recess mounted, semiflush in wall **OR** Surface mounted on wall **OR** Surface mounted on bollard **OR** As indicated on Drawings, **as directed**, on right-hand side of opening.
 - 3) Vertical Safety Strip: Compressible safety switch consisting of an impact-pressure-activated, internal-contact switch plate encapsulated in a flexible housing. Mount on enclosure walls at vertical edge of entry.
 - 4) Horizontal Safety Strip: Compressible safety switch consisting of an impact-pressure-activated, internal-contact switch plate encapsulated in a flexible housing. Mount at bottom edge of each wing.
2. Materials: Extruded aluminum **OR** Stainless-steel-clad, extruded aluminum **OR** Copper-alloy-clad, extruded aluminum, **as directed**.

- a. Main Extrusions and Tubing: Minimum wall thickness of **0.125 inch (3.2 mm)**.
 - b. Cladding: Minimum **0.04 inch (1.0 mm)** thick.
3. Fabrication: Fabricate revolving door entrance components to designs, sizes, thicknesses, and configurations indicated with profiles that are sharp, straight, and free of defects or deformations. Accurately fit joints with ends coped or mitered to produce hairline joints free of burrs and distortion. Prefit all hardware at the factory. Provide anchorage and alignment brackets for concealed support of assembly from the building structure.
 - a. Wings: Factory fabricated and assembled in profiles indicated. Reinforce as required to support imposed loads and for installing hardware.
 - 1) Glaze wings at the factory. Comply with glazing requirements specified in this Section and in Division 08 Section "Glazing". Provide minimum clearances for thickness and type of glass indicated according to GANA's "Glazing Manual."
 - 2) Provide sliding weather stripping, mortised into stiles and rails of wings, to be adjustable and replaceable without dismantling wings.
 - 3) Welded Construction: Weld reinforcement firmly in place. Weld corners. Grind and polish welds to produce an invisible joint. Mechanically finish exposed surfaces after fabrication to eliminate surface blemishes caused by welding, rolling, bending, and forming.
OR
 Mechanically Joined Construction: Joints shall be tightly bolted together. Glass stops shall be snap-in type where possible.
OR
 Mechanically Joined Clad Construction: Joints shall be tightly bolted together to produce hairline joints. Finish material before fabrication. Carefully assemble to prevent welds or adhesives from blemishing finished surfaces. Glass stops shall be snap-in type where possible.
 - b. Enclosure Walls and Ceilings: Fabricate tubular and channel frame assemblies in configuration indicated, with welded or mechanical joints, according to manufacturer's standards and as specified. Provide subframes as required for a complete system to support required loads.
 - 1) Exterior Framing: Fabricate components to drain water passing joints and condensation and moisture occurring or migrating within the system to the exterior. Provide anchorage and alignment brackets for concealed support of assembly from the building structure. Allow for thermal expansion of exterior units.
4. Aluminum Finishes: Clear anodic **OR** Color anodic **OR** Baked enamel or powder coat **OR** High performance, organic, **as directed**.
 - a. Color: As indicated by manufacturer's designations **OR** As selected from manufacturer's full range, **as directed**.
5. Stainless-Steel Finishes: No. 4 **OR** No. 7 **OR** No. 8, **as directed**.
6. Copper-Alloy Finishes: Buffed finish, lacquered **OR** Hand-rubbed finish, lacquered **OR** Medium-satin finish, lacquered **OR** Statuary conversion coating over satin finish, **as directed**.

E. Materials

1. Aluminum: Alloy and temper recommended by manufacturer for type of use and finish indicated.
 - a. Extruded Bars, Rods, Profiles, and Tubes: **ASTM B 221 (ASTM B 221M)**.
 - b. Sheet and Plate: **ASTM B 209 (ASTM B 209M)**.
2. Stainless-Steel Sheet: ASTM A 240/A 240M, austenitic stainless steel, Type 304 **OR** Type 316, **as directed**.
3. Plate, Sheet, Strip, and Bars; Bronze: ASTM B 36/B 36M, alloy UNS No. C28000 (muntz metal, 60 percent copper).
4. Steel: ASTM A 36/A 36M plate, shapes, and bars; or ASTM A 1008/A 1008M sheet.
5. Fasteners: Manufacturer's standard, of same basic metal as fastened metal, unless otherwise indicated.
6. Glazing Materials: Comply with requirements in Division 08 Section "Glazing".
7. Weather Stripping: Heavy-duty, single-piece rubber or combination of rubber and felt.

8. Nonshrink, Nonmetallic Grout: Premixed, nonmetallic, noncorrosive, nonstaining grout; complying with ASTM C 1107/C 1107M; of consistency suitable for application.
 9. Corrosion-Resistant Coating: Cold-applied asphalt mastic, compounded for **15-mil (0.4-mm)** dry film thickness per coat. Provide inert-type noncorrosive compound free of asbestos fibers, sulfur components, and other deleterious impurities.
 10. Lacquer for Copper Alloys: Clear, acrylic lacquer specially developed for coating copper-alloy products.
- F. General Finish Requirements
1. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
 2. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
 3. Finish revolving door entrance components to match adjacent curtain wall or storefront.
- G. Aluminum Finishes
1. Clear Anodic Finish: AAMA 611, AA-M12C22A41, Class I, 0.018 mm or thicker.
 2. Color Anodic Finish: AAMA 611, AA-M12C22A42/A44, Class I, 0.018 mm or thicker.
 3. Baked-Enamel or Powder-Coat Finish: AAMA 2603 except with a minimum dry film thickness of **1.5 mils (0.04 mm)**. Comply with coating manufacturer's written instructions for cleaning, conversion coating, and applying and baking finish.
 4. High-Performance Organic Finish: Two-coat **OR** Three-coat, **as directed**, fluoropolymer finish complying with AAMA 2605 and containing not less than 70 percent PVDF resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
- H. Stainless-Steel Finishes
1. General: Remove tool and die marks and stretch lines or blend into finish. Grind and polish surfaces to produce uniform, directionally textured, polished finish indicated, free of cross scratches. Run grain with long dimension of each piece.
 2. Directional Satin Finish: No. 4.
 3. Reflective, Directional Polish: No. 7.
 4. Mirrorlike Reflective, Nondirectional Polish: No. 8.
 5. When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.
- I. Copper-Alloy Finishes
1. Finish designations for copper alloys comply with the system established for designating copper-alloy finish systems defined in NAAMM's "Metal Finishes Manual for Architectural and Metal Products."
 2. Buffed Finish, Lacquered: M21-O6x (Mechanical Finish: buffed, smooth specular; Coating: clear organic, air drying, as specified below).
 - a. Clear, Organic Coating: Lacquer specified for copper alloys, applied by air spray in two coats per manufacturer's written instructions, with interim drying, to a total thickness of **1 mil (0.025 mm)**.
 3. Hand-Rubbed Finish, Lacquered: M31-M34-O6x (Mechanical Finish: directionally textured, fine satin; Mechanical Finish: directionally textured, hand rubbed; Coating: clear organic, air drying, as specified below).
 - a. Clear, Organic Coating: Lacquer specified for copper alloys, applied by air spray in two coats per manufacturer's written instructions, with interim drying, to a total thickness of **1 mil (0.025 mm)**.
 4. Medium-Satin Finish, Lacquered: M32-O6x (Mechanical Finish: directionally textured, medium satin; Coating: clear organic, air drying, as specified below).
 - a. Clear, Organic Coating: Lacquer specified for copper alloys, applied by air spray in two coats per manufacturer's written instructions, with interim drying, to a total thickness of **1 mil (0.025 mm)**.

5. Statuary Conversion Coating over Satin Finish: M31-C55-O6x (Mechanical Finish: directionally textured, fine satin; Chemical Finish: conversion coating, sulfide; Coating: clear, organic, air drying, as specified below), with color matching the Owner's sample.
 - a. Clear, Organic Coating: Lacquer specified for copper alloys, applied by air spray in two coats per manufacturer's written instructions, with interim drying, to a total thickness of **1 mil (0.025 mm)**.

1.3 EXECUTION

A. Examination

1. Examine substrates and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
2. Proceed with installation only after unsatisfactory conditions have been corrected.

B. Installation

1. General: Do not install damaged components. Fit frame joints to produce hairline joints free of burrs and distortion. Rigidly secure nonmovement joints. Seal joints watertight.
 - a. Where aluminum will contact dissimilar metals, protect against galvanic action by painting contact surfaces with primer or by applying sealant or tape recommended by manufacturer for this purpose.
 - b. Where aluminum will contact concrete or masonry, protect against corrosion by painting contact surfaces with corrosion-resistant coatings.
2. Recessed, Floor-Mounted Speed-Control Unit: Insert control unit in rough-in floor opening set on level bed of nonshrink, nonmetallic grout. Fill annular space between control unit and sides of recess with nonshrink, nonmetallic grout. Mix and place grout to comply with grout manufacturer's written instructions.
 - a. Connect speed-control unit to electrical power distribution system as specified in Division 22.

OR

- Overhead-Mounted Speed-Control Unit: Insert pivot bearing in rough-in floor opening set on level bed of nonshrink, nonmetallic grout. Fill annular space between pivot bearing and sides of recess with nonshrink, nonmetallic grout. Mix and place grout to comply with grout manufacturer's written instructions.
- b. Connect speed-control unit to electrical power distribution system as specified in Division 22.
 3. Install revolving door entrances according to manufacturer's written instructions, plumb and true, without warp or rack of framing members and wings. Anchor securely in place.
 - a. Install surface-mounted hardware using concealed fasteners to greatest extent possible.
 - b. Install components to drain water passing joints, condensation occurring within framing members, and moisture migrating within the assembly to exterior.
 - c. Cut and trim framing during installation only with approval of manufacturer.
 - 1) Restore finish and remove and replace members, as directed, where cutting and trimming have impaired strength or appearance.
 - 2) Do not install members that are warped, bowed, deformed, or otherwise damaged or defaced to such an extent as to impair strength or appearance. Remove and replace members that have been damaged during installation.
 4. Activation and Safety Devices: Adjust devices to provide detection field and functions indicated.
 5. Sealants: Comply with requirements specified in Division 07 Section "Joint Sealants" to provide weathertight installation.
 - a. Set continuous sill members and flashings in full sealant bed.
 - b. Seal perimeter of framing members with sealant.

C. Adjusting

1. Adjust wings to provide an even, tight fit at contact points and weather stripping for smooth operation and weathertight closure. Adjust wings to operate smoothly and rotate evenly, with hardware and operators functioning properly.
 - a. Lubricate operating hardware and other moving parts.
 - b. Adjust speed-control unit for specified rpm.
 - c. Adjust pressure for collapse of wings for specified breakaway force.
 2. Readjust wings and speed-control units after repeated operation of completed installation equivalent to three days' use by normal traffic (100 to 300 cycles). Lubricate hardware and other moving parts.
- D. Cleaning And Protection
1. Clean glass and aluminum surfaces promptly after installation. Remove excess glazing and sealant compounds, dirt, and other substances. Repair damaged finish to match original finish.
 2. Limit construction traffic during remainder of construction period.
- E. Demonstration
1. Train Owner's maintenance personnel to adjust, operate, and maintain revolving door entrances.

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Task	Specification	Specification Description
08 42 36 00	08 05 13 00	Steel Doors And Frames
08 42 36 00	08 12 13 13a	Stainless Steel Doors And Frames
08 43 13 00	08 42 13 00	Aluminum-Framed Entrances And Storefronts
08 43 19 00	01 22 16 00	No Specification Required

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SECTION 08 44 13 00 - GLAZED ALUMINUM CURTAIN WALLS

1.1 GENERAL

A. Description Of Work

1. This specification covers the furnishing and installation of material for glazed aluminum curtain walls. Products shall be as follows or as directed by the Owner. Installation procedures shall be in accordance with the products manufacturer's recommendations. Demolition and removal of materials shall be as required to support the work.

B. Summary

1. Section includes conventionally glazed aluminum curtain walls installed as stick, unitized, and unit-and-mullion assemblies.

C. Performance Requirements

1. General Performance: Comply with performance requirements specified, as determined by testing of manufacturer's standard glazed aluminum curtain walls representing those indicated for this Project without failure due to defective manufacture, fabrication, installation, or other defects in construction.
 - a. Glazed aluminum curtain walls shall withstand movements of supporting structure indicated on Drawings **OR as directed**, including, but not limited to, story drift, twist, column shortening, long-term creep, and deflection from uniformly distributed and concentrated live loads.
 - b. Failure also includes the following:
 - 1) Thermal stresses transferring to building structure.
 - 2) Glass breakage.
 - 3) Noise or vibration created by wind and thermal and structural movements.
 - 4) Loosening or weakening of fasteners, attachments, and other components.
 - 5) Failure of operating units.
2. Delegated Design: Design glazed aluminum curtain walls, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.
3. Structural Loads:
 - a. Wind Loads: As indicated on Drawings **OR as directed**.
 - 1) Basic Wind Speed: **85 mph (38 m/s) OR 90 mph (40 m/s) OR 100 mph (44 m/s) OR 110 mph (49 m/s), as directed.**
 - 2) Exposure Category: A **OR B OR C OR D, as directed.**
 - b. Blast Loads: As indicated on Drawings **OR as directed.**
 - c. Periodic Maintenance-Equipment Loads: As indicated on Drawings **OR as directed.**
4. Structural-Test Performance: Test according to ASTM E 330 as follows:
 - a. When tested at positive and negative wind-load design pressures, assemblies do not evidence deflection exceeding specified limits.
 - b. When tested at 150 percent of positive and negative wind-load design pressures, assemblies, including anchorage, do not evidence material failures, structural distress, and permanent deformation of main framing members exceeding 0.2 percent of span.
 - c. Test Durations: As required by design wind velocity, but not less than 10 seconds.
5. Deflection of Framing Members: At design wind pressure, as follows:
 - a. Deflection Normal to Wall Plane: Limited to edge of glass in a direction perpendicular to glass plane not exceeding L/175 of the glass edge length for each individual glazing lite **OR 1/175 of clear span for spans up to 13 feet 6 inches (4.1 m) and to 1/240 of clear span plus 1/4 inch (6.35 mm) for spans greater than 13 feet 6 inches (4.1 m), as directed**, or an amount that restricts edge deflection of individual glazing lites to **3/4 inch (19 mm)**, whichever is less.

- b. Deflection Parallel to Glazing Plane: Limited to L/360 of clear span or **1/8 inch (3.2 mm)**, whichever is smaller **OR** amount not exceeding that which reduces glazing bite to less than 75 percent of design dimension and that which reduces edge clearance between framing members and glazing or other fixed components to less than **1/8 inch (3.2 mm)**, **as directed**.
 - 1) Operable Units: Provide a minimum **1/16-inch (1.6-mm)** clearance between framing members and operable units.
 - c. Cantilever Deflection: Where framing members overhang an anchor point, limit deflection to two times the length of cantilevered member, divided by 175.
 - 6. Windborne-Debris-Impact-Resistance Performance: Pass missile-impact and cyclic-pressure tests when tested according to ASTM E 1886 and testing information in ASTM E 1996 for Wind Zone 1 **OR** Zone 2 **OR** Zone 3 **OR** Zone 4, **as directed**.
 - a. Large-Missile Test: For glazed openings located within **30 feet (9.1 m)** of grade.
 - b. Small-Missile Test: For glazed openings located more than **30 feet (9.1 m)** above grade.
 - 7. Seismic Performance: Glazed aluminum curtain walls shall withstand the effects of earthquake motions determined according to SEI/ASCE 7.
 - a. Component Importance Factor is 1.5 **OR** 1.0, **as directed**.
 - 8. Story Drift: Accommodate design displacement of adjacent stories indicated.
 - a. Design Displacement: As indicated on Drawings **OR as directed**.
 - b. Test Performance: Meeting criteria for passing based on building occupancy type when tested according to AAMA 501.4 at design displacement and 1.5 times the design displacement, **as directed**.
 - 9. Water Penetration under Static Pressure: No evidence of water penetration through fixed glazing and framing areas when tested according to ASTM E 331 at a minimum static-air-pressure differential of 20 percent of positive wind-load design pressure, but not less than **6.24 lbf/sq. ft. (300 Pa) OR 10 lbf/sq. ft. (480 Pa) OR 15 lbf/sq. ft. (720 Pa)**, **as directed**.
 - 10. Water Penetration under Dynamic Pressure: No evidence of water penetration through fixed glazing and framing areas when tested according to AAMA 501.1 at dynamic pressure equal to 20 percent of positive wind-load design pressure, but not less than **6.24 lbf/sq. ft. (300 Pa) OR 10 lbf/sq. ft. (480 Pa) OR 15 lbf/sq. ft. (720 Pa)**, **as directed**.
 - a. Maximum Water Leakage: According to AAMA 501.1 **OR** No uncontrolled water penetrating assemblies or water appearing on assemblies' normally exposed interior surfaces from sources other than condensation, **as directed**. Water leakage does not include water controlled by flashing and gutters that is drained to exterior.
 - 11. Thermal Movements: Allow for thermal movements resulting from the following maximum change (range) in ambient and surface temperatures:
 - a. Temperature Change (Range): **120 deg F (67 deg C)**, ambient; **180 deg F (100 deg C)**, material surfaces.
 - b. Test Interior Ambient-Air Temperature: **75 deg F (24 deg C)**.
 - c. Test Performance: No buckling; stress on glass; sealant failure; excess stress on framing, anchors, and fasteners; or reduction of performance when tested according to AAMA 501.5.
 - 12. Energy Performance: Glazed aluminum curtain walls shall have certified and labeled energy performance ratings in accordance with NFRC.
 - a. Thermal Transmittance (U-factor): Fixed glazing and framing areas shall have U-factor of not more than **0.45 Btu/sq. ft. x h x deg F (2.55 W/sq. m x K) OR 0.57 Btu/sq. ft. x h x deg F (3.23 W/sq. m x K) OR 0.69 Btu/sq. ft. x h x deg F (3.92 W/sq. m x K)**, **as directed**, as determined according to NFRC 100.
 - b. Solar Heat Gain Coefficient: Fixed glazing and framing areas shall have a solar heat gain coefficient of no greater than 0.35 **OR** 0.40 **OR** 0.45, **as directed**, as determined according to NFRC 200.
 - c. Air Infiltration: Maximum air leakage through fixed glazing and framing areas of **0.30 cfm/sq. ft. (1.50 L/s per sq. m)** of fixed wall area as determined according to ASTM E 283 at a minimum static-air-pressure differential of **1.57 lbf/sq. ft. (75 Pa) OR 6.24 lbf/sq. ft. (300 Pa)**, **as directed**.

- d. Condensation Resistance: Fixed glazing and framing areas shall have an NFRC- certified condensation resistance rating of no less than 15 **OR** 25 **OR** 35 **OR** 45, **as directed**, as determined according to NFRC 500.
 - 13. Sound Transmission: Provide glazed aluminum curtain walls with fixed glazing and framing areas having the following sound-transmission characteristics:
 - a. Outdoor-Indoor Transmission Class: Minimum 26 **OR** 30 **OR** 34, **as directed**, when tested for laboratory sound transmission loss according to ASTM E 90 and determined by ASTM E 1332.
- D. Submittals
 - 1. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.
 - 2. LEED Submittal:
 - a. Product Data for Credit EQ 4.1: For glazing sealants used inside of the weatherproofing system, including printed statement of VOC content.
 - 3. Shop Drawings: For glazed aluminum curtain walls. Include plans, elevations, sections, full-size details, and attachments to other work.
 - a. Include details of provisions for assembly expansion and contraction and for draining moisture occurring within the assembly to the exterior.
 - b. Include full-size isometric details of each vertical-to-horizontal intersection of glazed aluminum curtain walls, showing the following:
 - 1) Joinery, including concealed welds.
 - 2) Anchorage.
 - 3) Expansion provisions.
 - 4) Glazing.
 - 5) Flashing and drainage.
 - 4. Samples: For each type of exposed finish required.
 - 5. Delegated-Design Submittal: For glazed aluminum curtain walls indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
 - 6. Qualification Data: For qualified Installer and testing agency, **as directed**.
 - 7. Seismic Qualification Certificates: For glazed aluminum curtain walls, accessories, and components, from manufacturer.
 - a. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
 - 8. Welding certificates.
 - 9. Energy Performance Certificates: For glazed aluminum curtain walls, accessories, and components, from manufacturer.
 - a. Basis for Certification: NFRC-certified energy performance values for each glazed aluminum curtain wall.
 - 10. Product test reports.
 - 11. Field quality-control reports.
 - 12. Maintenance data.
 - 13. Warranties: Sample of special warranties.
- E. Quality Assurance
 - 1. Manufacturer Qualifications: A manufacturer capable of fabricating glazed aluminum curtain walls that meet or exceed energy performance requirements indicated and of documenting this performance by certification, labeling, and inclusion in lists.
 - 2. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for installation of units required for this Project.
 - 3. Testing Agency Qualifications: Qualified according to ASTM E 699 for testing indicated.
 - 4. Product Options: Information on Drawings and in Specifications establishes requirements for aesthetic effects and performance characteristics of assemblies. Aesthetic effects are indicated by dimensions, arrangements, alignment, and profiles of components and assemblies as they relate to sightlines, to one another, and to adjoining construction.

5. Welding Qualifications: Qualify procedures and personnel according to the following:
 - a. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
 - b. AWS D1.2/D1.2M, "Structural Welding Code - Aluminum."
6. Energy Performance Standards: Comply with NFRC for minimum standards of energy performance, materials, components, accessories, and fabrication. Comply with more stringent requirements if indicated.
 - a. Provide NFRC-certified glazed aluminum curtain walls with an attached label.
7. Preinstallation Conference: Conduct conference at Project site.

F. Warranty

1. Special Assembly Warranty: Standard form in which manufacturer **OR** Installer, **as directed**, agrees to repair or replace components of glazed aluminum curtain walls that do not comply with requirements or that fail in materials or workmanship within Two **OR** Five **OR** 10, **as directed**, years from date of Final Completion.
2. Special Finish Warranty: Standard form in which manufacturer agrees to repair finishes or replace aluminum that shows evidence of deterioration of factory-applied finishes within Five **OR** 10 **OR** 20, **as directed**, years from date of Final Completion.

1.2 PRODUCTS

A. Materials

1. Aluminum: Alloy and temper recommended by manufacturer for type of use and finish indicated.
 - a. Sheet and Plate: **ASTM B 209 (ASTM B 209M)**.
 - b. Extruded Bars, Rods, Profiles, and Tubes: **ASTM B 221 (ASTM B 221M)**.
 - c. Extruded Structural Pipe and Tubes: ASTM B 429.
 - d. Structural Profiles: ASTM B 308/B 308M.
 - e. Welding Rods and Bare Electrodes: AWS A5.10/A5.10M.
2. Steel Reinforcement: Manufacturer's standard zinc-rich, corrosion-resistant primer complying with SSPC-PS Guide No. 12.00; applied immediately after surface preparation and pretreatment. Select surface preparation methods according to recommendations in SSPC-SP COM and prepare surfaces according to applicable SSPC standard.
 - a. Structural Shapes, Plates, and Bars: ASTM A 36/A 36M.
 - b. Cold-Rolled Sheet and Strip: ASTM A 1008/A 1008M.
 - c. Hot-Rolled Sheet and Strip: ASTM A 1011/A 1011M.

B. Framing

1. Framing Members: Manufacturer's standard extruded- or formed-aluminum framing members of thickness required and reinforced as required to support imposed loads.
 - a. Construction: Nonthermal **OR** Thermally improved **OR** Thermally broken, **as directed**.
 - b. Glazing System: Retained mechanically with gaskets on four sides.
 - c. Glazing Plane: Front.
2. Brackets and Reinforcements: Manufacturer's standard high-strength aluminum with nonstaining, nonferrous shims for aligning system components.
3. Fasteners and Accessories: Manufacturer's standard corrosion-resistant, nonstaining, nonbleeding fasteners and accessories compatible with adjacent materials.
 - a. Use self-locking devices where fasteners are subject to loosening or turning out from thermal and structural movements, wind loads, or vibration.
 - b. Reinforce members as required to receive fastener threads.
 - c. Use exposed fasteners with countersunk Phillips screw heads, finished to match framing system **OR** fabricated from 300 series stainless steel, **as directed**.
4. Anchors: Three-way adjustable anchors with minimum adjustment of **1 inch (25.4 mm)** that accommodate fabrication and installation tolerances in material and finish compatible with adjoining materials and recommended by manufacturer.

- a. Concrete and Masonry Inserts: Hot-dip galvanized cast-iron, malleable-iron, or steel inserts complying with ASTM A 123/A 123M or ASTM A 153/A 153M requirements.
 5. Concealed Flashing: Manufacturer's standard corrosion-resistant, nonstaining, nonbleeding flashing compatible with adjacent materials **OR** Dead-soft, 0.018-inch- (0.457-mm-) thick stainless steel, ASTM A 240/A 240M of type recommended by manufacturer, **as directed**.
 6. Framing Sealants: Manufacturer's standard sealants.
- C. Glazing
 1. Glazing: Comply with Division 08 Section "Glazing".
 2. Glazing Gaskets: Manufacturer's standard sealed-corner pressure-glazing system of black, resilient elastomeric glazing gaskets, setting blocks, and shims or spacers **OR** Comply with Division 08 Section "Glazing", **as directed**.
 3. Glazing Sealants: As recommended by manufacturer **OR** Comply with Division 08 Section "Glazing", **as directed**.
 - a. Provide sealants for use inside of the weatherproofing system that have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- D. Insulated Spandrel Panels
 1. Insulated Spandrel Panels: Laminated, metal-faced flat panels with no deviations in plane exceeding 0.8 percent of panel dimension in width or length.
 - a. Overall Panel Thickness: As indicated **OR** 1 inch (25.4 mm), **as directed**.
 - b. Exterior Skin: Aluminum.
 - 1) Thickness: Manufacturer's standard for finish and texture indicated.
 - 2) Finish: Matching framing system.
 - 3) Texture: Smooth **OR** Embossed, **as directed**.
 - 4) Backing Sheet: 1/8-inch- (3.2-mm-) thick, tempered hardboard **OR** 0.157-inch- (4-mm-) thick, cement board **OR** 0.125-inch- (3.2-mm-) thick, corrugated, high-density polyethylene, **as directed**.
 - c. Interior Skin: Aluminum **OR** Manufacturer's standard galvanized-steel sheet, **as directed**.
 - 1) Thickness: Manufacturer's standard for finish and texture indicated.
 - 2) Finish: Matching curtain-wall framing **OR** Low-gloss, white baked enamel **OR** Mill finish, **as directed**.
 - 3) Texture: Smooth **OR** Embossed, **as directed**.
 - 4) Backing Sheet: 1/8-inch- (3.2-mm-) thick, tempered hardboard **OR** 0.157-inch- (4-mm-) thick, cement board **OR** 1/2-inch- (12.7-mm-) thick, gypsum board with proprietary fire-resistance-rated core **OR** 0.125-inch- (3.2-mm-) thick, corrugated, high-density polyethylene, **as directed**.
 - d. Thermal Insulation Core: Manufacturer's standard rigid, closed-cell, polyisocyanurate board **OR** extruded-polystyrene board **OR** expanded-perlite, mineral-insulation board, **as directed**.
 - e. Surface-Burning Characteristics: For exposed interior surfaces of panels, when tested according to ASTM E 84 as follows:
 - 1) Flame-Spread Index: 25 or less.
 - 2) Smoke-Developed Index: 450 or less.
- E. Operable Units
 1. Venting Windows: Comply with Division 08 Section "Aluminum Windows".
 2. Doors: Comply with Division 08 Section "Aluminum-framed Entrances And Storefronts".
- F. Accessory Materials
 1. Bituminous Paint: Cold-applied asphalt-mastic paint complying with SSPC-Paint 12 requirements except containing no asbestos, formulated for 30-mil (0.762-mm) thickness per coat.
- G. Fabrication
 1. Form or extrude aluminum shapes before finishing.

2. Weld in concealed locations to greatest extent possible to minimize distortion or discoloration of finish. Remove weld spatter and welding oxides from exposed surfaces by descaling or grinding.
3. Fabricate components that, when assembled, have the following characteristics:
 - a. Profiles that are sharp, straight, and free of defects or deformations.
 - b. Accurately fitted joints with ends coped or mitered.
 - c. Physical and thermal isolation of glazing from framing members.
 - d. Accommodations for thermal and mechanical movements of glazing and framing to maintain required glazing edge clearances.
 - e. Provisions for field replacement of glazing from exterior **OR** interior **OR** interior for vision glass and exterior for spandrel glazing or metal panels, **as directed**.
 - f. Provisions for safety railings mounted on interior face of mullions **OR** between mullions at interior, **as directed**.
 - g. Fasteners, anchors, and connection devices that are concealed from view to greatest extent possible.
 - h. Components curved to indicated radii.
4. Fabricate components that, when assembled, have the following characteristics:
 - a. Internal guttering system or other means to drain water passing joints, condensation occurring within framing members, and moisture migrating within glazed aluminum curtain wall to exterior.
 - b. Pressure-equalized system or double barrier design with primary air and vapor barrier at interior side of glazed aluminum curtain wall and secondary seal weeped and vented to exterior.
5. Curtain-Wall Framing: Fabricate components for assembly using shear-block system **OR** screw-spline system **OR** head-and-sill-receptor system with shear blocks at intermediate horizontal members, **as directed**.
6. Factory-Assembled Frame Units:
 - a. Rigidly secure nonmovement joints.
 - b. Seal joints watertight unless otherwise indicated.
 - c. Install glazing to comply with requirements in Division 08 Section "Glazing".
7. After fabrication, clearly mark components to identify their locations in Project according to Shop Drawings.

H. Aluminum Finishes

1. Clear Anodic Finish: AAMA 611, AA-M12C22A41, Class I, 0.018 mm **OR** AA-M12C22A31, Class II, 0.010 mm, **as directed**, or thicker.
2. Color Anodic Finish: AAMA 611, AA-M12C22A42/A44, Class I, 0.018 mm **OR** AA-M12C22A32/A34, Class II, 0.010 mm, **as directed**, or thicker.
 - a. Color: Light bronze **OR** Medium bronze **OR** Dark bronze **OR** Champagne **OR** Black **OR** Match sample **OR** As selected from full range of industry colors and color densities, **as directed**.
3. Baked-Enamel or Powder-Coat Finish: AAMA 2603 except with a minimum dry film thickness of **1.5 mils (0.04 mm)**. Comply with coating manufacturer's written instructions for cleaning, conversion coating, and applying and baking finish.
 - a. Color and Gloss: As indicated by manufacturer's designations **OR** Match sample **OR** As selected from manufacturer's full range, **as directed**.
4. High-Performance Organic Finish:
 - a. Two-coat fluoropolymer finish complying with AAMA 2604 **OR** AAMA 2605, **as directed**, and containing not less than 50 **OR** 70, **as directed**, percent PVDF resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
OR
Three-coat **OR** Four-coat, **as directed**, fluoropolymer finish complying with AAMA 2605 and containing not less than 50 **OR** 70, **as directed**, percent PVDF resin by weight in both color coat and clear topcoat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.

OR

Two-coat fluoropolymer finish complying with AAMA 2604 and containing 100 percent FEVE resin in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.

- b. Color and Gloss: As indicated by manufacturer's designations **OR** Match sample **OR** As selected from manufacturer's full range, **as directed**.

1.3 EXECUTION

A. Installation

1. General:
 - a. Comply with manufacturer's written instructions.
 - b. Do not install damaged components.
 - c. Fit joints to produce hairline joints free of burrs and distortion.
 - d. Rigidly secure nonmovement joints.
 - e. Install anchors with separators and isolators to prevent metal corrosion and electrolytic deterioration and to prevent impeding movement of moving joints.
 - f. Weld components in concealed locations to minimize distortion or discoloration of finish. Protect glazing surfaces from welding.
 - g. Seal joints watertight unless otherwise indicated.
2. Metal Protection:
 - a. Where aluminum will contact dissimilar metals, protect against galvanic action by painting contact surfaces with primer or by applying sealant or tape or installing nonconductive spacers as recommended by manufacturer for this purpose.
 - b. Where aluminum will contact concrete or masonry, protect against corrosion by painting contact surfaces with bituminous paint.
3. Install components to drain water passing joints, condensation occurring within framing members, and moisture migrating within glazed aluminum curtain wall to exterior.
4. Install components plumb and true in alignment with established lines and grades.
5. Install operable units level and plumb, securely anchored, and without distortion. Adjust weather-stripping contact and hardware movement to produce proper operation.
6. Install glazing as specified in Division 08 Section "Glazing".

B. Erection Tolerances

1. Erection Tolerances: Install glazed aluminum curtain walls to comply with the following maximum tolerances:
 - a. Plumb: **1/8 inch in 10 feet (3.2 mm in 3 m); 1/4 inch in 40 feet (6 mm in 12 m).**
 - b. Level: **1/8 inch in 20 feet (3.2 mm in 6 m); 1/4 inch in 40 feet (6 mm in 12 m).**
 - c. Alignment:
 - 1) Where surfaces abut in line or are separated by reveal or protruding element up to **1/2 inch (12.7 mm)** wide, limit offset from true alignment to **1/16 inch (1.6 mm).**
 - 2) Where surfaces are separated by reveal or protruding element from **1/2 to 1 inch (12.7 to 25.4 mm)** wide, limit offset from true alignment to **1/8 inch (3.2 mm).**
 - 3) Where surfaces are separated by reveal or protruding element of **1 inch (25.4 mm)** wide or more, limit offset from true alignment to **1/4 inch (6 mm).**
 - d. Location: Limit variation from plane to **1/8 inch in 12 feet (3.2 mm in 3.7 m); 1/2 inch (12.7 mm)** over total length.

C. Field Quality Control

1. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
2. Testing Services: Testing and inspecting of representative areas of glazed aluminum curtain walls shall take place as installation proceeds to determine compliance of installed assemblies with specified requirements.
 - a. Air Infiltration: Areas shall be tested for air leakage of 1.5 times the rate specified for laboratory testing in "Performance Requirements" Article, but not more than **0.50 cfm/sq. ft.**

(2.25 L/s per sq. m), of fixed wall area when tested according to ASTM E 783 at a minimum static-air-pressure differential of 1.57 lbf/sq. ft. (75 Pa) OR 6.24 lbf/sq. ft. (300 Pa), as directed.

- 1) Test Area: One bay wide, but not less than 30 feet (9.1 m), by one story of glazed aluminum curtain wall.
- 2) Perform a minimum of two OR three, as directed, tests in areas as directed by the Owner.
OR
Perform tests in each test area as directed by the Owner. Perform at least three tests, prior to 10, 35, and 70 percent completion.
- b. Water Penetration: Areas shall be tested according to ASTM E 1105 at a minimum uniform and cyclic static-air-pressure differential of 0.67 times the static-air-pressure differential specified for laboratory testing in "Performance Requirements" Article, but not less than 6.24 lbf/sq. ft. (300 Pa), and shall not evidence water penetration.
 - 1) Test Area: One bay wide, but not less than 30 feet (9.1 m), by one story of glazed aluminum curtain wall.
 - 2) Perform a minimum of two OR three, as directed, tests in areas as directed by the Owner.
OR
Perform tests in each test area as directed by the Owner. Perform at least three tests, prior to 10, 35, and 70 percent completion.
- c. Water Spray Test: Before installation of interior finishes has begun, areas designated by the Owner shall be tested according to AAMA 501.2 and shall not evidence water penetration.
 - 1) Test Area: A minimum area of 75 feet (23 m) by one story of glazed aluminum curtain wall.
3. Glazed aluminum curtain walls will be considered defective if they do not pass tests and inspections.
4. Prepare test and inspection reports.

END OF SECTION 08 44 13 00

SECTION 08 44 13 00a - STRUCTURAL-SEALANT-GLAZED CURTAIN WALLS

1.1 GENERAL

A. Description Of Work

1. This specification covers the furnishing and installation of material for structural-sealant-glazed curtain walls. Products shall be as follows or as directed by the Owner. Installation procedures shall be in accordance with the products manufacturer's recommendations. Demolition and removal of materials shall be as required to support the work.

B. Summary

1. Section Includes:
 - a. Factory-glazed **OR** Field-glazed, **as directed**, two-sided structural-sealant-glazed curtain-wall assemblies.
 - b. Factory-glazed, four-sided structural-sealant-glazed curtain-wall assemblies.

C. Performance Requirements

1. General Performance: Comply with performance requirements specified, as determined by testing manufacturer's standard of structural-sealant-glazed curtain walls representing those indicated for this Project without failure due to defective manufacture, fabrication, installation, or other defects in construction.
 - a. Structural-sealant-glazed curtain walls shall withstand movements of supporting structure indicated on Drawings, **OR as directed**, including, but not limited to, story drift, twist, column shortening, long-term creep, and deflection from uniformly distributed and concentrated live loads.
 - b. Failure also includes the following:
 - 1) Thermal stresses transferring to building structure.
 - 2) Glass breakage.
 - 3) Noise or vibration created by wind and thermal and structural movements.
 - 4) Loosening or weakening of fasteners, attachments, and other components.
 - 5) Failure of operating units.
2. Delegated Design: Design structural-sealant-glazed curtain walls, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.
3. Structural Loads:
 - a. Wind Loads: As indicated on Drawings **OR as directed**.
 - 1) Basic Wind Speed: **85 mph (38 m/s) OR 90 mph (40 m/s) OR 100 mph (44 m/s) OR 110 mph (49 m/s), as directed.**
 - 2) Exposure Category: **A OR B OR C OR D, as directed.**
 - b. Blast Loads: As indicated on Drawings **OR as directed**.
 - c. Periodic Maintenance-Equipment Loads: As indicated on Drawings **OR as directed**.
4. Structural-Test Performance: Provide structural-sealant-glazed curtain walls tested according to ASTM E 330 as follows:
 - a. When tested at positive and negative wind-load design pressures, assemblies do not evidence deflection exceeding specified limits.
 - b. When tested at 150 percent of positive and negative wind-load design pressures, assemblies, including anchorage, do not evidence material failures, structural distress, and permanent deformation of main framing members exceeding 0.2 percent of span.
 - c. Test Durations: As required by design wind velocity, but not less than 10 seconds.
5. Deflection of Framing Members: At design wind pressure, as follows:
 - a. Deflection Normal to Wall Plane: Limited to edge of glass in a direction perpendicular to glass plane not exceeding L/175 of the glass edge length for each individual glazing lite **OR 1/175 of clear span for spans up to 13 feet 6 inches (4.1 m) and to 1/240 of clear span plus 1/4 inch (6.35 mm) for spans greater than 13 feet 6 inches (4.1 m), as directed**, or an

- amount that restricts edge deflection of individual glazing lites to **3/4 inch (19 mm)**, whichever is less.
- b. Deflection Parallel to Glazing Plane: Limited to L/360 of clear span or **1/8 inch (3.2 mm)**, whichever is smaller **OR** amount not exceeding that which reduces glazing bite to less than 75 percent of design dimension and that which reduces edge clearance between framing members and glazing or other fixed components to less than **1/8 inch (3.2 mm)**, **as directed**.
 - 1) Operable Units: Provide a minimum **1/16-inch (1.6-mm)** clearance between framing members and operable units.
 - c. Cantilever Deflection: Where framing members overhang an anchor point, limit deflection to 2 times the length of cantilevered member divided by 175.
 6. Windborne-Debris-Impact-Resistance Performance: Pass missile-impact and cyclic-pressure tests when tested according to ASTM E 1886 and testing information in ASTM E 1996 for Wind Zone 1 **OR** Zone 2 **OR** Zone 3 **OR** Zone 4, **as directed**.
 - a. Large-Missile Test: For glazed openings located within **30 feet (9.1 m)** of grade.
 - b. Small-Missile Test: For glazed openings located more than **30 feet (9.1 m)** above grade.
 7. Seismic Performance: Structural-sealant-glazed curtain walls shall withstand the effects of earthquake motions determined according to SEI/ASCE 7.
 - a. Component Importance Factor is 1.5 **OR** 1.0, **as directed**.
 8. Story Drift: Accommodate design displacement of adjacent stories indicated.
 - a. Design Displacement: As indicated on Drawings **OR as directed**.
 - b. Test Performance: Meets criteria for passing based on building occupancy type when tested according to AAMA 501.4 at design displacement and 1.5 times the design displacement, **as directed**.
 9. Water Penetration under Static Pressure: No evidence of water penetration through fixed glazing and framing areas when tested according to ASTM E 331 at a minimum static-air-pressure differential of 20 percent of positive wind-load design pressure, but not less than **6.24 lbf/sq. ft. (300 Pa) OR 10 lbf/sq. ft. (480 Pa) OR 15 lbf/sq. ft. (720 Pa)**, **as directed**.
 10. Water Penetration under Dynamic Pressure: No evidence of water penetration through fixed glazing and framing areas when tested according to AAMA 501.1 at dynamic pressure equal to 20 percent of positive wind-load design pressure, but not less than **6.24 lbf/sq. ft. (300 Pa) OR 10 lbf/sq. ft. (480 Pa) OR 15 lbf/sq. ft. (720 Pa)**, **as directed**.
 - a. Maximum Water Leakage: According to AAMA 501.1 **OR** No uncontrolled water penetrating assemblies or water appearing on assemblies' normally exposed interior surfaces from sources other than condensation, **as directed**. Water leakage does not include water controlled by flashing and gutters that is drained to exterior.
 11. Thermal Movements: Allow for thermal movements resulting from the following maximum change (range) in ambient and surface temperatures:
 - a. Temperature Change (Range): **120 deg F (67 deg C)**, ambient; **180 deg F (100 deg C)**, material surfaces.
 - b. Test Interior Ambient-Air Temperature: **75 deg F (24 deg C)**.
 - c. Test Performance: No buckling, stress on glass, sealant failure, or excess stress on framing, anchors, and fasteners and no reduction of performance when tested according to AAMA 501.5.
 12. Energy Performance: Structural-sealant-glazed curtain walls shall have certified and labeled energy performance ratings according to NFRC.
 - a. Thermal Transmittance (U-Factor): Fixed glazing and framing areas shall have U-factor of not more than **0.45 Btu/sq. ft. x h x deg F (2.55 W/sq. m x K) OR 0.57 Btu/sq. ft. x h x deg F (3.23 W/sq. m x K) OR 0.69 Btu/sq. ft. x h x deg F (3.92 W/sq. m x K)**, **as directed**, as determined according to NFRC 100.
 - b. Solar Heat Gain Coefficient: Fixed glazing and framing areas shall have a SHGC of no greater than 0.35 **OR** 0.40 **OR** 0.45, **as directed**, as determined according to NFRC 200.
 - c. Air Infiltration: Maximum air leakage through fixed glazing and framing areas of **0.30 cfm/sq. ft. (1.50 L/s per sq. m)** of fixed wall area as determined according to ASTM E 283

- at a minimum static-air-pressure differential of **1.57 lbf/sq. ft. (75 Pa) OR 6.24 lbf/sq. ft. (300 Pa), as directed.**
- d. Condensation Resistance: Fixed glazing and framing areas shall have an NFRC-certified CR rating of no less than **15 OR 25 OR 35 OR 45, as directed**, as determined according to NFRC 500
 13. Sound Transmission: Fixed glazing and framing areas shall have the following sound-transmission characteristics:
 - a. Outdoor-Indoor Transmission Class: Minimum **26 OR 30 OR 34, as directed**, when tested for laboratory sound transmission loss according to ASTM E 90 and determined by ASTM E 1332.
 14. Structural Sealant: Capable of withstanding tensile and shear stresses imposed by structural-sealant-glazed curtain walls without failing adhesively or cohesively. When tested for preconstruction adhesion and compatibility, cohesive failure of sealant shall occur before adhesive failure.
 - a. Adhesive failure occurs when sealant pulls away from substrate cleanly, leaving no sealant material behind.
 - b. Cohesive failure occurs when sealant breaks or tears within itself but does not separate from each substrate because sealant-to-substrate bond strength exceeds sealant's internal strength.
 15. Structural-Sealant Joints:
 - a. Designed to carry gravity loads of glazing.
 - b. Designed to produce tensile or shear stress of less than **20 psi (138 kPa).**
 - c. Design reviewed and approved by structural-sealant manufacturer.
- D. Submittals
1. Product Data: For each type of product indicated.
 2. LEED Submittal:
 - a. Product Data for Credit EQ 4.1: For glazing sealants used inside of the weatherproofing system, including printed statement of VOC content.
 3. Shop Drawings: For structural-sealant-glazed curtain walls. Include plans, elevations, sections, full-size details, and attachments to other work.
 - a. Include details of provisions for assembly expansion and contraction and for draining moisture occurring within the assembly to the exterior.
 - b. Include full-size isometric details of each vertical-to-horizontal intersection of structural-sealant-glazed curtain walls, showing the following:
 - 1) Joinery, including concealed welds.
 - 2) Anchorage.
 - 3) Expansion provisions.
 - 4) Glazing.
 - 5) Flashing and drainage.
 4. Samples: For each type of exposed finish required.
 5. Delegated-Design Submittal: For structural-sealant-glazed curtain walls indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
 6. Qualification Data: For qualified Installer and testing agency.
 7. Seismic Qualification Certificates: For structural-sealant-glazed curtain walls, accessories, and components, from manufacturer.
 - a. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
 8. Welding certificates.
 9. Energy-Performance Certificates: For structural-sealant-glazed curtain walls, accessories, and components, from manufacturer.
 - a. Basis for Certification: NFRC-certified energy-performance values for each structural-sealant-glazed curtain wall.
 10. Product test reports.
 11. Preconstruction sealant test reports.

12. Quality-Control Program: Developed specifically for Project, including fabrication and installation, according to recommendations in ASTM C 1401. Include periodic quality-control reports.
13. Source quality-control reports.
14. Field quality-control reports.
15. Maintenance Data: For structural-sealant-glazed curtain walls to include in maintenance manuals. Include ASTM C 1401 recommendations for postinstallation-phase quality-control program.
16. Warranties: Sample of special warranties.

E. Quality Assurance

1. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for installation of units required for this Project.
2. Testing Agency Qualifications: Qualified according to ASTM E 699 for testing indicated.
3. Product Options: Information on Drawings and in Specifications establishes requirements for assemblies' aesthetic effects and performance characteristics. Aesthetic effects are indicated by dimensions, arrangements, alignment, and profiles of components and assemblies as they relate to sightlines, to one another, and to adjoining construction.
4. Structural-Sealant Glazing: Comply with ASTM C 1401 for design and installation of structural-sealant-glazed curtain walls.
5. Welding Qualifications: Qualify procedures and personnel according to the following:
 - a. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
 - b. AWS D1.2/D1.2M, "Structural Welding Code - Aluminum."
6. Energy-Performance Standards: Comply with NFRC for minimum standards of energy performance, materials, components, accessories, and fabrication. Comply with more stringent requirements if indicated.
 - a. Provide NFRC-certified, structural-sealant-glazed curtain walls with an attached label.
7. Preinstallation Conference: Conduct conference at Project site.

F. Warranty

1. Special Assembly Warranty: Standard form in which manufacturer **OR** Installer, **as directed** agrees to repair or replace components of structural-sealant-glazed curtain walls that do not comply with requirements or that fail in materials or workmanship within Two **OR** Five **OR** 10, **as directed**, years from date of Final Completion.
2. Special Finish Warranty: Standard form in which manufacturer agrees to repair finishes or replace aluminum that shows evidence of deterioration of factory-applied finishes within Five **OR** 10 **OR** 20, **as directed**, years from date of Final Completion.

1.2 PRODUCTS

A. Materials

1. Aluminum: Alloy and temper recommended by manufacturer for type of use and finish indicated.
 - a. Sheet and Plate: **ASTM B 209 (ASTM B 209M)**.
 - b. Extruded Bars, Rods, Profiles, and Tubes: **ASTM B 221 (ASTM B 221M)**.
 - c. Extruded Structural Pipe and Tubes: ASTM B 429.
 - d. Structural Profiles: ASTM B 308/B 308M.
 - e. Welding Rods and Bare Electrodes: AWS A5.10/A5.10M.
2. Steel Reinforcement: Manufacturer's standard zinc-rich, corrosion-resistant primer, complying with SSPC-PS Guide No. 12.00; applied immediately after surface preparation and pretreatment. Select surface preparation methods according to recommendations in SSPC-SP COM and prepare surfaces according to applicable SSPC standard.
 - a. Structural Shapes, Plates, and Bars: ASTM A 36/A 36M.
 - b. Cold-Rolled Sheet and Strip: ASTM A 1008/A 1008M.
 - c. Hot-Rolled Sheet and Strip: ASTM A 1011/A 1011M.

B. Framing

1. Framing Members: Manufacturer's standard formed- or extruded-aluminum framing members of thickness required and reinforced as required to support imposed loads.
2. Fasteners and Accessories: Manufacturer's standard corrosion-resistant, nonstaining, nonbleeding fasteners and accessories compatible with adjacent materials.
 - a. Use self-locking devices where fasteners are subject to loosening or turning out from thermal and structural movements, wind loads, or vibration.
 - b. Reinforce members as required to receive fastener threads.
 - c. Use exposed fasteners with countersunk Phillips screw heads finished to match framing system **OR** fabricated from Series 300 stainless steel, **as directed**.
3. Anchors: Three-way adjustable anchors, with minimum adjustment of **1 inch (25.4 mm)**, that accommodate fabrication and installation tolerances in material and finish and are compatible with adjoining materials and recommended by manufacturer.
 - a. Concrete and Masonry Inserts: Hot-dip galvanized cast-iron, malleable-iron, or steel inserts complying with ASTM A 123/A 123M or ASTM A 153/A 153M requirements.
4. Concealed Flashing: Manufacturer's standard corrosion-resistant, nonstaining, nonbleeding flashing compatible with adjacent materials **OR** Dead-soft, **0.018-inch- (0.457-mm-)** thick stainless steel, ASTM A 240/A 240M of type recommended by manufacturer, **as directed**.
5. Framing Sealants: Manufacturer's standard sealants with VOC content of 250g/L or less when calculated according to 40 CFR 59, Subpart D (EPA method 24), **as directed**.

C. Glazing

1. Glazing: Comply with Division 08 Section "Glazing".
2. Glazing Gaskets, Spacers, Setting Blocks, Sealant Backings, and Bond Breakers: Manufacturer's standard permanent, nonmigrating types compatible with sealants and suitable for joint movement and assembly performance requirements.
3. Glazing Sealants: For structural-sealant-glazed curtain walls, as recommended by manufacturer for joint type, and as follows:
 - a. Structural Sealant: ASTM C 1184, chemically curing silicone formulation that is compatible with system components with which it comes in contact, specifically formulated and tested for use as structural sealant and approved by structural-sealant manufacturer for use in curtain-wall assembly indicated.
 - 1) Provide sealants for use inside of the weatherproofing system that have a VOC content of 100 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 - 2) Color: Black **OR** Gray **OR** As selected from manufacturer's full range of colors, **as directed**.
 - b. Weatherseal Sealant: ASTM C 920 for Type S; Grade NS; Class 25; Uses NT, G, A, and O; chemically curing silicone formulation that is compatible with structural sealant and other system components with which it comes in contact; recommended by structural-sealant, weatherseal-sealant, and structural-sealant-glazed curtain-wall manufacturers for this use.
 - 1) Provide sealants for use inside of the weatherproofing system that have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 - 2) Color: Matching structural sealant.

D. Operable Units

1. Venting Windows: Comply with Division 08 Section "Aluminum Windows".
2. Doors: Comply with Division 08 Section "Aluminum-framed Entrances And Storefronts".

E. Accessory Materials

1. Bituminous Paint: Cold-applied asphalt-mastic paint complying with SSPC-Paint 12 requirements except containing no asbestos, formulated for **30-mil (0.762-mm)** thickness per coat.
2. Cleaning Agent and Cloth: As recommended by structural-sealant manufacturer.

F. Fabrication

1. Form or extrude aluminum shapes before finishing.
2. Weld in concealed locations to greatest extent possible to minimize distortion or discoloration of finish. Remove weld spatter and welding oxides from exposed surfaces by descaling or grinding.
3. Fabricate components that, when assembled, have the following characteristics:
 - a. Profiles that are sharp, straight, and free of defects or deformations.
 - b. Accurately fitted joints with ends coped or mitered.
 - c. Physical and thermal isolation of glazing from framing members.
 - d. Accommodations for thermal and mechanical movements of glazing and framing to maintain required glazing edge clearances.
 - e. Fasteners, anchors, and connection devices that are concealed from view to greatest extent possible.
 - f. Provisions for field replacement of glazing from exterior **OR** interior **OR** interior for vision glass and exterior for spandrel glazing or metal panels, **as directed**. Include accommodations for using temporary support device (dutchman) to retain glazing in place while sealant cures.
 - g. Provisions for safety railings mounted on interior face of mullions **OR** between mullions at interior, **as directed**.
 - h. Components curved to indicated radii.
 - i. Internal guttering systems or other means to drain water passing joints, condensation occurring within framing members, and moisture migrating within structural-sealant-glazed curtain wall to exterior.
4. Factory-Assembled Frame Units:
 - a. Rigidly secure nonmovement joints.
 - b. Prepare surfaces that will contact structural sealant according to sealant manufacturer's written instructions to ensure compatibility and adhesion.
 - c. Preparation includes, but is not limited to, cleaning and priming surfaces.
 - d. Seal joints watertight unless otherwise indicated.
 - e. Install glazing to comply with requirements in Division 08 Section "Glazing".
5. After fabrication, clearly mark components to identify their locations in Project according to Shop Drawings.

G. Aluminum Finishes

1. Clear Anodic Finish: AAMA 611, AA-M12C22A41, Class I, 0.018 mm **OR** AA-M12C22A31, Class II, 0.010 mm, **as directed**, or thicker.
2. Color Anodic Finish: AAMA 611, AA-M12C22A42/A44, Class I, 0.018 mm **OR** AA-M12C22A32/A34, Class II, 0.010 mm, **as directed**, or thicker.
 - a. Color: Light bronze **OR** Medium bronze **OR** Dark bronze **OR** Champagne **OR** Black **OR** Match sample **OR** As selected from full range of industry colors and color densities, **as directed**.
3. Baked-Enamel or Powder-Coat Finish: AAMA 2603 except with a minimum dry film thickness of **1.5 mils (0.04 mm)**. Comply with coating manufacturer's written instructions for cleaning, conversion coating, and applying and baking finish.
 - a. Color and Gloss: As selected from manufacturer's full range, **as directed**.
4. High-Performance Organic Finish:
 - a. Two-coat fluoropolymer finish complying with AAMA 2604 **OR** AAMA 2605, **as directed**, and containing not less than 50 **OR** 70, **as directed**, percent PVDF resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
OR
Three-coat **OR** Four-coat, **as directed**, fluoropolymer finish complying with AAMA 2605 and containing not less than 50 **OR** 70, **as directed**, percent PVDF resin by weight in both color coat and clear topcoat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
OR

Two-coat fluoropolymer finish complying with AAMA 2604 and containing 100 percent FEVE resin in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.

- b. Color and Gloss: As selected from manufacturer's full range.

H. Source Quality Control

- 1. Perform quality-control procedures complying with ASTM C 1401 recommendations including, but not limited to, assembly material qualification procedures, sealant testing, and assembly fabrication reviews and checks.

1.3 EXECUTION

A. Installation

- 1. General:
 - a. Comply with manufacturer's written instructions.
 - b. Do not install damaged components.
 - c. Fit joints to produce hairline joints free of burrs and distortion.
 - d. Rigidly secure nonmoving joints.
 - e. Install anchors with separators and isolators to prevent metal corrosion, electrolytic deterioration, and impediments to movement of joints.
 - f. Weld components in concealed locations to minimize distortion or discoloration of finish. Protect glazing surfaces from welding.
 - g. Seal joints watertight unless otherwise indicated.
- 2. Metal Protection:
 - a. Where aluminum will contact dissimilar metals, protect against galvanic action by painting contact surfaces with primer, applying sealant or tape, or installing nonconductive spacers as recommended by manufacturer for this purpose.
 - b. Where aluminum will contact concrete or masonry, protect against corrosion by painting contact surfaces with bituminous paint.
- 3. Install components to drain water passing joints, condensation occurring within framing members, and moisture migrating within structural-sealant-glazed curtain walls to exterior.
- 4. Install components plumb and true in alignment with established lines and grades.
- 5. Install operable units level and plumb, securely anchored, and without distortion. Adjust weather-stripping contact and hardware movement to produce proper operation.
- 6. Install glazing as specified in Division 08 Section "Glazing". Prepare surfaces that will contact structural sealant according to sealant manufacturer's written instructions to ensure compatibility and adhesion. Preparation includes, but is not limited to, cleaning and priming surfaces.
- 7. Install weatherseal sealant according to Division 07 Section "Joint Sealants" and according to sealant manufacturer's written instructions to produce weatherproof joints. Install joint filler behind sealant as recommended by sealant manufacturer.

B. Erection Tolerances

- 1. Erection Tolerances: Install to comply with the following nonaccumulating maximum tolerances:
 - a. Plumb: **1/8 inch in 10 feet (3 mm in 3 m); 1/4 inch in 40 feet (6 mm in 12 m).**
 - b. Level: **1/8 inch in 20 feet (3 mm in 6 m); 1/4 inch in 40 feet (6 mm in 12 m).**
 - c. Alignment:
 - 1) Where surfaces abut in line or are separated by reveal or protruding element up to **1/2 inch (12.7 mm)** wide, limit offset from true alignment to **1/16 inch (1.6 mm).**
 - 2) Where surfaces are separated by reveal or protruding element from **1/2 to 1 inch (12.7 to 25.4 mm)** wide, limit offset from true alignment to **1/8 inch (3.2 mm).**
 - 3) Where surfaces are separated by reveal or protruding element of **1 inch (25.4 mm)** wide or more, limit offset from true alignment to **1/4 inch (6 mm).**
 - d. Location: Limit variation from plane to **1/8 inch in 12 feet (3 mm in 3.7 m); 1/2 inch (12.7 mm)** over total length.

C. Field Quality Control

1. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
2. Testing Services: Testing and inspecting of representative areas of structural-sealant-glazed curtain walls shall take place as installation proceeds to determine compliance of installed assemblies with specified requirements.
 - a. Structural-Sealant Adhesion: Test structural sealant according to recommendations in ASTM C 1401, Destructive Test Method A, "Hand Pull Tab (Destructive)," Appendix X2.
 - 1) Test a minimum of two **OR** four **OR** six, **as directed**, areas on each building facade.
 - 2) Repair installation areas damaged by testing.
 - b. Air Infiltration: Areas shall be tested for air leakage of 1.5 times the rate specified for laboratory testing in "Performance Requirements" Article, but not more than **0.50 cfm/sq. ft. (2.25 L/s per sq. m)**, of fixed wall area when tested according to ASTM E 783 at a minimum static-air-pressure differential of **1.57 lbf/sq. ft. (75 Pa) OR 6.24 lbf/sq. ft. (300 Pa), as directed**.
 - 1) Test Area: One bay wide, but not less than **30 feet (9.1 m)**, by one story of structural-sealant-glazed curtain wall.
 - 2) Perform a minimum of two **OR** three, **as directed**, tests in areas as directed by the Owner.
OR
Perform tests in each test area as directed by the Owner. Perform at least three tests, prior to 10, 35, and 70 percent completion.
 - c. Water Penetration: Areas shall be tested according to ASTM E 1105 at a minimum uniform and cyclic static-air-pressure differential of 0.67 times the static-air-pressure differential specified for laboratory testing in "Performance Requirements" Article, but not less than **6.24 lbf/sq. ft. (300 Pa)**, and shall not evidence water penetration.
 - 1) Test Area: One bay wide, but not less than **30 feet (9.1 m)**, by one story of structural-sealant-glazed curtain wall.
 - 2) Perform a minimum of two **OR** three, **as directed**, tests in areas as directed by the Owner.
OR
Perform tests in each test area as directed by the Owner. Perform at least three tests, prior to 10, 35, and 70 percent completion.
 - d. Water Spray Test: Before installation of interior finishes has begun, areas designated by the Owner shall be tested according to AAMA 501.2 and shall not evidence water penetration.
 - 1) Test Area: A minimum area of **75 feet (23 m)** by one story of structural-sealant-glazed curtain wall.
3. Structural-sealant-glazed curtain walls will be considered defective if they do not pass tests and inspections.
4. Prepare test and inspection reports.

END OF SECTION 08 44 13 00a

SECTION 08 44 13 00b - SLOPED GLAZING ASSEMBLIES

1.1 GENERAL

A. Description Of Work

1. This specification covers the furnishing and installation of material for sloped glazing systems. Products shall be as follows or as directed by the Owner. Installation procedures shall be in accordance with the products manufacturer's recommendations. Demolition and removal of materials shall be as required to support the work.

B. Summary

1. Section Includes:
 - a. Conventionally glazed sloped glazing assemblies.
 - b. Two-sided, structural-sealant-glazed sloped glazing assemblies.
 - c. Four-sided, structural-sealant-glazed sloped glazing assemblies.

C. Performance Requirements

1. General Performance: Sloped glazing assemblies shall withstand movements of supporting structure (where applicable) without failure due to defective manufacture, fabrication, installation, or other defects in construction.
 - a. Sloped Glazing Assemblies: Comply with performance requirements specified, as determined by testing manufacturer's standard assemblies representing those indicated for this Project.
 - b. Failures also include, but are not limited to, the following:
 - 1) Thermal stresses transferring to building structure.
 - 2) Glass breakage.
 - 3) Noise or vibration created by wind and thermal and structural movements.
 - 4) Loosening or weakening of fasteners, attachments, and other components.
 - 5) Failure of operating units.
 - 6) Glazing-to-glazing contact.
2. Delegated Design: Design sloped glazing assemblies, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.
3. Structural Performance: Sloped glazing assemblies shall withstand the wind loads, the effects of gravity loads, and loads and stresses within limits and under conditions indicated according to ASCE/SEI 7.
 - a. Wind Loads: As indicated on Drawings **OR as directed**.
 - 1) Basic Wind Speed: **85 mph (38 m/s) OR 90 mph (40 m/s) OR 100 mph (44 m/s) OR 110 mph (49 m/s), as directed.**
 - 2) Exposure Category: **A OR B OR C OR D, as directed.**
 - b. Snow Loads: As indicated on Drawings **OR as directed**.
 - c. Concentrated Live Loads: As indicated on Drawings **OR as directed**, applied to framing members at locations that will produce greatest stress or deflection.
 - d. Uniform Live Loads: As indicated on Drawings **OR as directed**.
 - e. Load Combinations: Calculate according to requirements of applicable code indicated on Drawings **OR as directed**.
 - f. Blast Loads: As indicated on Drawings **OR as directed**.
 - g. Periodic Maintenance-Equipment Loads: As indicated on Drawings **OR as directed**.
4. Structural Performance: Provide sloped glazing assemblies tested according to ASTM E 330, as follows:
 - a. When tested at positive and negative wind-load design pressures, assemblies do not evidence deflection exceeding specified limits.

- b. When tested at 150 percent of positive and negative wind-load design pressures, assemblies, including anchorage, do not evidence material failures, structural distress, and permanent deformation of main framing members exceeding 0.2 percent of span.
 - c. Test Durations: As required by design wind velocity, but not less than 10 seconds.
- 5. Deflection of Framing Members: At design wind pressure, as follows:
 - a. Deflection Normal to Glazing Plane: Limited to edge of glass in a direction perpendicular to glass plane not exceeding $L/175$ of the glass edge length for each individual glazing lite **OR** $1/175$ of clear span for spans up to **13 feet 6 inches (4.1 m)** and to $1/240$ of clear span plus **1/4 inch (6.35 mm)** for spans more than **13 feet 6 inches (4.1 m)**, **as directed**, or an amount that restricts edge deflection of individual glazing lites to **3/4 inch (19.1 mm)**, whichever is less.
 - b. Deflection Parallel to Glazing Plane: Limited to $L/360$ of clear span or **1/8 inch (3.2 mm)**, whichever is smaller **OR** amount not exceeding that which reduces glazing bite to less than 75 percent of design dimension and that which reduces edge clearance between framing members and glazing or other fixed components to less than **1/8 inch (3.2 mm)**, **as directed**.
- 6. Flexural Members: Design for lateral bracing of compression flanges by cross members with minimum depth equal to 50 percent of braced flexural member. Glazing does not provide lateral support.
- 7. Windborne-Debris-Impact-Resistance Performance: Pass missile-impact and cyclic-pressure tests when tested according to ASTM E 1886 and testing information in ASTM E 1996 for Wind Zone 1 **OR** Zone 2 **OR** Zone 3 **OR** Zone 4, **as directed**.
 - a. Large-Missile Test: For glazed openings located within **30 feet (9.1 m)** of grade.
 - b. Small-Missile Test: For glazed openings located more than **30 feet (9.1 m)** above grade.
- 8. Seismic Performance: Sloped glazing assemblies shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.
 - a. Component Importance Factor is 1.5 **OR** 1.0, **as directed**.
- 9. Story Drift: Accommodate design displacement of adjacent stories indicated.
 - a. Design Displacement: As indicated on Drawings **OR as directed**.
 - b. Test Performance: Meet criteria for passing based on building occupancy type when tested according to AAMA 501.4 at design displacement and 1.5 times the design displacement.
- 10. Water Penetration under Static Pressure: No evidence of water penetration through fixed glazing and framing areas when tested according to ASTM E 331 at a minimum static-air-pressure differential of 20 percent of positive wind-load design pressure, but not less than **6.24 lbf/sq. ft. (300 Pa) OR 10 lbf/sq. ft. (480 Pa) OR 15 lbf/sq. ft. (720 Pa)**, **as directed**.
- 11. Water Penetration under Dynamic Pressure: No evidence of water penetration through fixed glazing and framing areas when tested according to AAMA 501.1 at dynamic pressure equal to 20 percent of positive wind-load design pressure, but not less than **6.24 lbf/sq. ft. (300 Pa) OR 10 lbf/sq. ft. (480 Pa) OR 15 lbf/sq. ft. (720 Pa)**, **as directed**.
 - a. Maximum Water Leakage: According to AAMA 501.1 **OR** No uncontrolled water penetrating assemblies or water appearing on assemblies' normally exposed interior surfaces from sources other than condensation, **as directed**. Water leakage does not include water controlled by flashing and gutters that is drained to exterior.
- 12. Thermal Movements: Allow for thermal movements from the following maximum change (range) in ambient and surface temperature:
 - a. Temperature Change (Range): **120 deg F (67 deg C)**, ambient; **180 deg F (100 deg C)**, material surfaces.
 - b. Test Interior Ambient-Air Temperature: **75 deg F (24 deg C)**.
 - c. Test Performance: No buckling, stress on glass, sealant failure, or excess stress on framing, anchors, and fasteners and no reduction of performance when tested according to AAMA 501.5.
- 13. Energy Performance: Sloped glazing assemblies shall have certified and labeled energy-performance ratings according to the NFRC.

- a. Thermal Transmittance (U-Factor): Fixed glazing and framing areas shall have U-factor of not more than 0.45 Btu/sq. ft. x h x deg F (2.55 W/sq. m x K) OR 0.57 Btu/sq. ft. x h x deg F (3.23 W/sq. m x K) OR 0.69 Btu/sq. ft. x h x deg F (3.92 W/sq. m x K), as directed, as determined according to NFRC 100.
- b. Solar Heat-Gain Coefficient: Fixed glazing and framing areas shall have an SHGC of not more than 0.35 OR 0.40 OR 0.45, as directed, as determined according to NFRC 200.
- c. Air Infiltration: Maximum air leakage through fixed glazing and framing areas of 0.30 cfm/sq. ft. (1.50 L/s per sq. m) of fixed area as determined according to ASTM E 283 at a minimum static-air-pressure differential of 1.57 lbf/sq. ft. (75 Pa) OR 6.24 lbf/sq. ft. (300 Pa), as directed.
- d. Condensation Resistance: Fixed glazing and framing areas shall have an NFRC-certified CR rating of not less than 15 OR 25 OR 35 OR 45, as directed, as determined according to NFRC 500.
14. Sound Transmission: Fixed glazing and framing areas shall have the following characteristics:
 - a. Outdoor-Indoor Transmission Class: Minimum 26 OR 30 OR 34, as directed, when tested for laboratory sound transmission loss according to ASTM E 90 and determined by ASTM E 1332.
15. Structural Sealant: Capable of withstanding tensile and shear stresses imposed by structural-sealant glazing without failing adhesively or cohesively. When tested for preconstruction adhesion and compatibility, cohesive failure of sealant shall occur before adhesive failure.
 - a. Adhesive failure occurs when sealant pulls away from substrate cleanly, leaving no sealant material behind.
 - b. Cohesive failure occurs when sealant breaks or tears within itself but does not separate from each substrate because sealant-to-substrate bond strength exceeds sealant's internal strength.
16. Structural-Sealant Joints:
 - a. Designed to carry gravity loads of glazing.
 - b. Designed to produce tensile or shear stress of less than 20 psi (138 kPa).
 - c. Design reviewed and approved by structural-sealant manufacturer.
- D. Submittals
 1. Product Data: For each type of product indicated.
 2. LEED Submittal:
 - a. Product Data for Credit EQ 4.1: For glazing sealants used inside the weatherproofing system, including printed statement of VOC content.
 3. Shop Drawings: For sloped glazing assemblies. Include plans, elevations, sections, details, and attachments to other work.
 - a. Include details of provisions for assembly expansion and contraction and for draining moisture within the assembly to the exterior.
 - b. Include full-size isometric details of each vertical-to-horizontal intersection of assembly, showing the following:
 - 1) Joinery including concealed welds.
 - 2) Anchorage.
 - 3) Expansion provisions.
 - 4) Glazing.
 - 5) Flashing and drainage.
 4. Samples: For each type of exposed finish required.
 5. Delegated-Design Submittal: For sloped glazing assemblies indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
 6. Qualification Data: For qualified Installer and testing agency.
 7. Seismic Qualification Certificates: For sloped glazing assemblies, accessories, and components, from manufacturer.
 - a. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
 8. Welding certificates.

9. Product test reports.
10. Preconstruction sealant test reports.
11. Quality-Control Program: Developed specifically for Project, including fabrication and installation, according to recommendations in ASTM C 1401. Include periodic quality-control reports.
12. Source quality-control reports.
13. Field quality-control reports.
14. Maintenance data.
15. Warranties: Sample of special warranties.

E. Quality Assurance

1. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for installation of units required for this Project.
2. Testing Agency Qualifications: Qualified according to ASTM E 699 for testing indicated.
3. Product Options: Information on Drawings and in Specifications establishes requirements for aesthetic effects and performance characteristics of assemblies. Aesthetic effects are indicated by dimensions, arrangements, alignment, and profiles of components and assemblies as they relate to sightlines, to one another, and to adjoining construction.
4. Structural-Sealant Glazing: Comply with ASTM C 1401 for design and installation.
5. Welding Qualifications: Qualify procedures and personnel according to the following:
 - a. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
 - b. AWS D1.2/D1.2M, "Structural Welding Code - Aluminum."
6. NFRC Certification: Provide NFRC-certified and -labeled sloped glazing assemblies.
7. Preinstallation Conference: Conduct conference at Project site.

F. Warranty

1. Special Assembly Warranty: Standard form in which manufacturer **OR** Installer, **as directed**, agrees to repair or replace components of sloped glazing assemblies that do not comply with requirements or that fail in materials or workmanship within Two **OR** Five **OR** 10, **as directed**, years from date of Final Completion.
2. Special Finish Warranty: Standard form in which manufacturer agrees to repair finishes or replace aluminum that shows evidence of deterioration of factory-applied finishes within Five **OR** 10 **OR** 20, **as directed**, years from date of Final Completion.

1.2 PRODUCTS

A. Materials

1. Aluminum: Alloy and temper recommended by manufacturer for type of use and finish indicated.
 - a. Sheet and Plate: **ASTM B 209 (ASTM B 209M)**.
 - b. Extruded Bars, Rods, Profiles, and Tubes: **ASTM B 221 (ASTM B 221M)**.
 - c. Extruded Structural Pipe and Tubes: ASTM B 429.
 - d. Structural Profiles: ASTM B 308/B 308M.
 - e. Welding Rods and Bare Electrodes: AWS A5.10/A5.10M.
2. Steel Reinforcement: With manufacturer's standard, zinc-rich, corrosion-resistant primer, complying with SSPC-PS Guide No. 12.00; applied immediately after surface preparation and pretreatment. Select surface preparation methods according to recommendations in SSPC-SP COM and prepare surfaces according to applicable SSPC standard.
 - a. Structural Shapes, Plates, and Bars: ASTM A 36/A 36M.
 - b. Cold-Rolled Sheet and Strip: ASTM A 1008/A 1008M.
 - c. Hot-Rolled Sheet and Strip: ASTM A 1011/A 1011M.

B. Framing

1. Framing Members: Manufacturer's standard, formed- or extruded-aluminum framing members of thickness required and reinforced as required to support imposed loads.

- a. Framing-Member Type: Self-supporting **OR** Skin type, supported by structural-steel members indicated, **as directed**.
 - b. Glass Retention: Field-installed pressure caps on four sides **OR** Field-installed structural sealant at horizontal members (purlins) and pressure caps at rafters **OR** Factory-installed structural sealant on four sides, **as directed**.
 2. Pressure Caps: Manufacturer's standard aluminum components that mechanically retain glazing.
 - a. Include snap-on aluminum trim that conceals fasteners.
 3. Brackets and Reinforcements: Manufacturer's standard high-strength aluminum with nonstaining, nonferrous shims for aligning assembly components.
 4. Fasteners and Accessories: Manufacturer's standard, corrosion-resistant, nonstaining, nonbleeding fasteners and accessories compatible with adjacent materials.
 - a. At pressure caps, use ASTM A 193/A 193M stainless-steel screws.
 - b. Use self-locking devices where fasteners are subject to loosening or turning out from thermal and structural movements, wind loads, or vibration.
 - c. Reinforce members as required to receive fastener threads.
 - d. Use exposed fasteners with countersunk Phillips screw heads, finished to match framing system **OR** fabricated from Series 300 stainless steel, **as directed**.
 5. Anchors: Three-way adjustable anchors, with minimum adjustment of **1 inch (25 mm)**, that accommodate fabrication and installation tolerances in material and finish compatible with adjoining materials, and recommended by manufacturer.
 - a. Concrete and Masonry Inserts: Hot-dip galvanized cast-iron, malleable-iron, or steel inserts complying with requirements in ASTM A 123/A 123M or ASTM A 153/A 153M.
 6. Anchor Bolts: **ASTM A 307, Grade A (ASTM F 568M, Property Class 4.6)**, galvanized steel.
 7. Concealed Flashing: Manufacturer's standard, corrosion-resistant, nonstaining, nonbleeding flashing compatible with adjacent materials **OR** Dead-soft, **0.018-inch- (0.457-mm-)** thick stainless steel, ASTM A 240/A 240M; of type recommended by manufacturer, **as directed**.
 8. Exposed Flashing and Closures: Manufacturer's standard aluminum components not less than **0.040 inch (1.016 mm) OR 0.060 inch (1.524 mm)**, **as directed**, thick.
 9. Framing Sealants: Manufacturer's standard.
- C. Glazing
1. General: Comply with Division 08 Section "Glazing".
 2. Glazing Gaskets: Manufacturer's standard resilient elastomeric glazing gaskets, setting blocks, and shims or spacers **OR** As specified in Division 08 Section "Glazing", **as directed**.
 3. Glazing Sealants: As recommended by manufacturer **OR** Comply with Division 08 Section "Glazing", **as directed**.
 - a. Provide sealants for use inside the weatherproofing system that have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 4. Glazing Sealants: For structural-sealant glazing, as recommended by manufacturer for joint type, and as follows:
 - a. Structural Sealant: ASTM C 1184, chemically curing silicone formulation that is compatible with system components with which it comes in contact, specifically formulated and tested for use as structural sealant, and approved by structural-sealant manufacturer for use in sloped glazing assemblies indicated.
 - 1) Provide sealants for use inside the weatherproofing system that have a VOC content of 100 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 - 2) Color: Black **OR** Gray **OR** As selected from manufacturer's full range of colors, **as directed**.
 - b. Weatherseal Sealant: ASTM C 920, Type S, Grade NS, Class 25, Uses NT, G, A, and O; chemically curing silicone formulation that is compatible with structural sealant and other system components with which it comes in contact; recommended by structural-sealant, weatherseal-sealant, and sloped glazing assembly manufacturers for this use.
 - 1) Provide sealants for use inside the weatherproofing system that have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

- 2) Color: Matching structural sealant.
 5. Bond-Breaker Tape: Manufacturer's standard TFE-fluorocarbon or polyethylene material to which sealants will not develop adhesion.
- D. Accessory Materials
1. Bituminous Paint: Cold-applied, asphalt-mastic paint complying with SSPC-Paint 33 requirements except containing no asbestos, formulated for **30-mil (0.76-mm)** thickness per coat.
 2. Cleaning Agent and Cloth: As recommended by structural-sealant manufacturer.
- E. Fabrication
1. Form or extrude aluminum shapes before finishing.
 2. Weld in concealed locations to greatest extent possible to minimize distortion or discoloration of finish. Remove weld spatter and welding oxides from exposed surfaces by descaling or grinding.
 3. Fabricate components that, when assembled, have the following characteristics:
 - a. Profiles that are sharp, straight, and free of defects or deformations.
 - b. Accurately fitted joints with ends coped or mitered.
 - c. Physical and thermal isolation of glazing from framing members.
 - d. Accommodations for thermal and mechanical movements of glazing and framing to maintain required glazing edge clearances.
 - e. Fasteners, anchors, and connection devices that are concealed from view to greatest extent possible.
 - f. Components curved to indicated radii.
 - g. Internal guttering systems or other means to drain water passing joints, condensation occurring within framing members, and moisture migrating within the system to exterior.
 4. Fabricate continuous, one-piece-type aluminum sill closures with weep holes.
 5. Four-Sided, Structural-Sealant-Glazed Frame Units:
 - a. Prepare surfaces that will contact structural sealant according to sealant manufacturer's written instructions to ensure compatibility and adhesion.
 - b. Preparation includes, but is not limited to, cleaning and priming surfaces.
 - c. Seal joints watertight unless otherwise indicated.
 - d. Factory install glazing to comply with requirements in Division 08 Section "Glazing".
 6. After fabrication, clearly mark components to identify their locations in Project according to Shop Drawings.
- F. Aluminum Finishes
1. Clear Anodic Finish: AAMA 611, AA-M12C22A41, Class I, 0.018 mm **OR** AA-M12C22A31, Class II, 0.010 mm, **as directed**, or thicker.
 2. Color Anodic Finish: AAMA 611, AA-M12C22A42/A44, Class I, 0.018 mm **OR** AA-M12C22A32/A34, Class II, 0.010 mm, **as directed**, or thicker.
 - a. Color: Light bronze **OR** Medium bronze **OR** Dark bronze **OR** Champagne **OR** Black **OR** Match sample **OR** As selected from full range of industry colors and color densities, **as directed**.
 3. Baked-Enamel or Powder-Coat Finish: AAMA 2603 except with a minimum dry film thickness of **1.5 mils (0.04 mm)**. Comply with coating manufacturer's written instructions for cleaning, conversion coating, and applying and baking finish.
 - a. Color and Gloss: As selected from manufacturer's full range, **as directed**.
 4. High-Performance Organic Finish:
 - a. Two-coat fluoropolymer finish complying with AAMA 2604 **OR** AAMA 2605, **as directed**, and containing not less than 50 **OR** 70, **as directed**, percent PVDF resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
OR
Three-coat **OR** Four-coat, **as directed**, fluoropolymer finish complying with AAMA 2605 and containing not less than 50 **OR** 70, **as directed**, percent PVDF resin by weight in both

color coat and clear topcoat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.

OR

Two-coat fluoropolymer finish complying with AAMA 2604 and containing 100 percent FEVE resin in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.

- b. Color and Gloss: As selected from manufacturer's full range.

G. Source Quality Control

- 1. Four-Sided, Structural-Sealant Glazing: Perform quality-control procedures complying with recommendations in ASTM C 1401 including, but not limited to, assembly material qualification procedures, sealant testing, and assembly fabrication reviews and checks.

1.3 EXECUTION

A. Installation

- 1. General:
 - a. Comply with manufacturer's written instructions.
 - b. Do not install damaged components.
 - c. Fit joints to produce hairline joints free of burrs and distortion.
 - d. Rigidly secure nonmovement joints.
 - e. Install anchors with separators and isolators to prevent metal corrosion, electrolytic deterioration, and impediments to movement of joints.
 - f. Weld components in concealed locations to minimize distortion or discoloration of finish. Protect glazing surfaces from welding.
 - g. Seal joints watertight unless otherwise indicated.
- 2. Metal Protection:
 - a. Where aluminum will contact dissimilar metals, protect against galvanic action by painting contact surfaces with primer, applying sealant or tape, or installing nonconductive spacers as recommended by manufacturer for this purpose.
 - b. Where aluminum will contact concrete or masonry, protect against corrosion by painting contact surfaces with bituminous paint.
 - c. Where aluminum will contact pressure-treated wood, separate dissimilar materials by method recommended by sloped glazing assembly manufacturer.
- 3. Install continuous sill closure with weatherproof expansion joints and locked and sealed or welded corners. Locate weep holes at rafters.
- 4. Install components to drain water passing joints, condensation occurring within framing members, and moisture migrating within the sloped glazing assembly to exterior.
- 5. Install components plumb and true in alignment with established lines and grades.
- 6. Install glazing as specified in Division 08 Section "Glazing".
 - a. Two-Sided, Structural-Sealant Glazing:
 - 1) Prepare surfaces that will contact structural sealant according to sealant manufacturer's written instructions to ensure compatibility and adhesion. Preparation includes, but is not limited to, cleaning and priming surfaces.
 - 2) Install weatherseal sealant according to Division 08 Section "Glazing" and according to sealant manufacturer's written instructions to produce weatherproof joints. Install joint filler behind sealant as recommended by sealant manufacturer.

B. Erection Tolerances

- 1. General: Install sloped glazing assemblies to comply with the following maximum tolerances:
 - a. Level: **1/8 inch in 20 feet (3 mm in 6 m); 1/4 inch in 40 feet (6 mm in 12 m).**
 - b. Alignment: Limit offset from true alignment to **1/32 inch (0.8 mm)** where surfaces abut in line, edge to edge, at corners, or where a reveal or protruding element separates aligned surfaces by less than **3 inches (76 mm)**; otherwise limit offset to **1/8 inch (3 mm).**

- c. Location and Plane: Limit variation from true location and plane to **1/8 inch in 12 feet (3 mm in 3.7 m)**; **1/2 inch (13 mm)** over total length.

C. Field Quality Control

1. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
2. Testing Services: Testing and inspecting of representative areas of sloped glazing assemblies shall take place as installation proceeds to determine compliance of installed assemblies with specified requirements.
 - a. Structural-Sealant Adhesion: Test structural sealant according to recommendations in ASTM C 1401, Destructive Test Method A, "Hand Pull Tab (Destructive)," Appendix X2.
 - 1) Test a minimum of two **OR** four **OR** six, **as directed**, areas on each assembly face.
 - 2) Repair installation areas damaged by testing.
 - b. Air Infiltration: Areas shall be tested for air leakage of 1.5 times the rate specified for laboratory testing in "Performance Requirements" Article, but not more than **0.50 cfm/sq. ft. (2.25 L/s per sq. m)**, of assembly surface area when tested according to ASTM E 783 at a minimum static-air-pressure differential of **1.57 lbf/sq. ft. (75 Pa) OR 6.24 lbf/sq. ft. (300 Pa), as directed**.
 - 1) Test Area: One bay wide, but not less than **30 by 30 feet (9.1 by 9.1 m)** of sloped glazing assembly.
 - 2) Perform a minimum of two **OR** three, **as directed**, tests in areas as directed by the Owner.
OR
Perform tests in each test area as directed by the Owner. Perform at least three tests prior to 10, 35, and 70 percent completion.
 - c. Water Penetration: Areas shall be tested according to ASTM E 1105 at a minimum uniform and cyclic static-air-pressure difference of 0.67 times the static-air-pressure difference specified for laboratory testing in "Performance Requirements" Article, but not less than **6.24 lbf/sq. ft. (300 Pa)**, and shall not evidence water penetration.
 - 1) Test Area: One bay wide, but not less than **30 by 30 feet (9.1 by 9.1 m)** of sloped glazing assembly.
 - 2) Perform a minimum of two **OR** three tests in areas as directed by the Owner.
OR
Perform tests in each test area as directed by the Owner. Perform at least three tests prior to 10, 35, and 70 percent completion.
 - d. Water-Spray Test: Before installation of interior finishes has begun, areas designated by the Owner shall be tested according to AAMA 501.2 and shall not evidence water penetration.
 - 1) Test Area: A minimum area of **30 by 30 feet (9.1 by 9.1 m)** of sloped glazing assembly.
3. Sloped glazing assemblies will be considered defective if they do not pass tests and inspections.
4. Prepare test and inspection reports.

END OF SECTION 08 44 13 00b

SECTION 08 45 23 00 - UNIT SKYLIGHTS

1.1 GENERAL

A. Description Of Work:

1. This specification covers the furnishing and installation of materials for unit skylights. Products shall be as follows or as directed by the Owner. Installation procedures shall be in accordance with the product manufacturer's recommendations. Demolition and removal of materials shall be as required to support the work.

B. Summary

1. Section Includes:
 - a. Self-flashing unit skylights with integral curb.
 - b. Unit skylights mounted on prefabricated **OR** site-built, **as directed**, curbs.

C. Performance Requirements

1. AAMA/WDMA Performance Requirements: Provide unit skylights of performance class and grade indicated that comply with AAMA/WDMA 101/I.S.2/NAFS unless more stringent performance requirements are indicated.
 - a. Performance Class and Grade:
 - 1) SKG-R15/15-1200x1200 **OR** SKP-R15/15-1200x1200, **as directed**.
 - 2) SKG-C30/30-1200x1200 **OR** SKP-C30/30-1200x1200, **as directed**.
 - 3) SKG-HC40/40-1200x2500 **OR** SKP-HC40/40-1200x2500, **as directed**.
 - 4) As indicated.
2. Windborne-Debris-Impact-Resistance Performance: Provide unit skylights that pass missile-impact and cyclic-pressure tests when tested according to ASTM E 1886 and testing information in ASTM E 1996 **OR** AAMA 506, **as directed**.
 - a. Large-Missile Impact: For unit skylights located within **30 feet (9.1 m)** of grade.
 - b. Small-Missile Impact: For unit skylights located more than **30 feet (9.1 m)** above grade.

D. Submittals

1. Product Data: For each type of unit skylight indicated.
2. Shop Drawings: For unit skylight work. Include plans, elevations, sections, details, and connections to supporting structure and other adjoining work.
 - a. Unit Skylight Operating System: Show locations, mounting, and details for installing operator components and controls.
 - b. Unit Skylight Operating System: Show locations and details for installing operator components, switches, and controls. Indicate motor size, electrical characteristics, drive arrangement, mounting, and grounding provisions.
 - c. Wiring Diagrams: For power, signal, and control wiring for electric motors of operable unit skylights.
3. Samples: For each type of exposed finish required, in a representative section of each unit skylight in manufacturer's standard size.
4. Qualification Data.
5. Product Test Reports.
6. Field quality-control reports.
7. Maintenance Data: For unit skylights and unit skylight operating system to include in maintenance manuals.
8. Warranty: Sample of special warranty.

E. Quality Assurance

1. Manufacturer Qualifications: A manufacturer capable of fabricating unit skylights that meet or exceed performance requirements indicated and of documenting this performance by inclusion in lists and by labels, test reports, and calculations.

2. Installer Qualifications: An installer acceptable to unit skylight manufacturer for installation of units required for this Project.
3. Surface-Burning Characteristics of Plastic Glazing: Provide plastic glazing sheets identical to those tested for fire-exposure behavior per test method indicated below by a testing and inspecting agency acceptable to authorities having jurisdiction. Identify materials with appropriate markings of applicable testing and inspecting agency.
 - a. Self-Ignition Temperature: **650 deg F (343 deg C)** or more for plastic sheets in thickness indicated when tested per ASTM D 1929.
 - b. Smoke-Production Characteristics: Comply with either requirement below:
 - 1) Smoke-Developed Index: 450 or less when tested per ASTM E 84 on plastic sheets in manner indicated for use.
 - 2) Smoke Density: 75 or less when tested per ASTM D 2843 on plastic sheets in thickness indicated for use.
 - c. Burning Characteristics: Tested per ASTM D 635.
 - 1) Acrylic Glazing: Class CC2, burning rate of **2-1/2 inches (64 mm)** per minute or less for nominal thickness of **0.060 inch (1.5 mm)** or thickness indicated for use.
 - 2) Polycarbonate Glazing: Class CC1, burning extent of **1 inch (25 mm)** or less for nominal thickness of **0.060 inch (1.5 mm)** or thickness indicated for use.
 - 3) Polycarbonate-Insulating-Panel Glazing: Class CC2, burning rate of **2-1/2 inches (64 mm)** per minute or less for nominal thickness of **0.060 inch (1.5 mm)** or thickness indicated for use.
4. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
5. Unit Skylight Standard: Comply with AAMA/WDMA 101/I.S.2/NAFS, "North American Fenestration Standard Voluntary Performance Specification for Windows, Skylights and Glass Doors," for minimum standards of performance, materials, components, accessories, and fabrication. Comply with more stringent requirements if indicated.
 - a. Provide AAMA-certified unit skylights with an attached label.
6. Preinstallation Conference: Conduct conference at Project site.

F. Warranty

1. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of unit skylights that fail in materials or workmanship within five years from date of Final Completion.

1.2 PRODUCTS

A. Materials

1. Aluminum Components:
 - a. Sheets: **ASTM B 209 (ASTM B 209M)**, alloy and temper to suit forming operations and finish requirements but with not less than the strength and durability of alclad Alloy 3005-H25.
 - b. Extruded Shapes: **ASTM B 221 (ASTM B 221M)**, alloy and temper to suit structural and finish requirements but with not less than the strength and durability of Alloy 6063-T52.
2. Fasteners: Same metal as metal being fastened, nonmagnetic stainless steel, or other noncorrosive metal as recommended by manufacturer. Finish exposed fasteners to match material being fastened.
 - a. Where removal of exterior exposed fasteners might allow access to building, provide nonremovable fastener heads.

B. Glazing

1. Acrylic Glazing: ASTM D 4802, thermoformable, monolithic sheet, category as standard with manufacturer, Finish 1 (smooth or polished), Type UVF (formulated with UV absorber).
 - a. Single-Glazing Profile: Dome, 25 percent rise **OR** Pyramid, 30-degree slope, **as directed**.

- 1) Thickness: As indicated **OR** Not less than thickness required to exceed performance requirements, **as directed**.
 - 2) Color: Colorless, transparent **OR** White, translucent **OR** Bronze-tinted, transparent **OR** Gray-tinted, transparent, **as directed**.
 - b. Double-Glazing Profile: Dome, 25 percent rise **OR** Pyramid, 30-degree slope, **as directed**.
 - 1) Thicknesses: As indicated **OR** Not less than thicknesses required to exceed performance requirements, **as directed**.
 - 2) Outer Glazing Color: Colorless, transparent **OR** White, translucent **OR** Bronze-tinted, transparent **OR** Gray-tinted, transparent, **as directed**.
 - 3) Inner Glazing Color: Colorless, transparent **OR** White, translucent **OR** Bronze-tinted, transparent **OR** Gray-tinted, transparent, **as directed**.
 2. Polycarbonate Glazing: Thermoformable, extruded monolithic sheets, UV resistant, burglar-resistance rated per UL 972, and with average impact strength of **12 to 16 ft-lb/in.** (**640 to 854 J/m**) of width when tested per ASTM D 256, Test Method A (Izod).
 - a. Single-Glazing Profile: Dome, 25 percent rise **OR** Pyramid, 30-degree slope, **as directed**.
 - 1) Thickness: As indicated **OR** Not less than thickness required to exceed performance requirements, **as directed**.
 - 2) Color: As indicated by manufacturer's designations **OR** As selected from full range of industry colors, **as directed**.
 - b. Double-Glazing Profile: Dome, 25 percent rise **OR** Pyramid, 30-degree slope, **as directed**.
 - 1) Thicknesses: As indicated **OR** Not less than thicknesses required to exceed performance requirements, **as directed**.
 - 2) Inner Glazing Color: As indicated by manufacturer's designations **OR** As selected from full range of industry colors, **as directed**.
 - 3) Outer Glazing Color: As indicated by manufacturer's designations **OR** As selected from full range of industry colors, **as directed**.
 3. Insulating Glass: Clear, sealed units that comply with Division 08 Section "Glazing", in manufacturer's standard overall thickness.
 - a. Exterior Lite: **1/4-inch (6-mm)** clear **OR** tinted, **as directed**, heat-strengthened **OR** fully tempered, **as directed**, glass.
 - b. Interior Lite:
 - 1) Laminated glass; 2 plies of **1/8-inch (3-mm)** clear heat-strengthened glass with **0.030-inch (0.762-mm)** clear polyvinyl butyral interlayer.
 - 2) **1/4-inch (6-mm)** clear **OR** tinted, **as directed**, heat-strengthened **OR** fully tempered **OR** wire, **as directed**, glass.
 - c. Interspace Content: Air **OR** Argon, **as directed**.
 - d. Low-Emissivity Coating: Manufacturer's standard.
 4. Polycarbonate-Insulating-Panel Glazing: Manufacturer's standard polycarbonate sheet with cellular cross section that provides isolated airspaces and that is coextruded with a UV-protective layer.
 - a. Thickness: As indicated **OR** Not less than thickness required to exceed performance requirements, **as directed**.
 - b. Color: As indicated by manufacturer's designations **OR** As selected from full range of industry colors, **as directed**.
 5. Fiberglass-Sandwich-Panel Glazing: Manufacturer's standard with uniformly colored, translucent, fiberglass-reinforced-polymer face sheets permanently adhered to a grid core.
 - a. Thickness: As indicated **OR** Not less than thickness required to exceed performance requirements, **as directed**.
 - b. Color: As indicated by manufacturer's designations **OR** As selected from full range of industry colors, **as directed**.
 6. Glazing Gaskets: Manufacturer's standard **OR** EPDM, neoprene, partially vulcanized butyl tape, or liquid-applied elastomeric sealant, **as directed**.
- C. Installation Materials
1. Bituminous Coating: SSPC-Paint 12, solvent-type, bituminous mastic, nominally free of sulfur and containing no asbestos fibers, formulated for **15-mil (0.4-mm)** dry film thickness per coating.

2. Joint Sealants: As specified in Division 07 Section "Joint Sealants".
3. Mastic Sealant: Polyisobutylene; nonhardening, nonskinning, nondrying, nonmigrating sealant.
4. Roofing Cement: ASTM D 4586, asbestos free, designed for trowel application or other adhesive compatible with roofing system.

D. Unit Skylights

1. General: Provide factory-assembled unit skylights that include glazing, extruded-aluminum glazing retainers, gaskets, and inner frames and that are capable of withstanding performance requirements indicated.
2. Integral Curb: Extruded-aluminum **OR** Vinyl **OR** Reinforced-thermoset-fiberglass profile, **as directed**, self-flashing type.
 - a. Height: As indicated **OR** 8 inches (200 mm) **OR** 9 inches (225 mm) **OR** 12 inches (300 mm), **as directed**.
 - b. Construction: Single **OR** Double, **as directed**, wall.
 - c. Insulation: Manufacturer's standard rigid or semirigid type.
3. Prefabricated Curb: As specified in Division 07 Section "Roof Accessories".
4. Site-Built Curb: As indicated.
5. Unit Shape and Size: As indicated **OR** Square, 40-by-40-inch (1016-by-1016-mm) inside curb **OR** Rectangular, 40-by-48-inch (1016-by-1220-mm) inside curb **OR** Circular, 40-inch- (1016-mm-) diameter inside curb, **as directed**.
6. Condensation Control: Fabricate unit skylights with integral internal gutters and non-clogging weeps to collect and drain condensation to the exterior.
7. Thermal Break: Fabricate unit skylights with thermal barrier separating exterior and interior metal framing.
8. Operable Unit Skylight System: Equip vent-type unit skylights with manufacturer's standard hinges, chain-driven operating hardware, and weather-sealing gaskets.
 - a. Manual Operator: Manufacturer's standard, rotary-crank extension device.
 - 1) Pole Operator: Manual, 60 inches (1524 mm) long **OR** Manual, telescoping to 144 inches (3658 mm) **OR** Rechargeable-motor power-driven type, telescoping to 144 inches (3658 mm), **as directed**.
 - b. Motor Operator: Manufacturer's standard electronic control, including switch, transformer, low-voltage motor, cover, and mounting hardware.
 - 1) Provide motor of size and capacity recommended by unit skylight manufacturer to suit unit skylight indicated.
 - 2) Provide rain sensor that automatically closes venting unit when water is detected.
 - 3) Provide motor operator with portable remote-control device.
9. Security Grilles: 1/2-inch- (13-mm-) diameter, hardened steel bars spaced not more than 5 inches (130 mm) o.c. in 1 direction and 16 inches (400 mm) o.c. in other direction **OR** 5 inches (130 mm) o.c. in both directions, **as directed**.
10. Protective Screens: Manufacturer's standard to protect interior glazing lite from breakage **OR** personnel from falls **OR** against windborne debris **OR** against hail, **as directed**.

E. General Finish Requirements

1. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
2. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

F. Aluminum Finishes

1. Mill Finish: Manufacturer's standard.
2. Clear Anodic Finish: AAMA 611, AA-M12C22A41, Class I, 0.018 mm **OR** AA-M12C22A31, Class II, 0.010 mm, **as directed**, or thicker.
3. Color Anodic Finish: AAMA 611, AA-M12C22A42/A44, Class I, 0.018 mm **OR** AA-M12C22A32/A34, Class II, 0.010 mm, **as directed**, or thicker.

- a. Color: As selected from full range of industry colors and color densities.
4. Baked-Enamel or Powder-Coat Finish: AAMA 2603 except with a minimum dry film thickness of **1.5 mils (0.04 mm)**. Comply with coating manufacturer's written instructions for cleaning, conversion coating, and applying and baking finish.
 - a. Color and Gloss: As indicated by manufacturer's designations **OR** As selected from manufacturer's full range, **as directed**.
5. High-Performance Organic Finish: 2-coat fluoropolymer finish complying with AAMA 2604 **OR** AAMA 2605, **as directed**, and containing not less than 50 **OR** 70, **as directed**, percent PVDF resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
 - a. Color and Gloss: As indicated by manufacturer's designations **OR** As selected from manufacturer's full range, **as directed**.
6. High-Performance Organic Finish: 3 **OR** 4, **as directed**, -coat fluoropolymer finish complying with AAMA 2605 and containing not less than 50 **OR** 70, **as directed**, percent PVDF resin by weight in both color coat and clear topcoat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
 - a. Color and Gloss: As indicated by manufacturer's designations **OR** As selected from manufacturer's full range, **as directed**.

1.3 EXECUTION

A. Installation

1. Coordinate installation of unit skylight with installation of substrates, vapor retarders, roof insulation, roofing membrane, and flashing as required to ensure that each element of the Work performs properly and that combined elements are waterproof and weathertight.
2. Comply with recommendations in AAMA 1607 and with manufacturer's written instructions for installing unit skylights.
3. Install unit skylights level, plumb, and true to line, without distortion.
4. Anchor unit skylights securely to supporting substrates.
5. Where metal surfaces of unit skylights will contact incompatible metal or corrosive substrates, including preservative-treated wood, apply bituminous coating on concealed metal surfaces, or provide other permanent separation recommended in writing by unit skylight manufacturer.
6. Set unit skylight flanges in thick bed of roofing cement to form a seal unless otherwise indicated.
7. Where cap flashing is indicated, install to produce waterproof overlap with roofing or roof flashing. Seal with thick bead of mastic sealant except where overlap is indicated to be left open for ventilation.

B. Field Quality Control

1. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
2. After completion of installation and nominal curing of sealant and glazing compounds but before installation of interior finishes, test for water leaks according to AAMA 501.2.
3. Perform test for total area of each unit skylight.
4. Work will be considered defective if it does not pass tests and inspections.
5. Additional testing and inspections, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

C. Cleaning

1. Clean exposed unit skylight surfaces according to manufacturer's written instructions. Touch up damaged metal coatings and finishes.
2. Remove excess sealants, glazing materials, dirt, and other substances.
3. Remove and replace glazing that has been broken, chipped, cracked, abraded, or damaged during construction period.
4. Protect unit skylight surfaces from contact with contaminating substances resulting from construction operations.



5. Unit Skylight Operating System: Clean and lubricate joints and hardware. Adjust for proper operation.

END OF SECTION 08 45 23 00

NOT FOR BID

SECTION 08 45 23 00a - METAL-FRAMED SKYLIGHTS

1.1 GENERAL

A. Description Of Work

1. This specification covers the furnishing and installation of material for metal-framed skylights. Products shall be as follows or as directed by the Owner. Installation procedures shall be in accordance with the products manufacturer's recommendations. Demolition and removal of materials shall be as required to support the work.

B. Summary

1. This Section includes aluminum-framed skylights with the following characteristics:
 - a. Glazing is glass **OR** plastic, **as directed**.
 - b. Glazing is retained by field-installed pressure caps on four sides **OR** field-installed structural sealant at horizontal members (purlins) and pressure caps at rafters **OR** factory-installed structural sealant on four sides, **as directed**.

C. Performance Requirements

1. Provide metal-framed skylights, including anchorage, capable of withstanding, without failure, the effects of the following:
 - a. Structural loads.
 - b. Thermal movements.
 - c. Movements of supporting structure.
 - d. Dimensional tolerances of building frame and other adjacent construction.
2. Failure includes the following:
 - a. Deflection exceeding specified limits.
 - b. Water leakage.
 - c. Thermal stresses transferred to building structure.
 - d. Noise or vibration created by wind and thermal and structural movements.
 - e. Framing members transferring stresses, including those caused by thermal and structural movements, to glazing.
 - f. Loosening or weakening of fasteners, attachments, and other components.
 - g. Sealant failure.
3. Structural Loads:
 - a. Wind Loads: As indicated by structural design data on Drawings **OR as directed**.
 - b. Snow Loads: As indicated by structural design data on Drawings **OR as directed**.
 - c. Concentrated Live Loads: **250 lbf (1112 N)** applied to framing members at locations that will produce greatest stress or deflection.
 - d. Seismic Loads: As indicated by earthquake design data on Drawings **OR as directed**.
 - e. Load Combinations: Calculate according to requirements of applicable code indicated on Drawings **OR as directed**.
4. Deflection of Framing Members:
 - a. Deflection Normal to Glazing Plane:
 - 1) Spans Up to **20 Feet (6 m)**: Limited to 1/175 **OR** 1/180, **as directed**, of clear span or **1 inch (25.4 mm)**, whichever is smaller.
 - 2) Spans Exceeding **20 Feet (6 m)**: Limited to 1/240 of clear span.
 - 3) Glass Edge Deflection: Limit edge deflection of individual glass lites to **3/4 inch (19 mm)**.
 - b. Deflection Parallel to Glazing Plane: Limited to 1/360 of clear span or **1/8 inch (3.2 mm)**, whichever is smaller **OR** amount not exceeding that which reduces glazing bite to less than 75 percent of design dimension and that which reduces edge clearance between framing members and glazing or other fixed components to less than **1/8 inch (3.2 mm)**, **as directed**.

5. Lateral Bracing of Framing Members: Compression flanges of flexural members are laterally braced by cross members with minimum depth equal to 50 percent of flexural member that is braced. Glazing does not provide lateral support.
 6. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes. Base engineering calculation on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.
 - a. Temperature Change (Range): 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.
 7. Structural-Sealant Glazing:
 - a. Structural Sealant: Capable of withstanding tensile and shear stresses imposed by metal-framed skylight assemblies without failing adhesively or cohesively. Sealant fails cohesively before sealant releases from substrate when tested for adhesive compatibility with each substrate and joint condition required.
 - 1) Adhesive failure occurs when sealant pulls away from substrate cleanly, leaving no sealant material behind.
 - 2) Cohesive failure occurs when sealant breaks or tears within itself but does not separate from each substrate because sealant-to-substrate bond strength exceeds sealant's internal strength.
 - b. Structural-Sealant Joints: Designed to produce tensile or shear stress in structural-sealant joints of less than 20 psi (138 kPa).
 - 1) Structural-sealant joints do not carry gravity loads of glazing.
- D. Performance Testing
1. Provide metal-framed skylights that comply with test-performance requirements indicated, as evidenced by reports of tests performed on manufacturer's standard assemblies by a qualified independent testing agency.
 2. Structural-Performance Test: ASTM E 330.
 - a. Performance at Design Load: When tested at positive and negative wind-load design pressures, assemblies do not evidence deflection exceeding specified limits.
 - b. Performance at Maximum Test Load: When tested at 150 percent of positive and negative wind-load design pressures, assemblies, including anchorage, do not evidence material failures, structural distress, and permanent deformation of main supporting members exceeding 0.2 percent of span.
 - c. Test Durations: As required by design wind velocity but not less than 10 seconds.
 3. Air-Infiltration Test: ASTM E 283.
 - a. Minimum Static-Air-Pressure Difference: 1.57 lbf/sq. ft. (75 Pa) which is equivalent to a 25-mph (40-km/h) wind **OR** 6.24 lbf/sq. ft. (300 Pa) which is equivalent to a 50-mph (80-km/h) wind, **as directed**.
 - b. Maximum Air Leakage: 0.06 cfm/sq. ft. (0.30 L/s per sq. m).
 4. Test for Water Penetration under Static Pressure: ASTM E 331.
 - a. Minimum Static-Air-Pressure Difference: 20 percent of positive wind-load design pressure, but not less than 6.24 lbf/sq. ft. (300 Pa).
 - b. Water Leakage: None.
 5. Test for Water Penetration under Dynamic Pressure: AAMA 501.1.
 - a. Dynamic Pressure: 20 percent of positive wind-load design pressure, but not less than 12 lbf/sq. ft. (574 Pa).
 - b. Water Leakage: None, as defined by AAMA 501.1 **OR** No uncontrolled water penetrating systems or appearing on systems' normally exposed interior surfaces from sources other than condensation, **as directed**. Water controlled by flashing and gutters that is drained to exterior and cannot damage adjacent materials or finishes is not considered water leakage.
- E. Submittals
1. Product Data: For each type of product indicated.
 2. LEED Submittal:

- a. Product Data for Credit EQ 4.1: For sealants used inside of the weatherproofing system, including printed statement of VOC content.
 3. Shop Drawings: For metal-framed skylights. Include plans, elevations, sections, details, and attachments to other work.
 - a. Include structural analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
 4. Samples: For each exposed finish.
 5. Compatibility Test Reports: For structural-sealant-glazed skylights, preconstruction test reports from structural- and nonstructural-sealant manufacturer indicating that materials forming joint substrates and joint-sealant backings have been tested for compatibility and adhesion with joint sealants. Include sealant manufacturer's interpretation of test results for sealant performance and written recommendations for primers and substrate preparation needed for adhesion.
 6. Field quality-control test and inspection reports.
 7. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for metal-framed skylights.
 8. Structural-Sealant-Glazing, Quality-Control Program: Developed specifically for Project.
 9. Structural-Sealant-Glazing, Quality-Control Program Reports: Documenting quality-control procedures and verifying results for metal-framed skylights.
 10. Maintenance Data: For metal-framed skylights to include in maintenance manuals.
 11. Warranties: Special warranties specified in this Section.
- F. Quality Assurance
 1. Installer Qualifications: Entity capable of assuming engineering responsibility and performing work of this Section and who is acceptable to manufacturer.
 2. Compatibility Testing: For structural-sealant-glazed skylights, perform structural- and nonstructural-sealant manufacturer's standard preconstruction tests for compatibility and adhesion of sealants with each material that will come in contact with sealants and each condition required by metal-framed skylights.
 3. Welding: Qualify procedures and personnel according to AWS D1.2, "Structural Welding Code - Aluminum."
 4. Structural-Sealant Glazing: Comply with recommendations in ASTM C 1401, "Guide for Structural Sealant Glazing," for joint design and quality-control procedures.
 - a. Joint designs are reviewed and approved by structural-sealant manufacturer.
 5. Preinstallation Conference: Conduct conference at Project site.
- G. Warranty
 1. Special Assembly Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of metal-framed skylights that fail in materials or workmanship within specified warranty period.
 - a. Failures include, but are not limited to, the following:
 - 1) Structural failures including, but not limited to, excessive deflection.
 - 2) Noise or vibration caused by thermal movements.
 - 3) Deterioration of metals, metal finishes, and other materials beyond normal weathering.
 - 4) Adhesive or cohesive sealant failures.
 - 5) Water leakage.
 - b. Warranty Period: Two **OR** Five **OR** 10, **as directed**, years from date of Final Completion.
 2. Special Finish Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components on which finishes fail within specified warranty period. Warranty does not include normal weathering.
 - a. Failures include, but are not limited to, checking, crazing, peeling, chalking, and fading of finishes.
 - b. Warranty Period: Five **OR** 10 **OR** 20, **as directed**, years from date of Final Completion.

1.2 PRODUCTS

A. Framing Systems

1. Aluminum: Alloy and temper recommended in writing by manufacturer for type of use and finish indicated.
 - a. Sheet and Plate: **ASTM B 209 (ASTM B 209M)**.
 - b. Extruded Bars, Rods, Profiles, and Tubes: **ASTM B 221 (ASTM B 221M)**.
 - c. Extruded Structural Pipe and Tubes: ASTM B 429.
2. Pressure Caps: Manufacturer's standard aluminum components that mechanically retain glazing.
 - a. Include snap-on aluminum trim that conceals fasteners.
3. Brackets and Reinforcements: Manufacturer's standard high-strength aluminum with nonstaining, nonferrous shims for aligning skylight components.
4. Anchors, Fasteners, and Accessories: Manufacturer's standard, corrosion-resistant, nonstaining, and nonbleeding; compatible with adjacent materials.
 - a. At pressure caps, use ASTM A 193/A 193M, 300 series stainless-steel screws.
 - b. Where fasteners are subject to loosening or turning out from thermal and structural movements, wind loads, or vibration, use self-locking devices.
 - c. Exposed Fasteners:
 - 1) Use exposed fasteners with countersunk Phillips screw heads.
 - d. Finish exposed portions to match framing system.
 - e. At movement joints, use slip-joint linings, spacers, and sleeves of material and type recommended in writing by manufacturer.
5. Concrete and Masonry Inserts: Hot-dip galvanized cast-iron, malleable-iron, or steel inserts complying with ASTM A 123/A 123M or ASTM A 153/A 153M requirements.
6. Anchor Bolts: **ASTM A 307, Grade A (ASTM F 568M, Property Class 4.6)**, hot-dip zinc coating, ASTM A 153/A 153M, Class C **OR** mechanically deposited zinc coating, ASTM B 695, Class 50, **as directed**.
7. Concealed Flashing: Manufacturer's standard, corrosion-resistant, nonstaining, nonbleeding flashing compatible with adjacent materials **OR** Dead-soft, **0.018-inch- (0.457-mm-)** thick stainless steel, ASTM A 240/A 240M of type recommended in writing by manufacturer, **as directed**.
8. Exposed Flashing and Closures: Manufacturer's standard aluminum components not less than **0.030 inch (0.762 mm) OR 0.040 inch (1.016 mm) OR 0.060 inch (1.524 mm)**, **as directed**, thick.
9. Framing Gaskets: Manufacturer's standard.
10. Framing Sealants: As recommended in writing by manufacturer **OR** specified in Division 07 Section "Joint Sealants", **as directed**.
 - a. Provide sealants for use inside of the weatherproofing system that have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

B. Glazing Systems

1. Glazing: As specified in Division 08 Section(s) "Glazing" OR "Plastic Glazing", **as directed**.
2. Spacers, Setting Blocks, and Gaskets: Manufacturer's standard elastomeric types **OR** As specified in Division 08 Section "Glazing", **as directed**.
3. Bond-Breaker Tape: Manufacturer's standard tetrafluoroethylene-fluorocarbon or polyethylene material to which sealants will not develop adhesion.
4. Glazing Sealants: As recommended in writing by manufacturer **OR** specified in Division 07 Section "Joint Sealants", **as directed**.
 - a. Provide sealants for use inside of the weatherproofing system that have a VOC content as indicated when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 - b. Structural Sealant: ASTM C 1184, neutral-curing silicone formulation compatible with system components with which it comes in contact, specifically formulated and tested for use as structural sealant, and approved by structural-sealant manufacturer for use in metal-framed skylights indicated.
 - 1) VOC Content: 100 g/L or less.
 - 2) Color: Black **OR** As selected from manufacturer's full range, **as directed**.

- c. Weatherseal Sealant: ASTM C 920 for Type S, Grade NS, Class 25, Uses NT, G, A, and O; neutral-curing silicone formulation compatible with structural sealant and other components with which it comes in contact; and recommended in writing by structural- and weatherseal-sealant and metal-framed skylight manufacturers for this use.
 - 1) VOC Content: 250 g/L or less.
 - 2) Color: Matching structural sealant.
- C. Accessory Materials
 - 1. Insulating Materials: Specified in Division 07 Section "Thermal Insulation".
 - 2. Bituminous Paint: Cold-applied asphalt-mastic paint complying with SSPC-Paint 12 requirements except containing no asbestos, formulated for **30-mil (0.762-mm)** thickness per coat.
- D. Fabrication
 - 1. Fabricate aluminum components before finishing.
 - 2. Fabricate aluminum components that, when assembled, have the following characteristics:
 - a. Profiles that are sharp, straight, and free of defects or deformations.
 - b. Accurately fitted joints with ends coped or mitered.
 - c. Internal guttering systems or other means to drain water passing joints, condensation occurring within framing members, and moisture migrating within skylight to exterior.
 - d. Physical and thermal isolation of glazing from framing members.
 - e. Accommodations for thermal and mechanical movements of glazing and framing to maintain required glazing edge clearances.
 - 3. Fabricate aluminum sill closures with weep holes and for installation as continuous component.
 - 4. Reinforce aluminum components as required to receive fastener threads.
 - 5. Weld aluminum components in concealed locations to greatest extent possible to minimize distortion or discoloration of finish. Remove weld spatter and welding oxides from exposed surfaces by descaling or grinding.
 - 6. Factory-Glazed Units:
 - a. Factory install glazing to comply with requirements in Division 08 Section(s) "Glazing" OR "Plastic Glazing", **as directed**.
 - b. Prepare surfaces that will contact structural sealant according to structural-sealant manufacturer's written instructions to ensure compatibility and adhesion. Preparation includes, but is not limited to, cleaning and priming surfaces.
 - 7. After fabrication, clearly mark components to identify their locations in Project according to Shop Drawings.
- E. Aluminum Finishes
 - 1. General: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
 - 2. Finish designations prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.
 - 3. Class II, Clear Anodic Finish: AA-M12C22A31 (Mechanical Finish: nonspecular as fabricated; Chemical Finish: etched, medium matte; Anodic Coating: Architectural Class II, clear coating 0.010 mm or thicker) complying with AAMA 611.
 - 4. Class I, Clear Anodic Finish: AA-M12C22A41 (Mechanical Finish: nonspecular as fabricated; Chemical Finish: etched, medium matte; Anodic Coating: Architectural Class I, clear coating 0.018 mm or thicker) complying with AAMA 611.
 - 5. Class I, Color Anodic Finish: AA-M12C22A42/A44 (Mechanical Finish: nonspecular as fabricated; Chemical Finish: etched, medium matte; Anodic Coating: Architectural Class I, integrally colored or electrolytically deposited color coating 0.018 mm or thicker) complying with AAMA 611.
 - a. Color: Light bronze **OR** Medium bronze **OR** Dark bronze **OR** Black **OR** Match sample **OR** As selected from full range of industry colors and color densities, **as directed**.
 - 6. High-Performance Organic Finish (2-Coat Fluoropolymer): AA-C12C40R1x (Chemical Finish: cleaned with inhibited chemicals; Chemical Finish: conversion coating; Organic Coating: manufacturer's standard 2-coat, thermocured system consisting of specially formulated inhibitive

primer and fluoropolymer color topcoat containing not less than 70 percent polyvinylidene fluoride resin by weight). Prepare, pretreat, and apply coating to exposed metal surfaces to comply with AAMA 2604 **OR** AAMA 2605, **as directed**, and with coating and resin manufacturers' written instructions.

7. High-Performance Organic Finish (3-Coat Fluoropolymer): AA-C12C40R1x (Chemical Finish: cleaned with inhibited chemicals; Chemical Finish: conversion coating; Organic Coating: manufacturer's standard 3-coat, thermocured system consisting of specially formulated inhibitive primer, fluoropolymer color coat, and clear fluoropolymer topcoat, with both color coat and clear topcoat containing not less than 70 percent polyvinylidene fluoride resin by weight). Prepare, pretreat, and apply coating to exposed metal surfaces to comply with AAMA 2605 and with coating and resin manufacturers' written instructions.
 - a. Color and Gloss: As selected from manufacturer's full range.

F. Source Quality Control

1. Structural-Sealant Glazing: Perform quality-control procedures complying with ASTM C 1401 recommendations including, but not limited to, material qualification procedures, sealant testing, and fabrication reviews and checks.

1.3 EXECUTION

A. Installation

1. General:
 - a. Comply with manufacturer's written instructions.
 - b. Do not install damaged components.
 - c. Fit joints between aluminum components to produce hairline joints free of burrs and distortion.
 - d. Rigidly secure nonmovement joints.
 - e. Install anchors with separators and isolators to prevent metal corrosion and electrolytic deterioration and to prevent impeding movement of moving joints.
 - f. Weld components in concealed locations to minimize distortion or discoloration of finish. Protect glazing surfaces from welding.
 - g. Seal joints watertight, unless otherwise indicated.
2. Metal Protection: Where aluminum will contact dissimilar materials, protect against galvanic action by painting contact surfaces with bituminous paint or by installing nonconductive spacers as recommended in writing by manufacturer for this purpose.
3. Install continuous aluminum sill closure with weatherproof expansion joints and locked and sealed or welded corners. Locate weep holes at rafters.
4. Install components to drain water passing joints, condensation occurring within framing members, and moisture migrating within skylight to exterior.
5. Install components plumb and true in alignment with established lines and elevations.
6. Install glazing as specified in Division 08 Section(s) "Glazing" **OR** "Plastic Glazing", **as directed**.
 - a. Structural-Sealant Glazing:
 - 1) Prepare surfaces that will contact structural sealant according to structural-sealant manufacturer's written instructions to ensure compatibility and adhesion. Preparation includes, but is not limited to, cleaning and priming surfaces.
 - 2) Install weatherseal sealant according to Division 07 Section "Joint Sealants" and according to weatherseal-sealant manufacturer's written instructions to produce weatherproof joints. Install joint filler behind weatherseal sealant as recommended in writing by weatherseal-sealant manufacturer.
7. Install insulation materials as specified in Division 07 Section "Thermal Insulation".
8. Erection Tolerances: Install metal-framed skylights to comply with the following maximum tolerances:

- a. Alignment: Limit offset from true alignment to **1/32 inch (0.8 mm)** where surfaces abut in line, edge to edge, at corners, or where a reveal or protruding element separates aligned surfaces by less than **3 inches (76 mm)**; otherwise, limit offset to **1/8 inch (3.2 mm)**.
 - b. Location and Plane: Limit variation from true location and plane to **1/8 inch in 12 feet (3.2 mm in 3.7 m)** but no greater than **1/2 inch (13 mm)** over total length.
- B. Field Quality Control
- a. Structural-Sealant Compatibility and Adhesion: Structural sealant shall be tested according to recommendations in ASTM C 1401.
 - 1) Destructive test method, Method A, Hand Pull Tab (Destructive) in ASTM C 1401, Appendix X2, shall be used.
 - a) A minimum of one **OR** two, **as directed**, area(s) on each skylight face shall be tested.
 - b) Repair installation areas damaged by testing.
 - b. Structural-Sealant Glazing Inspection: After installation of metal-framed skylights is complete, structural-sealant glazing shall be inspected and evaluated according to ASTM C 1401 recommendations for quality-control procedures.
 - c. Water Penetration under Static Pressure: Before installation of interior finishes has begun, areas shall be tested according to ASTM E 1105.
 - 1) Test Procedures: Test under uniform and cyclic static air pressure.
 - 2) Water Penetration: None.
 - d. Water-Spray Test: Before installation of interior finishes has begun, skylights shall be tested according to AAMA 501.2 and shall not evidence water penetration.
- 2. Repair or remove work where test results and inspections indicate that it does not comply with specified requirements.
 - 3. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

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SECTION 08 45 23 00b - STRUCTURED-POLYCARBONATE-PANEL ASSEMBLIES

1.1 GENERAL

A. Description Of Work

1. This specification covers the furnishing and installation of material for structured-polycarbonate-panel assemblies. Products shall be as follows or as directed by the Owner. Installation procedures shall be in accordance with the products manufacturer's recommendations. Demolition and removal of materials shall be as required to support the work.

B. Summary

1. This Section includes aluminum-framed assemblies glazed with multiwalled (structured) polycarbonate panels as follows:
 - a. Wall assemblies.
 - b. Roof (sloped, overhead) assemblies.
 - c. Skylight assemblies.

C. Performance Requirements

1. Provide assemblies, including anchorage, capable of withstanding, without failure, the effects of the following:
 - a. Structural loads.
 - b. Thermal movements.
 - c. Movements of supporting structure.
 - d. Dimensional tolerances of building frame and other adjacent construction.
2. Failure includes the following:
 - a. Deflection exceeding specified limits.
 - b. Water leakage.
 - c. Thermal stresses transferred to building structure.
 - d. Noise or vibration created by wind and thermal and structural movements.
 - e. Loosening or weakening of fasteners, attachments, and other components.

D. Structural Loads:

- a. Wind Loads: As indicated by structural design data on Drawings **OR as directed**.
 - b. Snow Loads: As indicated by structural design data on Drawings **OR as directed**.
 - c. Concentrated Live Loads on Overhead Assemblies: **300 lbf (1334 N)** applied to assemblies at locations that will produce greatest stress or deflection.
 - d. Seismic Loads: As indicated by earthquake design data on Drawings **OR as directed**.
 - e. Load Combinations: Calculate according to requirements of applicable code indicated on Drawings **OR as directed**.
2. Deflection of Assemblies:
 - a. Vertical Assemblies: Limited to 1/100 of clear span for each assembly component.
 - b. Overhead Assemblies: Limited to 1/100 **OR** 1/180, **as directed**, of clear span for each assembly component.
 3. Roof Assemblies: Class A **OR B OR C, as directed**, per ASTM E 108 or UL 790.
 4. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes. Base engineering calculation on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.
 - a. Temperature Change (Range): **120 deg F (67 deg C)**, ambient; **180 deg F (100 deg C)**, material surfaces.

E. Performance Testing

1. Provide assemblies that comply with test-performance requirements indicated, as evidenced by reports of tests performed on manufacturer's standard assemblies by a qualified independent testing agency.

2. Structural-Performance Test: ASTM E 330.
 - a. Performance at Design Load: When tested at positive and negative wind-load design pressures, assemblies do not evidence deflection exceeding specified limits.
 - b. Performance at Maximum Test Load: When tested at 150 percent of positive and negative wind-load design pressures, assemblies, including anchorage, do not evidence material failures, structural distress, and permanent deformation of main supporting members exceeding 0.2 percent of span.
 - c. Test Durations: As required by design wind velocity but not less than 10 seconds.
3. Air-Infiltration Test: ASTM E 283.
 - a. Minimum Static-Air-Pressure Difference: 1.57 lbf/sq. ft. (75 Pa) OR 6.24 lbf/sq. ft. (300 Pa), as directed.
 - b. Maximum Air Leakage: 0.06 cfm/sq. ft. (0.30 L/s per sq. m).
4. Test for Water Penetration under Static Pressure: ASTM E 331.
 - a. Minimum Static-Air-Pressure Difference: 20 percent of positive wind-load design pressure, but not less than 15 lbf/sq. ft. (718 Pa).
 - b. Water Leakage: None.
5. Test for Water Penetration under Dynamic Pressure: AAMA 501.1.
 - a. Dynamic Pressure: 20 percent of positive wind-load design pressure, but not less than 15 lbf/sq. ft. (718 Pa).
 - b. Water Leakage: None, as defined by AAMA 501.1 OR No uncontrolled water penetrating systems or appearing on systems' normally exposed interior surfaces from sources other than condensation, as directed. Water controlled by flashing and gutters that is drained to exterior and cannot damage adjacent materials or finishes is not considered water leakage.

F. Submittals

1. Product Data: For each type of product indicated.
2. LEED Submittal:
 - a. Product Data for Credit EQ 4.1: For sealants used inside of the weatherproofing system, documentation including printed statement of VOC content.
3. Shop Drawings: For assemblies. Include plans, elevations, sections, details, and attachments to other work.
 - a. Include structural analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
4. Samples: For each exposed finish.
5. Field quality-control test reports.
6. Product test reports.
7. Maintenance data.
8. Special warranties specified in this Section.

G. Quality Assurance

1. Installer Qualifications: Entity capable of assuming engineering responsibility and performing work of this Section and who is acceptable to manufacturer.
2. Fire-Test-Response Characteristics: Where fire-test-response characteristics are indicated for assemblies and components, provide products identical to those tested per test method indicated by an independent testing and inspecting agency acceptable to authorities having jurisdiction.
3. Welding: Qualify procedures and personnel according to AWS D1.2, "Structural Welding Code - Aluminum."
4. Preinstallation Conference: Conduct conference at Project site.

H. Warranty

1. Special Assembly Warranty: Manufacturer's standard form in which manufacturer and Installer agree to repair or replace components of assemblies that fail in materials or workmanship within specified warranty period.
 - a. Failures include, but are not limited to, the following:
 - 1) Structural failures including, but not limited to, excessive deflection.

- 2) Deterioration of metals, metal finishes, and other materials beyond normal weathering.
- 3) Water leakage.
- b. Warranty Period: Two **OR** Five, **as directed**, years from date of Final Completion.
2. Special Structured-Polycarbonate-Panel Warranty: Manufacturer's standard form agreeing to replace polycarbonate sheet that breaks or develops defects from normal use that are attributed to manufacturing process and not to practices for maintaining and cleaning products contrary to manufacturer's written instructions.
 - a. Defects include, but are not limited to, the following:
 - 1) Delamination.
 - 2) Color changes from original in excess of 3.0 units Delta E when measured per ASTM D 2244.
 - 3) Losses in light transmission beyond 6 percent from original when measured per ASTM D 1003.
 - b. Warranty Period: 10 years from date of Final Completion.
3. Special Aluminum-Finish Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components on which finishes fail within specified warranty period. Warranty does not include normal weathering.
 - a. Failures include, but are not limited to, checking, crazing, peeling, chalking, and fading of finishes.
 - b. Warranty Period: Five **OR** 10 **OR** 20, **as directed**, years from date of Final Completion.

1.2 PRODUCTS

A. Aluminum Framing Systems

1. Aluminum: Alloy and temper recommended in writing by manufacturer for type of use and finish indicated.
 - a. Sheet and Plate: **ASTM B 209 (ASTM B 209M)**.
 - b. Extruded Bars, Rods, Profiles, and Tubes: **ASTM B 221 (ASTM B 221M)**.
 - c. Extruded Structural Pipe and Tubes: ASTM B 429.
2. Components: Manufacturer's standard extruded-aluminum members of thickness required and reinforced as required to support imposed loads.
 - a. Construction: One-piece extruded-aluminum components **OR** Thermally broken; framing members are composite assemblies of two separate extruded-aluminum components permanently bonded by a material of low thermal conductance, **as directed**.
3. Exposed Flashing and Closures: Manufacturer's standard aluminum components not less than **0.040 inch (1.016 mm) OR 0.060 inch (1.524 mm)**, **as directed**, thick.
4. Framing Gaskets: Manufacturer's standard.
5. Framing Sealants: As recommended in writing by manufacturer **OR** specified in Division 07 Section "Joint Sealants", **as directed**.
 - a. Provide sealants for use inside of the weatherproofing system that have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
6. Anchors, Fasteners, and Accessories: Manufacturer's standard, corrosion-resistant, nonstaining, and nonbleeding; compatible with adjacent materials.
 - a. At closures, retaining caps, or battens, use ASTM A 193/A 193M, 300 series stainless-steel screws.
 - b. Where fasteners are subject to loosening or turning out from thermal and structural movements, wind loads, or vibration, use self-locking devices.
 - c. At movement joints, use slip-joint linings, spacers, and sleeves of material and type recommended in writing by manufacturer.
7. Concrete and Masonry Inserts: Hot-dip galvanized cast-iron, malleable-iron, or steel inserts complying with ASTM A 123/A 123M or ASTM A 153/A 153M requirements.
8. Anchor Bolts: **ASTM A 307, Grade A (ASTM F 568M, Property Class 4.6)**, hot-dip zinc coating, ASTM A 153/A 153M, Class C **OR** mechanically deposited zinc coating, ASTM B 695, Class 50, **as directed**.

9. Framing System Fabrication:

- a. Fabricate components before finishing.
- b. Fabricate components that, when assembled, have the following characteristics:
 - 1) Profiles that are sharp, straight, and free of defects or deformations.
 - 2) Accurately fitted joints with ends coped or mitered.
 - 3) Internal guttering systems or other means to drain water passing joints, condensation occurring within components, and moisture migrating within assembly to exterior.
- c. Fabricate sill closures with weep holes and for installation as continuous component.
- d. Reinforce components as required to receive fastener threads.
- e. Weld components in concealed locations to greatest extent possible to minimize distortion or discoloration of finish. Remove weld spatter and welding oxides from exposed surfaces by descaling or grinding.

B. Structured Polycarbonate Panels

1. General: Translucent, extruded-polycarbonate sheet with cellular cross section that provides isolated airspaces and that is coextruded with a UV-protective layer.
 - a. Plastic Self-Ignition Temperature: **650 deg F (343 deg C)** or more per ASTM D 1929.
 - b. Burning Extent: **1 inch (25 mm)** or less per ASTM D 635.
 - c. Burning Rate: **2.5 in./min. (1.06 mm/s)** or less per ASTM D 635.
 - d. Smoke-Developed Index: 450 or less per ASTM E 84, or 75 or less per ASTM D 2843.
 - e. Flame-Spread Index: Not more than 25 per ASTM E 84.
 - f. Exterior-Fire-Exposure Class: Class A **OR B OR C, as directed**, per ASTM E 108 or UL 790.
2. Panel U-Factor: Not more than **0.73 (4.15) OR 0.63 (3.58) OR 0.48 (2.73) OR 0.38 (2.16) OR 0.24 (1.36) OR 0.22 (1.25)**, **as directed**, measured in **Btu/sq. ft. x h x deg F (W/sq. m x K)** according to ASTM C 1363 and using procedures described in ASTM C 1199 and ASTM E 1423.
3. Color Stability: Not more than 3.0 units Delta E when measured according to ASTM D 2244 after outdoor weathering according to procedures in ASTM D 1435.
 - a. Outdoor Weathering Conditions: 60 months in Arizona or 120 months in a moderate North American climate.
4. Impact Resistance: No failure at impact of **200 ft. x lbf (271 J)** according to free-falling-ball impact test using a **3-1/2-inch- (89-mm-) diameter, 6.3-lb (2.9-kg) ball**.

C. Accessory Materials

1. Insulating Materials: Specified in Division 07 Section "Thermal Insulation".
2. Bituminous Paint: Cold-applied asphalt-mastic paint complying with SSPC-Paint 12 requirements except containing no asbestos, formulated for **30-mil (0.762-mm)** thickness per coat.

D. Aluminum Finishes

1. General: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
2. Finish designations prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.
3. Aluminum Anodic Finish: Class I, clear anodic coating complying with AAMA 611 **OR** Class I, color anodic coating complying with AAMA 611, **as directed**.
 - a. Color: Light bronze **OR** Medium bronze **OR** Dark bronze **OR** Black **OR** Match sample **OR** As selected from full range of industry colors and densities, **as directed**.
4. Aluminum High-Performance Organic Finish: Two-coat **OR** Three-coat, **as directed**, thermocured system with fluoropolymer topcoats containing not less than 70 percent polyvinylidene fluoride resin by weight; complying with AAMA 2604 **OR** AAMA 2605, **as directed**.
 - a. Color and Gloss: As selected from manufacturer's full range.

1.3 EXECUTION

A. Installation

1. General:
 - a. Comply with manufacturer's written instructions.
 - b. Do not install damaged components.
 - c. Fit joints between aluminum components to produce hairline joints free of burrs and distortion.
 - d. Rigidly secure nonmovement joints.
 - e. Install anchors with separators and isolators to prevent metal corrosion and electrolytic deterioration and to prevent impeding movement of moving joints.
 - f. Weld aluminum components in concealed locations to minimize distortion or discoloration of finish. Protect glazing surfaces from welding.
 - g. Seal joints watertight, unless otherwise indicated.
2. Metal Protection: Where aluminum components will contact dissimilar materials, protect against galvanic action by painting contact surfaces with bituminous paint or by installing nonconductive spacers as recommended in writing by manufacturer for this purpose.
3. Install continuous aluminum sill closures with weatherproof expansion joints and locked and sealed or welded corners. Locate weep holes at rafters.
4. Install components to drain water passing joints, condensation occurring within aluminum members, and moisture migrating within assembly to exterior.
5. Install components plumb and true in alignment with established lines and elevations.
6. Install insulation materials as specified in Division 07 Section "Thermal Insulation".
7. Erection Tolerances: Install assemblies to comply with the following maximum tolerances:
 - a. Alignment: Limit offset from true alignment to **1/32 inch (0.8 mm)** where surfaces abut in line, edge to edge, at corners, or where a reveal or protruding element separates aligned surfaces by less than **3 inches (76 mm)**; otherwise, limit offset to **1/8 inch (3.2 mm)**.
 - b. Location and Plane: Limit variation from true location and plane to **1/8 inch in 12 feet (3.2 mm in 3.7 m)**; **1/2 inch (13 mm)** over total length.

B. Field Quality Control

1. Testing Agency: Engage a qualified independent testing and inspecting agency to perform field tests and inspections and prepare test reports.
2. Testing Services: Testing and inspecting of representative areas to determine compliance of installed assemblies with specified requirements shall take place as follows and in successive stages as indicated on Drawings. Do not proceed with installation of the next area until test results for previously completed areas show compliance with requirements.
 - a. Water Penetration under Static Pressure: Before installation of interior finishes has begun, areas shall be tested according to ASTM E 1105.
 - 1) Test Procedures: Test under uniform and cyclic static air pressure.
 - 2) Static-Air-Pressure Difference: as directed by the Owner.
 - 3) Water Penetration: None.
 - b. Water-Spray Test: Before installation of interior finishes has begun, assemblies shall be tested according to AAMA 501.2 and shall not evidence water penetration.
3. Repair or remove work where test results and inspections indicate that it does not comply with specified requirements.
4. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

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SECTION 08 45 23 00c - FIBERGLASS-SANDWICH-PANEL ASSEMBLIES

1.1 GENERAL

A. Description Of Work

1. This specification covers the furnishing and installation of material for fiberglass-sandwich-panel assemblies. Products shall be as follows or as directed by the Owner. Installation procedures shall be in accordance with the products manufacturer's recommendations. Demolition and removal of materials shall be as required to support the work.

B. Summary

1. This Section includes assemblies incorporating fiberglass sandwich panels and aluminum frame systems as follows:
 - a. Wall assemblies.
 - b. Roof (sloped, overhead) assemblies.
 - c. Skylight assemblies.

C. Performance Requirements

1. Provide assemblies, including anchorage, capable of withstanding, without failure, the effects of the following:
 - a. Structural loads.
 - b. Thermal movements.
 - c. Movements of supporting structure.
 - d. Dimensional tolerances of building frame and other adjacent construction.
2. Failure includes the following:
 - a. Deflection exceeding specified limits.
 - b. Water leakage.
 - c. Thermal stresses transferred to building structure.
 - d. Noise or vibration created by wind and thermal and structural movements.
 - e. Loosening or weakening of fasteners, attachments, and other components.
 - f. Delamination of fiberglass-sandwich-panel faces from panel cores.
3. Structural Loads:
 - a. Wind Loads: As indicated by structural design data on Drawings **OR as directed**.
 - b. Snow Loads: As indicated by structural design data on Drawings **OR as directed**.
 - c. Concentrated Live Loads on Overhead Assemblies: **300 lbf (1334 N)** applied to assemblies at locations that will produce greatest stress or deflection.
 - d. Seismic Loads: As indicated by earthquake design data on Drawings **OR as directed**.
 - e. Load Combinations: Calculate according to requirements of applicable code indicated on Drawings **OR as directed**.
4. Deflection of Assemblies:
 - a. Vertical Assemblies: Limited to 1/60 **OR** 1/90 **OR** 1/180, **as directed**, of clear span for each assembly component.
 - b. Overhead Assemblies: Limited to 1/60 **OR** 1/90 **OR** 1/180, **as directed**, of clear span for each assembly component.
5. Roof Assemblies: Class A per ASTM E 108 or UL 790.
6. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes. Base engineering calculation on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.
 - a. Temperature Change (Range): **120 deg F (67 deg C)**, ambient; **180 deg F (100 deg C)**, material surfaces.

D. Performance Testing

1. Provide assemblies that comply with test-performance requirements indicated, as evidenced by reports of tests performed on manufacturer's standard assemblies by a qualified independent testing agency.
2. Structural-Performance Test: ASTM E 330.
 - a. Performance at Design Load: When tested at positive and negative wind-load design pressures, assemblies do not evidence deflection exceeding specified limits.
 - b. Performance at Maximum Test Load: When tested at 150 percent of positive and negative wind-load design pressures, assemblies, including anchorage, do not evidence material failures, structural distress, and permanent deformation of main supporting members exceeding 0.2 percent of span.
 - c. Test Durations: As required by design wind velocity but not less than 10 seconds.
3. Air-Infiltration Test: ASTM E 283.
 - a. Minimum Static-Air-Pressure Difference: **1.57 lbf/sq. ft. (75 Pa) OR 6.24 lbf/sq. ft. (300 Pa), as directed.**
 - b. Maximum Air Leakage: **0.06 cfm/sq. ft. (0.30 L/s per sq. m), as directed.**
4. Test for Water Penetration under Static Pressure: ASTM E 331.
 - a. Minimum Static-Air-Pressure Difference: 20 percent of positive wind-load design pressure, but not less than **10 lbf/sq. ft. (479 Pa).**
 - b. Water Leakage: None.
5. Test for Water Penetration under Dynamic Pressure: AAMA 501.1.
 - a. Dynamic Pressure: 20 percent of positive wind-load design pressure, but not less than **15 lbf/sq. ft. (718 Pa).**
 - b. Water Leakage: None, as defined by AAMA 501.1 **OR** No uncontrolled water penetrating systems or appearing on systems' normally exposed interior surfaces from sources other than condensation, **as directed.** Water controlled by flashing and gutters that is drained to exterior and cannot damage adjacent materials or finishes is not considered water leakage.
6. Water-Penetration, Wind-Driven-Rain Test: Wind-driven-rain test in ICBO ES AC07, "Special Roofing Systems."
 - a. Water Leakage: None.

E. Submittals

1. Product Data: For each type of product indicated.
2. LEED Submittal:
 - a. Product Data for Credit EQ 4.1: For sealants used inside of the weatherproofing system, documentation including printed statement of VOC content.
3. Shop Drawings: For assemblies. Include plans, elevations, sections, details, and attachments to other work.
 - a. Include structural analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
4. Field quality-control test reports.
5. Product test reports.
6. Maintenance data.
7. Special warranties specified in this Section.

F. Quality Assurance

1. Installer Qualifications: Entity capable of assuming engineering responsibility, including preparation of Shop Drawings, and performing work of this Section and who is acceptable to manufacturer.
2. Manufacturer Qualifications: For fiberglass sandwich panels, a qualified manufacturer whose facilities, processes, and products are monitored by an independent, accredited quality-control agency for compliance with applicable requirements in ICBO ES AC04, "Sandwich Panels."
3. Fire-Test-Response Characteristics: Where fire-test-response characteristics are indicated for assemblies and components, provide products identical to those tested per test method indicated by an independent testing and inspecting agency acceptable to authorities having jurisdiction.

4. Welding: Qualify procedures and personnel according to AWS D1.2, "Structural Welding Code - Aluminum."
5. NFRC Certification: Provide fiberglass sandwich panels that are certified for U-factors indicated according to NFRC 100 and listed in its "National Fenestration Council Incorporated - Certified Products Directory."
6. Preinstallation Conference: Conduct conference at Project site.

G. Warranty

1. Special Assembly Warranty: Manufacturer's standard form in which manufacturer and Installer agree to repair or replace components of assemblies that fail in materials or workmanship within specified warranty period.
 - a. Failures include, but are not limited to, the following:
 - 1) Structural failures including, but not limited to, excessive deflection.
 - 2) Deterioration of metals, metal finishes, and other materials beyond normal weathering.
 - 3) Water leakage.
 - b. Warranty Period: Two **OR** Five, **as directed**, years from date of Final Completion.
2. Special Fiberglass-Sandwich-Panel Warranty: Manufacturer's standard form in which manufacturer agrees to replace panels that exhibit defects in materials or workmanship.
 - a. Defects include, but are not limited to, the following:
 - 1) Fiberbloom.
 - 2) Delamination of coating, if any, from exterior face sheet.
 - 3) Discoloration of exterior face sheet of more than 8.0 units Delta E when measured according ASTM D 2244.
 - 4) Delamination of panel face sheets from panel cores.
 - b. Warranty Period: 10 years from date of Final Completion.
3. Special Aluminum-Finish Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components on which finishes fail within specified warranty period. Warranty does not include normal weathering.
 - a. Failures include, but are not limited to, checking, crazing, peeling, chalking, and fading of finishes.
 - b. Warranty Period: Five **OR** 10 **OR** 20, **as directed**, years from date of Final Completion.

1.2 PRODUCTS

A. Aluminum Frame Systems

1. Aluminum: Alloy and temper recommended in writing by manufacturer for type of use and finish indicated.
 - a. Sheet and Plate: **ASTM B 209 (ASTM B 209M)**.
 - b. Extruded Bars, Rods, Profiles, and Tubes: **ASTM B 221 (ASTM B 221M)**.
 - c. Extruded Structural Pipe and Tubes: ASTM B 429.
2. Components: Manufacturer's standard extruded-aluminum members of thickness required and reinforced as required to support imposed loads.
 - a. Construction: One-piece extruded-aluminum components **OR** Thermally broken; framing members are composite assemblies of two separate extruded-aluminum components permanently bonded by a material of low thermal conductance, **as directed**.
3. Exposed Flashing and Closures: Manufacturer's standard aluminum components not less than **0.040 inch (1.016 mm) OR 0.060 inch (1.524 mm)**, **as directed**, thick.
4. Frame-System Gaskets: Manufacturer's standard.
5. Frame-System Sealants: As recommended in writing by manufacturer **OR** specified in Division 07 Section "Joint Sealants", **as directed**.
 - a. Provide sealants for use inside of the weatherproofing system that have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
6. Anchors, Fasteners, and Accessories: Manufacturer's standard, corrosion-resistant, nonstaining, and nonbleeding; compatible with adjacent materials.

- a. At closures, retaining caps, or battens, use ASTM A 193/A 193M, 300 series stainless-steel screws.
- b. Where fasteners are subject to loosening or turning out from thermal and structural movements, wind loads, or vibration, use self-locking devices.
- c. At movement joints, use slip-joint linings, spacers, and sleeves of material and type recommended in writing by manufacturer.
7. Concrete and Masonry Inserts: Hot-dip galvanized cast-iron, malleable-iron, or steel inserts complying with ASTM A 123/A 123M or ASTM A 153/A 153M requirements.
8. Anchor Bolts: **ASTM A 307, Grade A (ASTM F 568M, Property Class 4.6)**, hot-dip zinc coating, ASTM A 153/A 153M, Class C **OR** mechanically deposited zinc coating, ASTM B 695, Class 50, **as directed**.
9. Frame System Fabrication:
 - a. Fabricate components before finishing.
 - b. Fabricate components that, when assembled, have the following characteristics:
 - 1) Profiles that are sharp, straight, and free of defects or deformations.
 - 2) Accurately fitted joints with ends coped or mitered.
 - 3) Internal guttering systems or other means to drain water passing joints, condensation occurring within components, and moisture migrating within the assembly to exterior.
 - c. Fabricate sill closures with weep holes and for installation as continuous component.
 - d. Reinforce components as required to receive fastener threads.
 - e. Weld components in concealed locations to greatest extent possible to minimize distortion or discoloration of finish. Remove weld spatter and welding oxides from exposed surfaces by descaling or grinding.
- B. Fiberglass Sandwich Panels
 1. Panel Construction: Assembly of uniformly colored, translucent, thermoset, fiberglass-reinforced-polymer face sheets bonded to both sides of a grid core and complying with requirements applicable to panel materials in ICBO ES AC04, "Sandwich Panels."
 - a. Face-Sheet, Self-Ignition Temperature: **650 deg F (343 deg C)** or more per ASTM D 1929.
 - b. Face-Sheet Burning Extent: **1 inch (25 mm)** or less per ASTM D 635.
 - c. Face-Sheet, Smoke-Developed Index: 450 or less per ASTM E 84.
 - d. Interior Face-Sheet, Flame-Spread Index: Not more than 25 **OR** 75, **as directed**, per ASTM E 84.
 - e. Roof-Covering Class: Class A **OR** Class A, burning brand test (only), **as directed**, per ASTM E 108 or UL 790.
 2. Panel Thickness: **2-3/4 inches (70 mm) OR 1-1/2 to 1-9/16 inches (38 to 40 mm), as directed.**
 3. Panel U-Factor: Not more than **0.70 (3.97) OR 0.53 (3.01) OR 0.44 (2.50) OR 0.40 (2.27) OR 0.29 (1.65) OR 0.28 (1.59) OR 0.26 (1.48) OR 0.24 (1.36) OR 0.23 (1.31) OR 0.22 (1.25) OR 0.18 (1.02) OR 0.15 (0.85) OR 0.14 (0.79) OR 0.10 (0.57)**, **as directed**, measured in **Btu/sq. ft. x h x deg F (W/sq. m x K)** according to NFRC 100 or ASTM C 1363 using procedures described in ASTM C 1199 and ASTM E 1423.
 4. Panel Strength Characteristics:
 - a. Maximum Panel Deflection: **3-1/2 inches (89 mm)** when a **4-by-12-foot (1.2-by-3.6-m)** panel is tested according to ASTM E 72 at **34 lbf/ sq. ft. (1.6 kPa)**, with a maximum **0.090-inch (2.3-mm)** set deflection after 5 minutes.
 - b. Panel Support Strength: Capable of supporting, without failure, a **300-lbf (1334 N)** concentrated load when applied to a **3-inch- (76-mm-)** diameter disk according to ASTM E 661.
 5. Grid Core: Mechanically interlocked extruded-aluminum I-beams, with a minimum flange width of **7/16 inch (11.1 mm)**.
 - a. Extruded Aluminum: **ASTM B 221 (ASTM B 221M)**, in alloy and temper recommended in writing by manufacturer.

- b. I-Beam Construction: One-piece extruded-aluminum components **OR** Thermally broken; two separate extruded-aluminum components permanently bonded by a material of low thermal conductance, **as directed**.
 - c. Grid Pattern: Inline rectangle, nominal **12 by 24 inches (305 by 610 mm)** **OR** Staggered rectangle, nominal **12 by 24 inches (305 by 610 mm)** **OR** Square, nominal **12 inches (305 mm)** **OR** As indicated on Drawings, **as directed**.
 6. Exterior Face Sheet:
 - a. Thickness: **0.070 inches (1.778 mm)** **OR** **0.060 inches (1.524 mm)** **OR** **0.052 inches (1.321 mm)**, **as directed**.
 - b. Color: White **OR** Crystal **OR** As selected from manufacturer's full range, **as directed**.
 - c. Color Stability: Not more than 3.0 **OR** 4.0 **OR** 7.0, **as directed**, units Delta E when measured according to ASTM D 2244 after outdoor weathering in southern Florida according to procedures in ASTM D 1435 with panels mounted facing south and as follows:
 - 1) Panel Mounting Angle: Not more than 5 **OR** 45, **as directed**, degrees from horizontal.
 - 2) Exposure Period: 60 months **OR** 30 months **OR** 60 months for vertical assemblies, 30 months for components of Class A roof assemblies, **as directed**.
 - d. Erosion Protection: Manufacturer's standard **OR** Integral, embedded glass erosion barrier **OR** Surface-applied, polyvinyl fluoride film not less than **1.0 mils (0.03 mm)** thick, **as directed**.
 - e. Impact Resistance: No fracture or tear at impact of **60 ft. x lbf (81 J)** **OR** **70 ft. x lbf (95 J)** **OR** **230 ft. x lbf (312 J)**, **as directed**, by a **3-1/4-inch- (83-mm-)** diameter, **5-lb (2.3-kg)** free-falling ball according to test procedure in UL 972.
 7. Interior Face Sheet:
 - a. Thickness: **0.045 inch (1.143 mm)** **OR** **0.060 inch (1.524 mm)**, **as directed**.
 - b. Color: White **OR** Crystal **OR** As selected from manufacturer's full range, **as directed**.
 8. Fiberglass-Sandwich-Panel Adhesive: ASTM D 2559.
 - a. Compatible with facing and core materials.
 - b. Tensile and shear bond strength of aged adhesive ensures permanent adhesion of facings to cores, as evidenced by testing according to ASTM C 297 and ASTM D 1002 after accelerated aging procedures that comply with aging requirements for adhesives with high resistance to moisture in ICBO ES AC05, "Sandwich Panel Adhesives."
 9. Panel Fabrication: Factory assemble and seal panels.
 - a. Laminate face sheets to grid core under a controlled process using heat and pressure to produce straight adhesive bonding lines that cover width of core members and that have sharp edges.
 - 1) White spots indicating lack of bond at intersections of grid-core members are limited in number to 4 for every **40 sq. ft. (3.7 sq. m)** of panel and limited in diameter to **3/64 inch (1.2 mm)**.
 - b. Fabricate with grid pattern that is symmetrical about centerlines of each panel.
 - c. Fabricate panel to allow condensation within panel to escape.
 - d. Reinforce panel corners.
- C. Accessory Materials
 1. Insulating Materials: Specified in Division 07 Section "Thermal Insulation".
 2. Bituminous Paint: Cold-applied asphalt-mastic paint complying with SSPC-Paint 12 requirements except containing no asbestos, formulated for **30-mil (0.762-mm)** thickness per coat.
- D. Aluminum Finishes
 1. General: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
 2. Finish designations prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.
 3. Aluminum Anodic Finish: Class I, clear anodic coating complying with AAMA 611 **OR** Class I, color anodic coating complying with AAMA 611, **as directed**.

- a. Color: Light bronze **OR** Medium bronze **OR** Dark bronze **OR** Black **OR** Match sample **OR** As selected from full range of industry colors and densities, **as directed**.
- 4. Aluminum High-Performance Organic Finish: Two-coat **OR** Three-coat, **as directed**, thermocured system with fluoropolymer topcoats containing not less than 70 percent polyvinylidene fluoride resin by weight; complying with AAMA 2604 **OR** AAMA 2605, **as directed**.
 - a. Color: Match sample **OR** As selected from manufacturer's full range, **as directed**.

1.3 EXECUTION

A. Installation

1. General:
 - a. Comply with manufacturer's written instructions.
 - b. Do not install damaged components.
 - c. Fit joints between aluminum components to produce hairline joints free of burrs and distortion.
 - d. Rigidly secure nonmovement joints.
 - e. Install anchors with separators and isolators to prevent metal corrosion and electrolytic deterioration and to prevent impeding movement of moving joints.
 - f. Weld aluminum components in concealed locations to minimize distortion or discoloration of finish. Protect glazing surfaces from welding.
 - g. Seal joints watertight, unless otherwise indicated.
2. Metal Protection: Where aluminum components will contact dissimilar materials, protect against galvanic action by painting contact surfaces with bituminous paint or by installing nonconductive spacers as recommended in writing by manufacturer for this purpose.
3. Install continuous aluminum sill closure with weatherproof expansion joints and locked and sealed or welded corners. Locate weep holes at rafters.
4. Install components to drain water passing joints, condensation occurring within aluminum members and panels, and moisture migrating within assembly to exterior.
5. Install components plumb and true in alignment with established lines and elevations.
6. Install insulation materials as specified in Division 07 Section "Thermal Insulation".
7. Erection Tolerances: Install assemblies to comply with the following maximum tolerances:
 - a. Alignment: Limit offset from true alignment to **1/32 inch (0.8 mm)** where surfaces abut in line, edge to edge, at corners, or where a reveal or protruding element separates aligned surfaces by less than **3 inches (76 mm)**; otherwise, limit offset to **1/8 inch (3.2 mm)**.
 - b. Location and Plane: Limit variation from true location and plane to **1/8 inch in 12 feet (3.2 mm in 3.7 m)**; **1/2 inch (13 mm)** over total length.

B. Field Quality Control

1. Testing Agency: Engage a qualified independent testing and inspecting agency to perform field tests and inspections and prepare test reports.
2. Testing Services: Testing and inspecting of representative areas to determine compliance of installed assemblies with specified requirements shall take place as follows and in successive stages as indicated on Drawings. Do not proceed with installation of the next area until test results for previously completed areas show compliance with requirements.
 - a. Water Penetration under Static Pressure: Before installation of interior finishes has begun, areas shall be tested according to ASTM E 1105.
 - 1) Test Procedures: Test under uniform and cyclic static air pressure.
 - 2) Static-Air-Pressure Difference: as directed by the Owner.
 - 3) Water Penetration: None.
 - b. Water-Spray Test: Before installation of interior finishes has begun, assemblies shall be tested according to AAMA 501.2 and shall not evidence water penetration.
3. Repair or remove work where test results and inspections indicate that it does not comply with specified requirements.

4. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

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SECTION 08 51 13 00 - ALUMINUM WINDOWS

1.1 GENERAL

A. Description Of Work

1. This specification covers the furnishing and installation of material for fixed and operable aluminum framed windows for exterior locations. Products shall be as follows or as directed by the Owner. Installation procedures shall be in accordance with the products manufacturer's recommendations. Demolition and removal of materials shall be as required to support the work.

B. Summary

1. This Section includes fixed and operable aluminum-framed windows.

C. Definitions

1. Performance class designations according to AAMA/WDMA 101/I.S.2/NAFS:
 - a. AW: Architectural.
 - b. HC: Heavy Commercial.
 - c. C: Commercial.
 - d. LC: Light Commercial.
 - e. R: Residential.
2. Performance grade number according to AAMA/WDMA 101/I.S.2/NAFS:
 - a. Design pressure number in **pounds force per square foot (pascals)** used to determine the structural test pressure and water test pressure.
3. Structural Test Pressure: For uniform load structural test, is equivalent to 150 percent of the design pressure.
4. Minimum Test Size: Smallest size permitted for performance class (gateway test size). Products must be tested at minimum test size or at a size larger than minimum test size to comply with requirements for performance class.

D. Performance Requirements

1. General: Provide aluminum windows capable of complying with performance requirements indicated, based on testing manufacturer's windows that are representative of those specified, and that are of minimum test size indicated below:
 - a. Size required by AAMA/WDMA 101/I.S.2/NAFS for gateway performance **OR** optional performance grade **OR** gateway performance for both gateway performance and optional performance grade, **as directed**.
 - b. Size indicated on Drawings **OR** in a schedule, **as directed**.
2. Structural Performance: Provide aluminum windows capable of withstanding the effects of the following loads, based on testing units representative of those indicated for Project that pass AAMA/WDMA 101/I.S.2/NAFS, Uniform Load Structural Test:
 - a. Design Wind Loads: Determine design wind loads applicable to Project from basic wind speed indicated in **miles per hour (meters per second)** at **33 feet (10 m)** above grade, according to ASCE 7, Section 6.5, "Method 2-Analytical Procedure," based on mean roof heights above grade indicated on Drawings.
 - 1) Basic Wind Speed: **85 mph (38 m/s) OR 90 mph (40 m/s), as directed**.
 - 2) Importance Factor.
 - 3) Exposure Category: **A OR B OR C OR D, as directed**.
 - b. Deflection: Design glass framing system to limit lateral deflections of glass edges to less than 1/175 of glass-edge length or **3/4 inch (19 mm)**, whichever is less, at design pressure based on testing performed according to AAMA/WDMA 101/I.S.2/NAFS, Uniform Load Deflection Test or structural computations.
3. Windborne-Debris Resistance: Provide glazed windows capable of resisting impact from windborne debris, based on the pass/fail criteria as determined from testing glazed windows

identical to those specified, according to ASTM E 1886 and testing information in ASTM E 1996 or AAMA 506 and requirements of authorities having jurisdiction.

4. Thermal Movements: Provide aluminum windows, including anchorage, that allow for thermal movements resulting from the following maximum change (range) in ambient and surface temperatures by preventing buckling, opening of joints, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Base engineering calculation on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.
 - a. Temperature Change (Range): 120 deg F (67 deg C), ambient; 180 deg F (100 deg C) material surfaces.

E. Submittals

1. Product Data: For each type of aluminum window indicated.
2. Shop Drawings: Include plans, elevations, sections, details, hardware, attachments to other work, operational clearances, and installation details
3. Samples: For each exposed finish.
4. Product Schedule: Use same designations indicated on Drawings.
5. Field quality-control test reports.
6. Product test reports.
7. Maintenance data.

F. Quality Assurance

1. Installer: A qualified installer, approved by manufacturer to install manufacturer's products.
2. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
3. Fenestration Standard: Comply with AAMA/WDMA 101/I.S.2/NAFS, "North American Fenestration Standard Voluntary Performance Specification for Windows, Skylights and Glass Doors," for definitions and minimum standards of performance, materials, components, accessories, and fabrication. Comply with more stringent requirements if indicated.
 - a. Provide AAMA **OR** WDMA, **as directed**, -certified aluminum windows with an attached label.
4. Glazing Publications: Comply with published recommendations of glass manufacturers and with GANA's "Glazing Manual" unless more stringent requirements are indicated.
5. Preinstallation Conference: Conduct conference at Project site.

G. Warranty

1. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace aluminum windows that fail in materials or workmanship within specified warranty period.
 - a. Failures include, but are not limited to, the following:
 - 1) Failure to meet performance requirements.
 - 2) Structural failures including excessive deflection, water leakage, air infiltration, or condensation.
 - 3) Faulty operation of movable sash and hardware.
 - 4) Deterioration of metals, other materials, and metal finishes beyond normal weathering.
 - 5) Failure of insulating glass.
 - b. Warranty Period:
 - 1) Window: Two **OR** Three, **as directed**, years from date of Final Completion.
 - 2) Glazing: Five **OR** 10, **as directed**, years from date of Final Completion.
 - 3) Metal Finish: Five **OR** 10 **OR** 15, **as directed**, years from date of Final Completion.

1.2 PRODUCTS

A. Materials

1. Aluminum Extrusions: Alloy and temper recommended by aluminum window manufacturer for strength, corrosion resistance, and application of required finish, but not less than **22,000-psi (150-MPa)** ultimate tensile strength, not less than **16,000-psi (110-MPa)** minimum yield strength, and not less than **0.062-inch (1.6-mm)** thickness at any location for the main frame and sash members.
2. Fasteners: Aluminum, nonmagnetic stainless steel, epoxy adhesive, or other materials warranted by manufacturer to be noncorrosive and compatible with aluminum window members, trim, hardware, anchors, and other components.
 - a. Reinforcement: Where fasteners screw anchor into aluminum less than **0.125 inch (3.2 mm)** thick, reinforce interior with aluminum or nonmagnetic stainless steel to receive screw threads, or provide standard, noncorrosive, pressed-in, splined grommet nuts.
 - b. Exposed Fasteners: Unless unavoidable for applying hardware, do not use exposed fasteners. For application of hardware, use fasteners that match finish of member or hardware being fastened, as appropriate.
3. Anchors, Clips, and Accessories: Aluminum, nonmagnetic stainless steel, or zinc-coated steel or iron complying with ASTM B 633 for SC 3 severe service conditions; provide sufficient strength to withstand design pressure indicated.
4. Reinforcing Members: Aluminum, nonmagnetic stainless steel, or nickel/chrome-plated steel complying with ASTM B 456 for Type SC 3 severe service conditions, or zinc-coated steel or iron complying with ASTM B 633 for SC 3 severe service conditions; provide sufficient strength to withstand design pressure indicated.
5. Compression-Type Weather Stripping: Provide compressible weather stripping designed for permanently resilient sealing under bumper or wiper action and for complete concealment when aluminum window is closed.
 - a. Weather-Stripping Material: Elastomeric cellular preformed gaskets complying with ASTM C 509.
 - b. Weather-Stripping Material: Dense elastomeric gaskets complying with ASTM C 864.
 - c. Weather-Stripping Material: Manufacturer's standard system and materials complying with AAMA/WDMA 101/I.S.2/NAFS.
6. Sliding-Type Weather Stripping: Provide woven-pile weather stripping of wool, polypropylene, or nylon pile and resin-impregnated backing fabric. Comply with AAMA 701/702.
 - a. Weather Seals: Provide weather stripping with integral barrier fin or fins of semirigid, polypropylene sheet or polypropylene-coated material. Comply with AAMA 701/702.
7. Replaceable Weather Seals: Comply with AAMA 701/702.
8. Sealant: For sealants required within fabricated windows, provide window manufacturer's standard, permanently elastic, nonshrinking, and nonmigrating type recommended by sealant manufacturer for joint size and movement.

B. Window

1. Window Type: Casement **OR** Double hung **OR** Dual action **OR** Fixed **OR** Horizontal sliding **OR** Projected **OR** Projected awning **OR** Single hung **OR** Top-hinged inswinging **OR** Vertically pivoted **OR** As indicated on Drawings **OR** As indicated in a schedule, **as directed**.
2. AAMA/WDMA Performance Requirements: Provide aluminum windows of performance indicated that comply with AAMA/WDMA 101/I.S.2/NAFS unless more stringent performance requirements are indicated.
 - a. Performance Class and Grade: R15 **OR** R20 **OR** R25, **as directed**.
 - b. Performance Class and Grade: LC25 **OR** LC30 **OR** LC35, **as directed**.
 - c. Performance Class and Grade: C30 **OR** C35 **OR** C40, **as directed**.
 - d. Performance Class and Grade: HC40 **OR** HC45 **OR** HC50, **as directed**.
 - e. Performance Class and Grade: AW40 **OR** AW45 **OR** AW50, **as directed**.
 - f. Performance Class and Grade: As indicated.

- g. Performance Class (if test performance method is selected for specifying windows and designating a performance class does not conflict with basic wind speed and performance testing indicated): **R OR LC OR C OR HC OR AW, as directed.**
- 3. Condensation-Resistance Factor (CRF): Provide aluminum windows tested for thermal performance according to AAMA 1503, showing a CRF of 45 **OR 52, as directed.**
- 4. Thermal Transmittance: Provide aluminum windows with a whole-window, U-factor maximum indicated at **15-mph (24-km/h)** exterior wind velocity and winter condition temperatures when tested according to AAMA 1503 **OR ASTM E 1423 OR NFRC 100, as directed.**
 - a. U-Factor: **0.35 Btu/sq. ft. x h x deg F (2.0 W/sq. m x K) OR 0.40 Btu/sq. ft. x h x deg F (2.3 W/sq. m x K) OR 0.43 Btu/sq. ft. x h x deg F (2.5 W/sq. m x K) OR 0.60 Btu/sq. ft. x h x deg F (3.4 W/sq. m x K), as directed,** or less.
- 5. Solar Heat-Gain Coefficient (SHGC): Provide aluminum windows with a whole-window SHGC maximum of 0.40 **OR 0.50 OR 0.55, as directed,** determined according to NFRC 200 procedures.
- 6. Sound Transmission Class (STC): Provide glazed windows rated for not less than 26 **OR 30 OR 35, as directed,** STC when tested for laboratory sound transmission loss according to ASTM E 90 and determined by ASTM E 413.
- 7. If test performance method is selected for specifying windows
 - a. Air Infiltration: Maximum rate not more than indicated when tested according to AAMA/WDMA 101/I.S.2/NAFS, Air Infiltration Test.
 - 1) Maximum Rate: **0.3 cfm/sq. ft. (5 cu. m/h x sq. m)** of area at an inward test pressure of **1.57 lbf/sq. ft. (75 Pa).**
 - 2) Maximum Rate: **0.3 cfm/sq. ft. (5 cu. m/h x sq. m)** of area at an inward test pressure of **6.24 lbf/sq. ft. (300 Pa).**
 - 3) Maximum Rate: **0.1 cfm/sq. ft. (2 cu. m/h x sq. m)** of area at an inward test pressure of **6.24 lbf/sq. ft. (300 Pa).**
 - b. Water Resistance: No water leakage as defined in AAMA/WDMA referenced test methods at a water test pressure equaling that indicated, when tested according to AAMA/WDMA 101/I.S.2/NAFS, Water Resistance Test.
 - 1) Test Pressure: 15 percent of positive design pressure, but not less than **2.86 lbf/sq. ft. (140 Pa)** or more than **15 lbf/sq. ft. (720 Pa).**
 - 2) Test Pressure: 20 percent of positive design pressure, but not more than **15 lbf/sq. ft. (720 Pa).**
- 8. Forced-Entry Resistance: Comply with Performance Grade 10 **OR 20 OR 30 OR 40, as directed,** requirements when tested according to ASTM F 588.
- 9. Life-Cycle Testing: Test according to AAMA 910 and comply with AAMA/WDMA 101/I.S.2/NAFS.
- 10. Operating Force and Auxiliary (Durability) Tests: Comply with AAMA/WDMA 101/I.S.2/NAFS for operating window types indicated.

C. Glazing

- 1. Glass: Clear, insulating-glass units **OR** Clear, insulating-glass units, with low-E coating pyrolytic on second surface or sputtered on second or third surface, **OR** Clear, insulating-glass units, argon gas filled, with low-E coating pyrolytic on second surface or sputtered on second or third surface, **as directed,** complying with Division 08 Section "Glazing".
- 2. Glazing System: Manufacturer's standard factory-glazing system that produces weathertight seal. **OR** Manufacturer's standard factory-glazing system that produces weathertight seal and complies with requirements for windborne-debris resistance **OR** Manufacturer's standard factory-glazing system as indicated in Division 08 Section "Glazing", **as directed.**
- 3. Dual-Action Windows: Provide pivoting unit for double glazing, constructed of one sheet of glass in a removable sash for access to interior of unit, installed with airtight gaskets.

D. Hardware

- 1. General: Provide manufacturer's standard hardware fabricated from aluminum, stainless steel, carbon steel complying with AAMA 907, or other corrosion-resistant material compatible with aluminum; designed to smoothly operate, tightly close, and securely lock aluminum windows, and

- sized to accommodate sash or ventilator weight and dimensions. Do not use aluminum in frictional contact with other metals. Where exposed, provide solid bronze **OR** extruded, cast, or wrought aluminum **OR** die-cast zinc with special coating finish **OR** nonmagnetic stainless steel, **as directed**.
2. Counterbalancing Mechanism: Comply with AAMA 902.
 - a. Sash Balance: Concealed, tape-spring type **OR** spiral-tube type **OR** spring-loaded, block-and-tackle type **OR** ultralift spring type capable of lifting 70 percent of sash weight, **as directed**, of size and capacity to hold sash stationary at any open position.
 3. Sill Cap/Track: Extruded-aluminum track with natural anodized finish **OR** Rigid PVC or other weather-resistant plastic track with manufacturer's standard integral color, **as directed**, of thickness, dimensions, and profile indicated; designed to comply with performance requirements indicated and to drain to the exterior.
 4. Locks and Latches: Designed to allow unobstructed movement of the sash across adjacent sash in direction indicated and operated from the inside only.
 5. Roller Assemblies: Low-friction design.
 6. Push-Bar Operators: Provide telescoping-type, push-bar operator designed to open and close ventilators with fixed screens.
 7. Gear-Type Rotary Operators: Comply with AAMA 901 when tested according to ASTM E 405, Method A.
 - a. Operation Function: All ventilators move simultaneously and securely close at both jambs without using additional manually controlled locking devices.
 8. Four- or Six-Bar Friction Hinges: Comply with AAMA 904.
 - a. Locking mechanism and handles for manual operation.
 - b. Friction Shoes: Provide friction shoes of nylon or other nonabrasive, nonstaining, noncorrosive, durable material.
 9. Limit Devices: Provide limit devices designed to restrict sash or ventilator opening.
 - a. Safety Devices: Limit clear opening to **4 inches (100 mm) OR 6 inches (150 mm)**, **as directed**, for ventilation; with custodial key release.
 10. Pole Operators: Tubular-shaped anodized aluminum; with rubber-capped lower end and standard push-pull hook at top to match hardware design; of sufficient length to operate window without reaching more than **60 inches (1500 mm)** above floor; 1 pole operator and pole hanger per room that has operable windows more than **72 inches (1800 mm)** above floor.
 11. Casement Windows: Provide the following operating hardware:
 - a. Operator: Gear-type rotary single-arm operator located on jamb at sill **OR** Gear-type rotary dual-arm operator located on jamb at sill, **as directed**.
 - 1) Rating: Provide rotary operator rated C-R15 **OR** C-C20 **OR** C-HC40, **as directed**, according to AAMA 901.
 - 2) Handle: Standard crank **OR** Folding crank **OR** Removable crank **OR** Knob **OR** T-handle, **as directed**.
 - b. Hinge: Extension hinge or pivot, nonfriction type.
 - c. Hinge: Heavy-duty, three **OR** five, **as directed**,-knuckle butt hinge with nylon bushings.
 - d. Hinge: Standard **OR** Heavy, **as directed**,-duty, concealed, four- or six-bar friction hinge with adjustable-slide friction shoe; designed to permit ventilator operation for inside cleaning of outside glass face; two per ventilator.
 - e. Hinge: Standard **OR** Heavy, **as directed**,-duty, concealed, four- or six-bar friction egress hinge with adjustable-slide friction shoe; designed to achieve 90-degree ventilator opening and to permit ventilator operation for inside cleaning of outside glass face; two per ventilator.
 - f. Lock: Lift-type throw, cam-action lock with keeper; one **OR** two, **as directed**, per ventilator.
 - g. Lock: Combination lever handle and cam-action lock with keeper; one **OR** two, **as directed**, per ventilator.
 - h. Lock: Combination dual lever handles, tie rod, and cam-action lock with keepers.
 - i. Lock: Key-operated custodial lock and keeper with removable handle; one **OR** two, **as directed**, per ventilator.

- j. Lock: Concealed multipoint lock operated by single lever handle or lift-type throw; three per ventilator.
- k. Limit Device: Concealed friction adjuster, adjustable stay bar **OR** support arms with adjustable, limited, hold-open, **as directed**, limit device.
- 12. Double **OR** Single, **as directed**, Hung Windows: Provide the following operating hardware:
 - a. Sash Balances: Two per sash.
 - b. Handles: Applied sash lift bar **OR** pull-downs, **as directed**, on bottom rail of forward-placed operating sash; two per sash.
 - c. Handle: Continuous, integral, sash lift bar **OR** pull-down, **as directed**, on bottom rail of forward-placed operating sash.
 - d. Sash Lock: Cam-action sweep lock and keeper on meeting rail; one **OR** two, **as directed**, per sash.
 - e. Sash Lock: Spring-loaded, snap-type lock on bottom rail of lower sash; two per sash.
 - f. Sash Lock: Spring-loaded plunger lock with keeper on meeting rail of lower sash; two per sash.
 - g. Sash Lock: Pole-operated, cam-action lock on meeting rail of windows with meeting rail more than **72 inches (1800 mm)** above floor; with keeper.
 - h. Pole Socket: Provide a pole socket or groove on inside face of top rail of upper **OR** lower, **as directed**, sash on windows with meeting rails more than **72 inches (1800 mm)** above floor.
 - i. Limit Device: Sash stop **OR** Keyed sash, **as directed**, limit device; for top **OR** bottom **OR** each operable, **as directed**, sash located at jamb; one **OR** two, **as directed**, per sash.
 - j. Removable Lift-Out Sash: Design windows and provide with tamperproof, key-operated, **as directed**, hardware to permit removal of sash from inside for cleaning.
 - k. Tilt Lock: Design windows and provide with tamperproof, key-operated, **as directed**, tilt latch and pivot bar hardware to permit tilting of sash inward for cleaning both sides of sash from interior.
- 13. Dual-Action Windows: Provide the following operating hardware:
 - a. Operator: Two-position, combination lever handle and cam-type latch.
 - b. Operator: Concealed, internal, multipoint locking bar and combination locking handle mechanism.
 - c. Hinge: Combination three-knuckle **OR** five-knuckle butt, **as directed**, hinge and stay bar.
 - d. Lock: Key-operated, concealed **OR** exposed, **as directed**, custodial lock.
 - e. Stabilizing Arm: Aluminum.
- 14. Horizontal-Sliding Windows: Provide the following operating hardware:
 - a. Sash Rollers: Nylon rollers **OR** Steel, lubricated ball-bearing rollers with nylon tires **OR** Stainless-steel, lubricated ball-bearing rollers with nylon tires, **as directed**.
 - b. Sash Lock: Cam-action sweep sash lock and keeper at meeting rails.
 - c. Sash Lock: Spring-loaded, snap-type lock at jambs; two per sash.
 - d. Sash Lock: Spring-loaded plunger lock with keeper on meeting rail; two per sash.
 - e. Limit Device: Sash stop limit device; mounted in bottom of pull stile.
 - f. Removable Lift-Out Sash: Design windows and provide with tamperproof, key-operated, **as directed**, hardware to permit removal of sash from inside for cleaning.
- 15. Projected Windows: Provide the following operating hardware:
 - a. Operator: Underscreen push-bar **OR** Underscreen pivot-shoe-type, gear-type rotary operator, **as directed**.
 - b. Hinge: Five-knuckle butt hinge.
 - c. Hinge: Concealed four- or six-bar friction hinge with adjustable-slide friction shoe; two per ventilator.
 - d. Lock: Cam-action, sweep lock handle with strike; one **OR** two, **as directed**, per ventilator.
 - e. Lock: Combination lever handle and cam-action lock with concealed pawl and keeper.
 - f. Lock: Key-operated security lock and keeper.
 - g. Lock: Key-operated custodial lock and keeper with removable handle.
 - h. Lock: Pole-operated, spring-catch lock and keeper **OR** cam-action, sweep lock handle and strike, **as directed**.

- i. Limit Device: Concealed friction adjuster, adjustable stay bar **OR** support arms with adjustable, limited, hold-open, **as directed**, limit device; located on jamb of each ventilator.
 16. Projected Awning Windows: Provide the following operating hardware:
 - a. Operator: Push-bar **OR** Lever **OR** Gear-type rotary, **as directed**, operator located on jamb at sill.
 - 1) Handle: Standard crank **OR** Folding crank **OR** Removable crank **OR** Knob **OR** T-handle, **as directed**.
 - b. Window-Operating System: Wall-mounted, group or gang-type window operating system with chain-wheel **OR** rotary crank-type **OR** electric, **as directed**, operator.
 - c. Hinge: Concealed four- or six-bar friction hinge located on each jamb near top rail; two per ventilator.
 - d. Lock: Lift-type throw, cam-action lock with keeper; one **OR** two, **as directed**, per ventilator.
 - e. Lock: Combination lever handle and cam-action lock with concealed pawl and keeper; one **OR** two, **as directed**, per ventilator.
 - f. Lock: Pole-operated, combination handle and cam-action lock **OR** face-mounted transom latch, **as directed**, and keeper.
 - g. Lock: Key-operated custodial lock with removable handle.
 - h. Limit Device: Concealed friction adjuster, adjustable stay bar **OR** support arms with adjustable, limited, hold-open, **as directed**, limit device; located on jamb of each ventilator.
 17. Top-Hinged Inswinging Windows: Provide the following operating hardware:
 - a. Hinge: Exposed, applied butt hinge located at corners; two **OR** three, **as directed**, per ventilator.
 - b. Hinge: Exposed, applied continuous hinge.
 - c. Hinge: Concealed, applied pivot hinge located at corners; two **OR** three, **as directed**, per ventilator.
 - d. Hinge: Continuous, integrally extruded hinge.
 - e. Hinge: Four- or six-bar friction hinge with adjustable-slide friction shoe; two per ventilator.
 - f. Lock: Internal, key-operated, limited-access locks located not more than **48 inches (1220 mm)** o.c. at jambs and sill.
 - g. Hold-Open Device: Automatic-locking hold-open arms **OR** stay bars, **as directed**, designed to permit sash operation for inside cleaning of outside glass face; two per ventilator.
 18. Vertically Pivoted Windows: Provide the following operating hardware:
 - a. Pivot Assembly: Aluminum-alloy **OR** Manganese-bronze **OR** Stainless-steel, **as directed**, pivot assembly designed for center **OR** off-center, **as directed**, axis pivoting.
 - b. Lock: Internal, key-operated, limited-access lock; one **OR** two, **as directed**, per jamb.
 - c. Limit device.
- E. Group Or Gang-Type Window Operating Systems
1. Provide window operating system of the type and in groups as indicated. Coordinate operating system design with window fabrication and hardware selection to ensure smooth, durable operation of ventilators.
 2. Operation Function: All ventilators move simultaneously and securely close at sash frames without using additional manually controlled locking devices.
 3. Rack-and-Pinion **OR** Screw, **as directed**, Type Operating System: Complete with shafts, brackets, levers, rods, oil-encased gear boxes, and standard fittings and accessories for operation indicated.
 4. Horizontal-Movement Operating System: Tension type; complete with mounting brackets, oil-encased gear boxes, steel rod or cable operating in conduit between sash operator units, and standard fittings and accessories for operation indicated.
 5. Operation: Manual, with chain-wheel operator on each gear box shaft; with chain loops terminated **24 inches (600 mm)** above floor.
 6. Operation: Manual, with crank-type operator on each gear box shaft, with removable crank. Where necessary, extend crankshaft with universal joints and support brackets to a suitable

crank-mounting location not more than **44 inches (1115 mm)** above floor, with an oil-encased miter gear box.

7. Operation: Electric, with factory-assembled electric operator designed for operating windows of type, size, weight, construction, use, and operating frequency indicated.
 - a. Electric Operator: Provide operating system complying with NFPA 70; of size and capacity and with features, characteristics, and accessories suitable for Project conditions, recommended in writing by window manufacturer; complete with operating system indicated, electric motor and factory-prewired motor controls with limit switches, remote-control stations, power disconnect switches, enclosures protecting controls and all operating parts, and accessories required for reliable operation. Include wiring from motor controls to motor. Coordinate operator wiring requirements and electrical characteristics with building electrical system.
 - 1) Control Equipment: Comply with NEMA ICS 1, NEMA ICS 2, and NEMA ICS 6.
 - 2) Electric Motor: Comply with NEMA MG 1; with thermal-overload protection; sized to start and operate size and weight of window sash ventilators under any conditions; one per each gear box shaft.
 - a) Motor Characteristics: Single phase, sized by electric operator manufacturer, 60 Hz.
 - 3) Remote Controls: Electric controls with NEMA ICS 6, Type 1 enclosure and momentary-contact, single push-button-operated control **OR** three-position, push-button-operated control with open, close, and stop functions, **as directed**.
 - 4) Limit Switches: Adjustable switches, interlocked with motor controls and set to automatically stop sash ventilators at fully opened and fully closed positions.

F. Insect Screens

1. General: Design windows and hardware to accommodate screens in a tight-fitting, removable arrangement, with a minimum of exposed fasteners and latches. Fabricate insect screens to fully integrate with window frame. Locate screens on inside **OR** outside, **as directed**, of window and provide for each operable exterior sash or ventilator.
 - a. Aluminum Tubular Frame Screens: Comply with SMA 1004, "Specifications for Aluminum Tubular Frame Screens for Windows," Residential R-20 **OR** Architectural C-24 **OR** Monumental M-32, **as directed**, class.
 - b. Comply with SMA 1004, "Specifications for Aluminum Tubular Frame Screens for Windows," for minimum standards of appearance, fabrication, attachment of screen fabric, hardware, and accessories unless more stringent requirements are indicated.
2. Stainless-Steel Insect Screen Frames: Fabricate frames of nonmagnetic stainless-steel members of **0.020-inch (0.5-mm)** minimum wall thickness, with mitered or coped joints or corner extrusions, concealed fasteners, adjustable rollers, and removable PVC spline/anchor concealing edge of frame. Finish frames with No. 2B, bright mill finish.
3. Aluminum Insect Screen Frames: Manufacturer's standard aluminum alloy complying with SMA 1004. Fabricate frames with mitered or coped joints or corner extrusions, concealed fasteners, adjustable rollers, **as directed**, and removable PVC spline/anchor concealing edge of frame.
 - a. Aluminum Tubular Framing Sections and Cross Braces: Roll formed from aluminum sheet with minimum wall thickness as required for class indicated.
 - b. Extruded-Aluminum or Aluminum Tubular Framing Sections and Cross Braces: Not less than **0.040-inch (1.0-mm) OR 0.050-inch (1.3-mm)**, **as directed**, wall thickness.
 - c. Finish: Match aluminum window members.
 - d. Finish: Anodized aluminum **OR** Baked-on organic coating, **as directed**, in manufacturer's standard color.
 - e. Finish: Anodized aluminum **OR** Baked-on organic coating, **as directed**, in color selected from manufacturer's full range.
 - f. Finish: Manufacturer's standard.
4. Glass-Fiber Mesh Fabric: **18-by-14 (1.1-by-1.4-mm)** or **18-by-16 (1.0-by-1.1-mm) OR 20-by-20 (0.85-by-0.85-mm)** or **20-by-30 (0.85-by-0.42-mm)**, **as directed**, mesh of PVC-coated, glass-fiber

threads; woven and fused to form a fabric mesh resistant to corrosion, shrinkage, stretch, impact damage, and weather deterioration; in the following color. Comply with ASTM D 3656.

- a. Mesh Color: Charcoal gray **OR** Silver gray **OR** Aquamarine, **as directed**.
5. Aluminum Wire Fabric: **18-by-16 (1.1-by-1.3-mm)** mesh of **0.011-inch- (0.28-mm-)** diameter, coated aluminum wire.
 - a. Wire-Fabric Finish: Natural bright **OR** Charcoal gray **OR** Black, **as directed**.
6. Copper Wire Fabric: **16-by-16 (1.3-by-1.3-mm)** mesh of **0.011-inch- (0.28-mm-)** diameter copper wire.
7. Bronze Wire Fabric: **18-by-14 (1.2-by-1.6-mm)** mesh of **0.009-inch- (0.23-mm-)** **OR** **18-by-14 (1.13-by-1.5-mm)** mesh of **0.011-inch- (0.28-mm-)**, **as directed**, diameter bronze wire with a clear varnish finish.
8. Stainless-Steel Wire Fabric: **18-by-14 (1.2-by-1.6-mm)** mesh of **0.009-inch- (0.23-mm-)** **OR** **18-by-16 (1.2-by-1.4-mm)** mesh of **0.009-inch- (0.23-mm-)** **OR** **18-by-16 (1.13-by-1.3-mm)** mesh of **0.011-inch- (0.28-mm-)**, **as directed**, diameter, nonmagnetic stainless-steel wire, Type 304 or 316, complying with FS RR-W-365, Type VI.
9. Solar-Screening Mesh Fabric: **17-by-15 (0.86-by-1.1-mm)** **OR** **40-by-40 (0.3-by-0.3-mm)**, **as directed**, mesh of PVC-coated, glass-fiber threads; woven and fused to form a fabric mesh resistant to corrosion, shrinkage, stretch, impact damage, and weather deterioration. Comply with ASTM D 3656.
10. Wickets: Provide sliding **OR** hinged, **as directed**, wickets, framed and trimmed for a tight fit and for durability during handling.

G. Accessories

1. Integral Ventilating System/Device: Where indicated, provide weather-stripped, adjustable, horizontal fresh-air vent, with a free airflow slot, full width of window sash by approximately **1 inch (25 mm)** **OR** **3 inches (75 mm)**, **as directed**, when open, complying with AAMA/WDMA 101/I.S.2/NAFS. Equip vent bar with an integral insect screen, removable for cleaning.
2. Window Cleaner Anchor Bolts: Provide window cleaner anchor bolts of standard design, complying with requirements of authorities having jurisdiction. Fabricate bolts of nonmagnetic stainless steel.
 - a. Reinforce window units or mullions to receive bolts and provide additional anchorage of units at bolt locations.
3. Integral Louver Blinds: Provide remotely operated horizontal louver blinds in the space between two panes of glass. Construct blinds of aluminum slats, approximately **1 inch (25 mm)** wide, with polyester fiber cords, equipped for tilting, raising, and lowering by standard operating hardware located on inside face of sash.
4. Exterior Louver Units: Manually adjustable, extruded-aluminum, solar-shade louver units; of type recommended by manufacturer for application over operable or fixed windows. Provide main extrusion members of **0.062-inch (1.6-mm)** minimum wall thickness.
 - a. Operator: Crank-type gang operator, operable from inside building, designed to rotate louver blades simultaneously at least 80 degrees and to lock units in closed position; one operator per each louver unit. Form unit framing or mounting without interfering with insect screens.

H. Fabrication

1. Fabricate aluminum windows in sizes indicated. Include a complete system for assembling components and anchoring windows.
2. Fabricate aluminum windows that are reglazable without dismantling sash or ventilator framing.
3. Thermally Improved Construction: Fabricate aluminum windows with an integral, concealed, low-conductance thermal barrier; located between exterior materials and window members exposed on interior side; in a manner that eliminates direct metal-to-metal contact.
 - a. Provide thermal-break construction that has been in use for not less than three years and has been tested to demonstrate resistance to thermal conductance and condensation and to show adequate strength and security of glass retention.

- b. Provide thermal barriers tested according to AAMA 505; determine the allowable design shear flow per the appendix in AAMA 505.
 - c. Provide hardware with low conductivity or nonmetallic material for hardware bridging thermal breaks at frame or vent sash.
 4. Weather Stripping: Provide full-perimeter weather stripping for each operable sash and ventilator.
 - a. Horizontal-Sliding Windows: Provide operable sash with a double row of sliding weather stripping in horizontal rails and single- or double-row weather stripping in meeting or jamb stiles, as required to meet specified performance requirements. Provide compression-type weather stripping at perimeter of each movable panel where sliding-type weather stripping is not appropriate.
 - b. Vertically Pivoted Windows: Provide double-row weather stripping.
 5. Weep Holes: Provide weep holes and internal passages to conduct infiltrating water to exterior.
 6. Provide water-shed members above side-hinged ventilators and similar lines of natural water penetration.
 7. Mullions: Provide mullions and cover plates as shown, matching window units, complete with anchors for support to structure and installation of window units. Allow for erection tolerances and provide for movement of window units due to thermal expansion and building deflections, as indicated. Provide mullions and cover plates capable of withstanding design loads of window units.
 8. Subframes: Provide subframes with anchors for window units as shown, of profile and dimensions indicated but not less than ~~0.062-inch~~ (1.6-mm) thick extruded aluminum. Miter or cope corners, and weld and dress smooth with concealed mechanical joint fasteners. Finish to match window units. Provide subframes capable of withstanding design loads of window units.
 9. Factory-Glazed Fabrication: Glaze aluminum windows in the factory where practical and possible for applications indicated. Comply with requirements in Division 08 Section "Glazing" and with AAMA/WDMA 101/I.S.2/NAFS.
 10. Glazing Stops: Provide snap-on glazing stops coordinated with Division 08 Section "Glazing" and glazing system indicated. Provide glazing stops to match sash and ventilator frames.
- I. Finishes, General
1. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
 2. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
 3. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in the same piece are not acceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.
- J. Aluminum Finishes
1. Finish designations prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.
 2. Class II, Clear Anodic Finish: AA-M12C22A31 (Mechanical Finish: nonspecular as fabricated; Chemical Finish: etched, medium matte; Anodic Coating: Architectural Class II, clear coating 0.010 mm or thicker) complying with AAMA 611.
 3. Class I, Clear Anodic Finish: AA-M12C22A41 (Mechanical Finish: nonspecular as fabricated; Chemical Finish: etched, medium matte; Anodic Coating: Architectural Class I, clear coating 0.018 mm or thicker) complying with AAMA 611.
 4. Class II, Color Anodic Finish: AA-M12C22A32/A34 (Mechanical Finish: nonspecular as fabricated; Chemical Finish: etched, medium matte; Anodic Coating: Architectural Class II, integrally colored or electrolytically deposited color coating 0.010 mm or thicker) complying with AAMA 611.

5. Class I, Color Anodic Finish: AA-M12C22A42/A44 (Mechanical Finish: nonspecular as fabricated; Chemical Finish: etched, medium matte; Anodic Coating: Architectural Class I, integrally colored or electrolytically deposited color coating 0.018 mm or thicker) complying with AAMA 611.
 - a. Color: Light bronze **OR** Medium bronze **OR** Dark bronze **OR** Black **OR** Match sample **OR** As selected from full range of industry colors and color densities, **as directed**.
6. Baked-Enamel Finish: AA-C12C42R1x (Chemical Finish: cleaned with inhibited chemicals; Chemical Finish: acid-chromate-fluoride-phosphate conversion coating; Organic Coating: as specified below). Apply baked enamel complying with paint manufacturer's written instructions for cleaning, conversion coating, and painting.
 - a. Organic Coating: Thermosetting, modified-acrylic or polyester enamel primer/topcoat system complying with AAMA 2603, except with a minimum dry film thickness of **1.5 mils (0.04 mm)**, medium gloss.
 - b. Color: As indicated by manufacturer's designations **OR** Match sample **OR** As selected from manufacturer's full range, **as directed**.
7. High-Performance Organic Finish (2-Coat Fluoropolymer): AA-C12C40R1x (Chemical Finish: cleaned with inhibited chemicals; Chemical Finish: conversion coating; Organic Coating: manufacturer's standard 2-coat, thermocured system consisting of specially formulated inhibitive primer and fluoropolymer color topcoat containing not less than 50 **OR** 70, **as directed**, percent polyvinylidene fluoride resin by weight). Prepare, pretreat, and apply coating to exposed metal surfaces to comply with AAMA 2604 **OR** AAMA 2605, **as directed**, and with coating and resin manufacturers' written instructions.
8. High-Performance Organic Finish (3-Coat Fluoropolymer): AA-C12C40R1x (Chemical Finish: cleaned with inhibited chemicals; Chemical Finish: conversion coatings; Organic Coating: manufacturer's standard 3-coat, thermocured system consisting of specially formulated inhibitive primer, fluoropolymer color coat, and clear fluoropolymer topcoat, with both color coat and clear topcoat containing not less than 70 percent polyvinylidene fluoride resin by weight). Prepare, pretreat, and apply coating to exposed metal surfaces to comply with AAMA 2605 and with coating and resin manufacturers' written instructions.
 - a. Color and Gloss: As indicated by manufacturer's designations **OR** Match sample **OR** As selected from manufacturer's full range, **as directed**.

1.3 EXECUTION

A. Installation

1. Comply with Drawings, Shop Drawings, and manufacturer's written instructions for installing windows, hardware, accessories, and other components.
2. Install windows level, plumb, square, true to line, without distortion or impeding thermal movement, anchored securely in place to structural support, and in proper relation to wall flashing and other adjacent construction.
3. Set sill members in bed of sealant or with gaskets, as indicated, for weathertight construction.
4. Install windows and components to drain condensation, water penetrating joints, and moisture migrating within windows to the exterior.
5. Separate aluminum and other corrodible surfaces from sources of corrosion or electrolytic action at points of contact with other materials.
6. Connect automatic operators to building electrical system.

B. Field Quality Control

1. Testing Agency: Engage a qualified testing agency to perform tests and inspections and prepare test reports.
 - a. Testing and inspecting agency will interpret tests and state in each report whether tested work complies with or deviates from requirements.
2. Testing Services: Testing and inspecting of installed windows shall take place as follows:
 - a. Testing Methodology: Testing of windows for air infiltration and water resistance shall be performed according to AAMA 502, Test Method A **OR** B, **as directed**, by applying same

test pressures required to determine compliance with AAMA/WDMA 101/I.S.2/NAFS in Part 1 "Performance Requirements" Article.

- b. Testing Extent: Three windows as selected by the Owner and a qualified independent testing and inspecting agency. Windows shall be tested immediately after installation.
- c. Test Reports: Shall be prepared according to AAMA 502.
3. Remove and replace noncomplying aluminum window and retest as specified above.
4. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

C. Adjusting, Cleaning, And Protection

1. Adjust operating sashes and ventilators, screens, hardware, operators, **as directed**, and accessories for a tight fit at contact points and weather stripping for smooth operation and weathertight closure. Lubricate hardware and moving parts.
2. Clean aluminum surfaces immediately after installing windows. Avoid damaging protective coatings and finishes. Remove excess sealants, glazing materials, dirt, and other substances.
3. Clean factory-glazed glass immediately after installing windows. Comply with manufacturer's written recommendations for final cleaning and maintenance. Remove nonpermanent labels, and clean surfaces.
4. Remove and replace glass that has been broken, chipped, cracked, abraded, or damaged during construction period.
5. Protect window surfaces from contact with contaminating substances resulting from construction operations. In addition, monitor window surfaces adjacent to and below exterior concrete and masonry surfaces during construction for presence of dirt, scum, alkaline deposits, stains, or other contaminants. If contaminating substances do contact window surfaces, remove contaminants immediately according to manufacturer's written recommendations.

END OF SECTION 08 51 13 00

SECTION 08 51 13 00a - ALUMINUM REPLACEMENT WINDOWS

DESCRIPTION OF WORK

This specification covers the furnishing and installation of materials for aluminum replacement windows. Products shall be as directed by the Owner. Installation procedures shall be in accordance with the product manufacturer's recommendations. Demolition and removal of materials shall be as required to support the work.

GENERAL

Definitions

1. Window Types: ANSI/AAMA 101.
 - a. Horizontal Slider (HS): Primary horizontally operating window.
 - b. Single Hung (SH): Primary vertically operating window with only one operable sash.
 - c. Double Hung (DH): Primary vertically operating window with two operable sashes.
 - d. Thermally Improved: Primary window with thermal break between interior and exterior metal surfaces both at frame and sash or panel members.
 - 1) Single Window Construction: Provide insulating glass.
 - 2) Thermally improved aluminum windows may use members with thermal breaks or be of dual window construction (i.e., primary-secondary (storm) or primary-primary).
 - e. Dual Window Construction (DW):
 - 1) Primary-Secondary: Primary window with either interior or exterior secondary (storm) window.
 - 2) Primary-Primary: Combination of two primary windows employing common frame.
2. Type of Stainless Steel Screens (Frames and Screening): Medium, and Heavy Types: As defined by and comply with requirements of ANSI/SMA 6001.
3. Supply and Delivery Only: Include supply and delivery to site(s) FOB destination freight prepaid. Unless otherwise specified or scheduled, unloading and handling at site is by the Owner.

System Description

4. Performance Requirements: Comply with following:
 - a. Aluminum Replacement Windows: HUD UM 39a.
 - b. Aluminum Replacement Windows: ANSI/AAMA 101 (Including test size requirements):
 - 1) Horizontal Sliding Windows: HS C35.
 - a) Water Resistance: ASTM E 547, no leakage at 251.4 Pa (5.25 PSF) test pressure.
 - 2) Single Hung and Double Hung Windows: DH C35.
 - a) Water Resistance: ASTM E 547, no leakage at 251.4 Pa (5.25 PSF) test pressure.
 - 3) Single Hung and Double Hung Windows: DH C45.
 - a) Water Resistance: ASTM E 547, no leakage at 323.4 Pa (6.75 PSF) test pressure.
 - 4) Air Infiltration: ASTM E 283, Not exceed 0.049 cu m/s/mm (0.34 CFM/ft) of crack length of operable sash at 75 Pa (1.57 PSF) test pressure.
 - 5) Dual Window Construction: DW.
 - c. Aluminum Replacement Windows: ASTM F 588, Annex A1, forced entry resistance performance level 10.
 - d. Thermally Improved Windows: AAMA 1504:

- 1) Thermal Transmittance (U-Value): Maximum U70, 3.97 W/sq. m C (0.70 BTU/HR.FT.F) if not otherwise scheduled.
- 2) Condensation Resistance Factor (CRF): Minimum CRF C50 if not otherwise scheduled.
- e. Sealed Insulating Glass: Tested and certified in accordance with HUD UM 82 complying with ASTM E 774, Class C.

Submittals

5. Product Data:
6. Shop Drawings:
 - a. Include window elevations, installation details, anchorage details, clearance between frame and rough opening, hardware, glazing, and accessories.
7. Samples: Submit full set of finish color samples for color selection.
 - a. For Supply and Deliver Only Contract: Submit one full size sample of each type of aluminum replacement window with specified finish for acceptance. Include sample of trickle ventilator.
8. Quality Assurance/Control Submittals:
 - a. Certificates: Manufacturer's written third party certification that aluminum windows meet or exceed HUD UM 39a, HUD 82, and ANSI/AAMA 101 and other specified requirements.
 - b. Manufacturer's installation instructions.
9. Closeout Submittals
 - a. Operation and maintenance data.
 - b. Special warranty.

Quality Assurance

10. Regulatory Requirements:
 - a. Glazing Materials: Comply with CPSC 16 CFR 1201 or ANSI Z97.1.
 - b. Egress Requirements: Comply with applicable codes and regulations.
 - c. Provide emergency egress, single point locking release, and bit key lock fire entry from exterior as and where required by applicable codes and regulations.
 - d. Accessibility:
 - 1) Architectural Barriers Act of 1968 as amended (42 USC 4151-4157) and HUD implementing regulations (24 CFR Part 40).
 - a) Uniform Federal Accessibility Standards (UFAS).
 - 2) Section 504 of the Rehabilitation Act of 1973 as amended (29 USC 794) and HUD implementing regulations 24 CFR Part 8.
 - 3) Fair Housing Accessibility Guidelines (24 CFR Chapter 1).
 - 4) Americans with Disabilities Act of 1990 (ADA) (42 USC §§ 12101, et seq.) and implementing regulations (28 CFR Part 35).
11. Certifications: Comply with HUD UM 39a, HUD UM 82, ANSI Z34.1 and HUD 24 CFR 200.935.
12. Mock-ups: For Supply and Install Contract: Install one full size mock-up of each type of aluminum replacement window with specified finish for acceptance.
 - a. Location
 - b. Approved Mock-up: Standard for rest of work.
 - c. Approved Mock-up: May remain part of completed project.

Delivery, Storage, And Handling

13. Packing, Shipping, Handling, and Unloading: Pack materials at manufacturing plant to prevent damage during shipping.
 - a. Aluminum Replacement Windows: Label in accordance with HUD UM 39a attached signifying compliance with ANSI/AAMA 101 performance requirements.
 - b. Thermally Improved Windows: Label in accordance with HUD UM 39a attached signifying compliance with specified AAMA 1504 performance requirements.
14. Acceptance at Site: Inspect aluminum replacement windows upon delivery. Replace damaged or defective materials before installation.

15. Storage and Protection: Store aluminum replacement windows in manner to protect from weather and other damage.

Project Conditions

16. Field Measurements: Field measure openings for aluminum replacement windows before start of fabrication.

Scheduling And Sequencing

17. Scheduling and Completion: Comply with requirements of Detailed Scope of Work.

Warranty

18. Special Warranty: Provide one year written covering materials and installation for aluminum replacement windows.
 - a. Warranty: Include coverage of inserts, hardware, and latches.
 - 1) Screening and glazing not included.
 - 2) Defects resulting from vandalism not included.
 - b. For Supply and Delivery Only Contract:
 - 1) Contractor: Agrees to supply and deliver to the Owner, free of charge, any required replacement parts that can be readily installed by the Owner without special tools.
 - 2) Contractor: Agrees to supply and deliver free of charge, complete replacement window, when defective part or parts cannot be installed without use of special tools.
 - c. For Supply and Install Contract:
 - 1) Contractor: Agrees to supply and install, free of charge, any required replacement parts or complete replacement window.

PRODUCTS

Aluminum Replacement Windows

19. General: Type(s) and size(s) indicated, specified, or scheduled with necessary hardware, anchors and equipment.

Materials

20. Aluminum Materials:
 - a. Extruded Aluminum: ASTM B 221, Alloy 6063-T5 or stronger.
 - b. Aluminum Alloys: Commercial quality and of proper alloy for window construction, free from defects impairing strength and/or durability.
 - 1) Wrought Aluminum Alloys: Alloying Elements: ANSI/AAMA 101.
 - c. Window Members, Including Muntins: Aluminum except as allowed by ANSI/AAMA 101.
 - 1) Sill Members: Minimum 2.0 mm (0.078 inch) thick.
 - d. Interlocks and mating fins may vary by tapering at maximum projected distance of 8 mm (5/16 inch) from edge.
 - 1) Other appendages may taper providing design results in net area of at least that calculated by using prescribed wall thickness for appendage length.
 - e. Edge or Corner: May be eased with radius not to exceed wall thickness permitted for member.
 - f. Glazing Legs, Channels or Glazing Bead Retainers, Serrated or Not: Minimum 1.3 mm (0.050 inch) thick for distance of not more than 13 mm (1/2 inch) each leg.
21. Other Metal Materials:
 - a. Carbon Steel (reinforcing members): ASTM A 36, zinc coated in accordance with ASTM B 633 or cadmium coated in accordance with ASTM B 766.
 - b. Stainless Steel: ASTM A 167, Type 302.
 - c. Welding Filler Rods: AWS A5.3.
22. Glazing Materials: Comply with CPSC 16 CFR 1201 or ANSI Z97.1.
 - a. Glass: ASTM C 1036, Type 1, Class 1, Glazing B Quality.
 - b. Tempered Glass: ASTM C 1048, Kind FT, Condition A, Type 1, Class 1, Glazing B Quality.

- c. Plastic: Extruded polycarbonate clear sheets, minimum 4.5 mm (0.177 inch) thick with following characteristics:
 - 1) Impact Resistance: ASTM D 256, Method A, 12-18 foot-pound per inch.
 - 2) Elongation/Modulus of Elasticity: ASTM D 638, 110 percent maximum/340,000 PSI.
 - 3) Heat Deflection: ASTM D 648, 132.2 degrees C (270 degrees F) at 264 PSI.
 - 4) Abrasion Resistance: Coated on both surfaces to produce abrasion resistance of 3-19 percent maximum haze increase for 500 revolutions of CS-1 OF wheel per ASTM D 1044.
- d. Insulating Glass Units: HUD UM 82 and ASTM E 774, Class CBA.
- e. Glass Thickness: Determined in accordance with ANSI/AAMA 101 Appendix, minimum 3 mm (1/8 inch) (DS).
 - 1) Design Wind Pressures: Determined in accordance with applicable codes and regulations.
- f. Glass: Labeled to show name of manufacturer and type.
- 23. Glazing Materials: Particularly suited for use with aluminum and not require painting.
 - a. Make adequate provisions for use of glazing compound, if applicable.
 - b. Remove material from glazing surfaces to which glazing compound will not readily adhere.
 - c. Windows: May be either factory or field glazed by either channel-type gaskets or back-bedding materials.
 - d. Glazing Clips: Not required when face stops are used.
- 24. Glazing Beads or Retainers: Material compatible with aluminum, and 6 required to retain glass, of sufficient strength and fixation to serve this purpose.
 - a. Thickness of Glazing Beads: Optional except as otherwise specified.
- 25. Screens: Provide windows with screens as indicated, specified, or scheduled in manufacturer's standard approved design, applicable to specific aluminum windows.
 - a. Screen Frames: Extruded aluminum frames of suitable alloy and of sufficient rigidity, crossbraces, as required, to lie flat against window and to prevent excessive bow in frame members and sag in screening.
 - 1) Frame Corners: Firmly joined in secure and rigid manner.
 - 2) Screen Spline: Aluminum or a material compatible with aluminum.
 - b. Screening: One of following as indicated, specified, or scheduled:
 - 1) Vinyl Coated Fibrous Glass Yam: ASTM D 3656, Class 1, 18 by 16 mesh, 0.29 mm (0.0115 inch) diameter yam.
 - 2) Polyvinylidene Chloride or Polypropylene Filament: FS L-S-12513, Type I or III, Class 1 or 2, 18 by 18 mesh, 0.31 mm (0.012 inch) or 0.38 mm (0.015 inch) diameter filament.
 - 3) Aluminum: FS RR-W-365, Type VII, 18 x 16 or 18 by 18 regular, 0.28 mm (0.011 inch) diameter wire.
 - 4) Stainless Steel: Type 304 stainless steel:
 - a) Medium: ANSI/SMA 6001 Medium Type, 12 x 12 mesh 0.58 mm (0.023 inch) diameter wire.
 - b) Heavy: ANSI/SMA 6001 Heavy Type, 12 x 12 mesh 0.71 mm (0.028 inch) diameter wire, high tensile strength.
 - c) Screen Frames: ANSI/SMA 6001 performance requirements, minimum 1.6 mm (0.062 inch) aluminum extruded 6063-T5 alloy designed to accept stainless steel wire cloth.
 - d) Emergency Egress Windows: Design screen to be opened from interior only (to allow for egress to exterior).
 - c. Screening: Fastened to frame in manner to permit replacement of screening.
 - d. Screens: Provide with fastening devices, suited particularly for application to specific window made of aluminum or materials compatible with aluminum and of sufficient strength to perform satisfactorily.
 - e. Assembled Screen with Insect Screening and Spline in Place: Outside dimension as measured from midpoint of opposite framing members shall not vary more than 4.8 mm (3/16 Inch) from outside dimension as measured at extreme ends of framing members.

- f. Screens: Comply with applicable fire codes for egress and fireman access.
 - 1) Provide single point release as and where required by applicable codes and regulations.
 - 2) Provide bit key lock fire entry from exterior if required by applicable codes and regulations.
- g. Window Screens: Include warning label indicating that screen will not stop child from falling out of window in accordance with SMA 7001.

Accessories

- 26. Hardware: Designed to perform functions for which it is intended and securely attached to window.
- 27. Thermal Break Material: Urethane, PVC, ISP, vinyl, or other material suitable for application that is compatible with aluminum.
- 28. Fasteners: Comply with ANSI/AAMA 101.
- 29. Panning and Receptor Systems: Extruded aluminum designed to fit existing openings, to receive windows, and to withstand wind forces as required by applicable codes and regulation.
 - a. Exterior Trim System: Designed to withstand expansion/contraction forces of trim material.
 - b. Interior Snap Trim: Provide manufacturer's standard interior trim package.
 - c. Extruded Aluminum Minimum Thickness: 1.57 mm (0.062 inches).
- 30. Thermal Insulation: Unfaced fiberglass batt insulation in accordance with ASTM C 665, Type 1.
 - a. Vapor Barrier: ASTM D 4397, 4 mil polyethylene sheeting with pressure sensitive adhesive sealing tape.
- 31. Joint Sealants:
 - a. Exterior Joint Sealant: AAMA 800, Type 808.3 Exterior Perimeter Sealing Compound.
 - b. Back-up Material: Standard preformed and precompressed foam material, round rod or semi-circular type, permanently elastic, mildew resistant, nonmigratory, nonstaining, and compatible with joint substrates and with sealant.
 - 1) Materials impregnated with oil, solvents, or bituminous materials not allowed.
 - 2) Provide type as recommended by sealant manufacturer for particular installation.
 - 3) Material: Neoprene, butyl, polyurethane, vinyl, or polyethylene rod.
 - c. Interior Joint Sealant: ASTM C 834, latex acrylic.

Fabrication

- 32. Windows: Assembled in secure manner to perform as specified and to provide neat, weather tight construction.
 - a. Make permanent watertight joints at junctions of sill and jamb members.
 - b. Joint Sealant at Mechanically Fixed Joints: AAMA 800, Type 803.3.
 - c. Welding or Brazing Flux: Completely removed immediately upon completion of welding or brazing operation.
- 33. Mullions and Structural Members: Mullion (whether joined by integral mullions, independent mullions, or by combination of frame members): Capable of withstanding load outlined under Uniform Load in ANSI/AAMA 101, Section 2 without deflecting more than 1/175th of its span.
- 34. Fin Trim or Installation Fins: Aluminum or other suitable material compatible with aluminum and of sufficient strength and thickness to assure satisfactory installation.
 - a. Nailing grooves and/or break off score lines in extrusions are acceptable.
 - b. Applied fins or fin trim may be assembled to windows by interlocking with frame members or with fasteners located not over 400 mm (16 inches) OC.
- 35. Thermally Improved Windows: Single window construction with thermal breaks and insulating glass units or dual window construction.
 - a. Thermal Break in Two Frame or One Frame Windows: Not bridged by any screws, fasteners, panning, etc., that would allow excessive heat transfer through window frame.
 - b. Do not make structural connection in loading bearing member into thermal break material.
- 36. Sills: Provide weep holes in sill of glazing pocket to provide means for water to flow to exterior.
- 37. Trickle Ventilators: Type which fits within glazing channels of sash frame, and contains gasketed channel to accept sealed insulating glass used in window sash.

- a. Ventilator: Installed in top rail of upper sash, accurately sized to extend full width of sash, properly fit sash, and sash frame above and insulating glass below.
- b. Ventilator: Consist of two piece aluminum housing connected by, and separated by, PVC extrusion forming thermal break.
- c. Gasketed Shutter: Operate Internal flap to open and close ventilator.
- d. Unit: Complete with fly-screen.
- e. Color: Selected from manufacturers standard colors.
- 38. Secondary Windows (Storm Windows): Comply with Division 8 Section "Aluminum Storm Windows."
- 39. Windows: Comply with applicable fire codes for egress.

Finishes

- 40. Finish:
 - a. Aluminum: Provide one of following finishes as specified or scheduled:
 - 1) Pigmented Organic Coating: Factory applied pigmented organic coating, AAMA 603.8.
 - a) Color: As selected from manufacturers standard colors.
 - 2) High Performance Organic Coating: Factory applied pigmented organic coating, AAMA 605.2.
 - a) Color: As selected from manufacturer's standard colors.
 - 3) Color Anodized: Factory applied anodic coating, AAMA 608.1, Class 1.
 - a) Color: As scheduled.
 - 4) Clear Anodized: Factory applied anodic coating, AAMA 607.1, Class 1.
 - b. Exposed Surfaces of Aluminum Members: Clean and free from serious surface blemishes.
 - c. Dress and finish exposed welded joints.
- 41. Protective Coatings:
 - a. Steel Subframes: Insulate surfaces of steel from direct contact with aluminum surfaces by heavy coat or alkali-resistant bituminous paint or zinc-chromate prime coat, or other coating suitable for this purpose.
 - b. Wood Subframes: Properly treat with preservative which will not promote corrosion of aluminum.
 - c. Steel or Wood Subframes: Do not leave exposed on exterior of building.

Source Quality Control

- 42. Fabrication Tolerances: Wall Thickness, Cross-sectional Size and Overall Size: In accordance with ANSI/AAMA 101.
- 43. Testing: Performed under Third Party Administrator who is in compliance with HUD UM 39a, ANSI Z34.1, and HUD 24 CFR 200.935.

EXECUTION

Examination

- 44. Site Verification of Conditions:
 - a. Field Measurements: Verify field measurements are as indicated on Shop Drawings.
 - b. Existing Conditions: Examine openings before beginning installation.
 - c. Do not proceed with installation until conditions are satisfactory.

Preparation

- 45. Protection: Protect adjacent elements from damage and disfiguration in accordance with Detailed Scope of Work.
 - a. Contractor: Responsible for damage to grounds, plantings, buildings and any other facilities or property caused by construction operations.
 - b. Adequately enclose and protect against weather any interior space where installation is incomplete at end of working day.

- c. Repair or replace damaged elements in accordance with Detailed Scope of Work.
- 46. Existing Widows: Remove existing windows and debris from site in accordance with Detailed Scope of Work.
- 47. Preparation: Prepare openings and existing frames in accordance with ASTM E 737.
 - a. Existing Window Jambs: Prepare as necessary to provide for straight, plumb, level, tight and aesthetically appealing installation of new windows.
 - b. Preparatory Work: Include, but not limited to repair of jambs, filling holes and/or dents, removing peeling and scaling paint, etc.

Installation

- 48. General: Install in accordance with ASTM E 737 except as modified by ANSI/AAMA 101 Appendix, manufacturer's recommendations, Reference Standards, and approved Shop Drawings.
 - a. Securely fasten windows in place to straight, plumb and level condition, without distortion of window or window frame, and make final adjustments for proper operation and satisfactory weatherstrip contact and seal.
 - b. Make proper allowance for expansion/contraction movement of aluminum.
 - c. Panning and Receptor Systems: Install to ensure watertight seal at joints with existing opening and with new replacement window.
 - 1) Thermal Insulation: Fill voids in panning system with thermal insulation.
 - 2) Vapor Barrier: Apply vapor barrier on inside between panning and existing opening. Seal laps and terminations with pressure sensitive tape.
 - d. Comply with applicable codes and regulations regarding egress requirements and fireman entry.
- 49. Joint Sealants: Apply in accordance with manufacturers recommendations.
 - a. Surfaces to be Sealed: Clean, dry and free of any foreign matter that would degrade adhesion. Remove existing caulking and joint sealants from areas to receive new joint sealant.
 - b. Prime cleaned surfaces in accordance with sealant manufacturer's recommendations.
 - c. Protect surfaces adjacent to joints by masking tape before applying sealant. Remove tape upon finishing sealing work.
 - d. Seal joints between perimeter of window frame and underlying or surrounding construction at
 - e. Exterior and interior with joint sealant to accomplish weather-tight installation. Maximum Width of Sealed Joint: 13 mm (1/2 inch).
- 50. Dissimilar Materials: Isolate materials from incompatible materials as necessary to prevent deterioration and galvanic action.
 - a. Separate dissimilar metals with bituminous paint, suitable sealant, nonabsorptive plastic or elastomeric tape. or gasket between surfaces.
 - b. Coat aluminum in direct contact with concrete, masonry, steel, or other non-compatible materials with bituminous paint, zinc chromate primer, or other suitable insulating material.

Field Quality Control

- 51. Owners Field Testing: the Owner may have field testing of windows conducted by its own testing agency in accordance with AAMA 502.
 - a. Tests: May include, but not limited to:
 - 1) Field Testing (Hose Test) for Water Leakage: AAMA 501.2.
 - 2) Field Testing (Air Pressure Difference) for Water Leakage: AAMA 502, Test Method B.
 - a) Field Testing for Air Leakage: ASTM E 783.
 - b) Field Testing for Water Determination: ASTM E 1105.
 - b. Test Pressures: Comply with specified performance requirements.
 - c. Contractor: Provide incidental labor facilities necessary to facilitate inspections and tests.
 - d. Costs of Testing:
 - 1) By the Owner: Successful initial tests.



- 2) By Contractor: Initial tests with failures and subsequent tests as required because of test failures. Costs shall include costs of the Owner and other consultants for observations of tests and corrective work.
- e. Corrective Measures: Meet standards of quality of specified window and subject to acceptance of the Owner.

Adjusting And Cleaning

- 52. Adjusting: At completion of job, check, adjust, and lubricate hardware as required and leave windows and hardware in proper operating condition.
- 53. Cleaning: Comply with requirements of Detailed Scope of Work.
 - a. Clean windows after installation is completed to remove foreign matter and surface blemishes.
 - b. Scratched or Abraded Surfaces: Touch-up with rust inhibitor primer and enamel paint compatible with factory finish.

Protection

- 54. Installed Work: Protect windows from damage after installation.

END OF SECTION 08 51 13 00a



Task	Specification	Specification Description
08 51 19 00	01 22 16 00	No Specification Required

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SECTION 08 51 23 00 - STEEL WINDOWS

1.1 GENERAL

A. Description Of Work

1. This specification covers the furnishing and installation of material for steel windows. Products shall be as follows or as directed by the Owner. Installation procedures shall be in accordance with the products manufacturer's recommendations. Demolition and removal of materials shall be as required to support the work.

B. Summary

1. Section Includes:
 - a. Steel windows from hot-rolled sections.
 - b. Steel windows from cold-formed steel members.

C. Performance Requirements

1. Structural Performance: Provide steel windows capable of withstanding the effects of the following loads and stresses within limits and under conditions indicated, based on testing windows that are representative of those specified according to ASTM E 330 or structural calculations:
 - a. Design Wind Loads: Determine design wind loads under conditions indicated according to ASCE/SEI 7.
 - 1) Basic Wind Speed: **85 mph (38 m/s) OR 90 mph (40 m/s), as directed.**
 - 2) Importance Factor.
 - 3) Exposure Category: **B OR C OR D, as directed.**
 - b. Deflection Limits: Design glass framing system to limit lateral deflections of glass edges to less than 1/175 of glass-edge length or **3/4 inch (19 mm)**, whichever is less, at design pressures.
2. Windborne-Debris Resistance: Provide glazed steel windows capable of resisting impact from windborne debris, based on the pass/fail criteria as determined from testing glazed steel windows identical to those specified, according to ASTM E 1886 and testing information in ASTM E 1996 and requirements of authorities having jurisdiction.
3. Condensation-Resistance: Provide steel windows with a CRF when tested according to AAMA 1503 **OR** CR determined according to NFRC 500, **as directed**, of 36 **OR** 40, **as directed**, minimum.
4. Thermal Transmittance: Provide steel windows with the maximum whole-fenestration product U-factor indicated, when tested according to AAMA 1503 **OR** determined according to ASTM E 1423 **OR** determined according to NFRC 100, **as directed**.
 - a. U-Factor: 0.49 Btu/sq. ft. x h x deg F **OR** 2.8 W/sq. m x K, **as directed**.
5. Solar Heat-Gain Coefficient (SHGC): Provide steel windows with a maximum whole-fenestration product SHGC of 0.40 **OR** 0.55, **as directed**, determined according to NFRC 200.
6. Air Infiltration for Weather-Stripped Ventilators: Not more than **0.37 cfm/ft. (0.18 L/s per m)** of ventilator crack length at an inward test pressure of **6.24 lbf/sq. ft. (298 Pa)** when tested according to ASTM E 283.
7. Air Infiltration for Non-Weather-Stripped Ventilators: Not more than **1.0 cfm/ft. (0.47 L/s per m)** of ventilator crack length at an inward test pressure of **1.56 lbf/sq. ft. (75 Pa)** when tested according to ASTM E 283.
8. Water Penetration: No leakage for 15 minutes when window is subjected to a rate of flow of **5 gal./h per sq. ft. (0.05 L/s per sq. m)** with a differential pressure across the window of **2.86 lbf/sq. ft. (137 Pa) OR 6.24 lbf/sq. ft. (298 Pa), as directed**, when tested according to ASTM E 331.
9. Forced-Entry Resistance: Comply with Performance Grade 10 requirements when tested according to ASTM F 588.
10. Crack Tolerances: Test each type and size of required window unit, with ventilators closed and locked, for compliance with the following tolerances:

- a. Casement Windows: It shall not be possible to freely insert a steel feeler gage **2 inches (51 mm)** wide by **0.020 inch (0.5 mm)** thick between more than 40 percent of the inside metal-to-metal contacts between frames and ventilators without forcing.
 - b. Projected Windows: It shall not be possible to freely insert a steel feeler gage **2 inches (51 mm)** wide by **0.031 inch (0.8 mm)** thick between the inside metal-to-metal contacts between frames and ventilators without forcing, or to freely insert a steel feeler gage **2 inches (51 mm)** wide by **0.020 inch (0.5 mm)** thick between more than 40 percent of such contacts between frames and ventilators without forcing.
11. Recycled Content of Steel Products: Provide products with an average recycled content of steel products so postconsumer recycled content plus one-half of preconsumer recycled content is not less than 25 percent.

D. Submittals

1. Product Data: For each type of product indicated. Include construction details, material descriptions, fabrication methods, dimensions of individual components and profiles, hardware, finishes, and operating instructions.
 - a. Motors: Show nameplate data, ratings, characteristics, and mounting arrangements.
2. LEED Submittal:
 - a. Product Data for Credit MR 4.1 and Credit MR 4.2, **as directed**: For products having recycled content, documentation indicating percentages by weight of postconsumer and preconsumer recycled content. Include statement indicating costs for each product having recycled content.
3. Shop Drawings: Include plans, elevations, sections, details, hardware, attachments to other work, operational clearances, installation details, and the following:
 - a. Mullion details including reinforcement and stiffeners.
 - b. Joinery details.
 - c. Expansion provisions.
 - d. Flashing and drainage details.
 - e. Weather-stripping details.
 - f. Glazing details.
 - g. Window-cleaning provisions.
 - h. Window System Operators: Show locations and details for installing operator components, switches, and controls. Indicate motor size, electrical characteristics, drive arrangement, mounting, and grounding provisions.
 - i. Wiring Diagrams: Power, signal, and control wiring.
 - j. Accessories.
4. Samples: For steel windows and components required, prepared on Samples of size indicated below:
 - a. Main Framing Member: **12-inch- (300-mm-)** long, full-sized sections, with glazing bead, weather stripping and factory-applied color finish.
 - b. Hardware: Full-size units with factory-applied finish.
5. Product Schedule: For steel windows. Use same designations indicated on Drawings.
6. Delegated-Design Submittal: For steel windows indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
7. Qualification Data: For qualified Installer, manufacturer, professional engineer and testing agency.
8. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for steel windows.
9. Field quality-control reports.
10. Operation and Maintenance Data: For operable window sash, operable hardware, operable fire-rated window hardware, window system operators, weather stripping and finishes to include in operation and maintenance manuals.
11. Warranties: Sample of special warranty.

E. Quality Assurance

1. Manufacturer Qualifications: A manufacturer capable of fabricating steel windows that meet or exceed performance requirements indicated and of documenting this performance by inclusion in lists, and by labels, test reports, and calculations.
2. Installer Qualifications: An installer acceptable to window manufacturer for installation of units required for this Project.
 - a. Installer's responsibilities include providing professional engineering services needed to assume engineering responsibility including preparation of data for steel windows, including Shop Drawings and Designated Design Submittal based on testing and engineering analysis of manufacturer's standard units in assemblies similar to those indicated for this Project.
3. Source Limitations: Obtain steel windows from single source from single manufacturer.
4. Fire-Test-Response Characteristics: Assemblies complying with NFPA 80 that are listed and labeled by a qualified testing agency, for fire-protection ratings indicated on Drawings, based on testing indicated.
 - a. Neutral-Pressure Test: NFPA 257 **OR** UL 9, **as directed**.
OR
Positive-Pressure Test: ASTM E 2010 **OR** NFPA 257 **OR** UBC 7-4 **OR** UL 9, **as directed**.
5. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
6. SWI Publication: Comply with applicable requirements in SWI's "The Architect's Guide to Steel Windows and Doors" except where more stringent requirements are indicated.
7. Preinstallation Conference: Conduct conference at Project site.

F. Project Conditions

1. Field Measurements: Verify actual dimensions of steel window openings by field measurements before fabrication.

G. Warranty

1. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of steel windows that fail in materials or workmanship within specified warranty period.
 - a. Failures include, but are not limited to, the following:
 - 1) Failure to meet performance requirements.
 - 2) Structural failures including excessive deflection.
 - 3) Water leakage or air infiltration.
 - 4) Faulty operation of operable sash and hardware.
 - 5) Deterioration of metals, metal finishes, and other materials beyond normal weathering.
 - b. Warranty Period: Two **OR** Three, **as directed**, years from date of Final Completion.
 - c. Warranty Period for Metal Finishes: Five **OR** 10 **OR** 15, **as directed**, years from date of Final Completion.

1.2 PRODUCTS

A. Materials

1. Fasteners: Provide fasteners of bronze, brass, stainless steel, or other metal that are warranted by manufacturer to be noncorrosive and compatible with trim, hardware, anchors, and other components of steel windows.
 - a. Exposed Fasteners: If exposed fasteners are used, provide Phillips flat-head machined screws that match finish of member or hardware being fastened, as appropriate.
2. Anchors, Clips, and Window Accessories: Provide units of stainless steel, hot-dip zinc-coated steel, bronze, brass, or iron complying with ASTM A 123/A 123M. Provide units with sufficient strength to withstand design pressure indicated.

3. Compression-Type Weather Stripping: Provide compressible weather stripping designed for permanently resilient sealing under bumper or wiper action and for complete concealment when steel window is closed.
 - a. Weather-Stripping Material: Elastomeric, cellular, preformed gaskets complying with ASTM C 509.
OR
Weather-Stripping Material: Dense elastomeric gaskets complying with ASTM C 864.
OR
Weather-Stripping Material: Manufacturer's standard.
4. Sliding-Type Weather Stripping: Provide manufacturer's standard woven-pile weather stripping of wool, polypropylene, or nylon pile and resin-impregnated backing fabric.
 - a. Weather Seals: Provide weather stripping with integral barrier fin or fins of semirigid, polypropylene sheet or polypropylene-coated material.
5. Trim Members, Screen Frames, Retainers for Weather Stripping, Flashing, and Similar Items: Extruded aluminum **OR** Formed sheet aluminum **OR** Stainless steel **OR** Formed steel **OR** Manufacturer's standard, **as directed**.
6. Glazing Stops: Extruded aluminum **OR** Formed sheet aluminum **OR** Stainless steel **OR** Formed steel **OR** Manufacturer's standard, **as directed**.
7. Sealant: For sealants required within fabricated windows, provide manufacturer's standard, permanently elastic, nonshrinking, and nonmigrating type recommended by sealant manufacturer for joint size and movement.

B. Window

1. Window Type: Casement **OR** Double hung **OR** Fixed **OR** Horizontally pivoted **OR** Horizontal sliding **OR** Projected **OR** Single hung **OR** Vertically pivoted **OR** As indicated on Drawings **OR** As indicated in a schedule, **as directed**.
2. Hot-Rolled Steel Window Members: Provide frame and ventilator members formed from hot-rolled, new billet steel sections. For combined weight of frame and ventilator members and front-to-back depth of frame or ventilator members, comply with the following requirements:
 - a. Light Intermediate Windows: Not less than 2.0 lb/ft. (2.98 kg/m) in combined weight and not less than 1 inch (25.4 mm) deep.
 - b. Standard Intermediate Windows: Not less than 3.0 lb/ft. (4.46 kg/m) in combined weight and not less than 1-1/4 inches (32 mm) deep.
 - c. Heavy Intermediate Windows: Not less than 3.5 lb/ft. (5.21 kg/m) in combined weight and not less than 1-5/16 inches (33.34 mm) deep.
 - d. Heavy Custom Windows: Not less than 4.2 lb/ft. (6.25 kg/m) in combined weight and not less than 1-1/2 inches (38.1 mm) deep.
 - 1) Dimensions of Projected Frame and Ventilator Members: Nominally 1/8 inch (3 mm) thick by 1-3/8 inches (35 mm) deep except members nominally 1-1/4 inches (32 mm) deep may be used provided corners are welded and ground.
 - 2) Applied Weather Stripping: Where indicated, 0.074-inch (1.9-mm) **OR** 0.060-inch (1.5-mm), **as directed**, minimum thickness.
 - e. Window Finish: Galvanized **OR** Galvanized and factory primed **OR** Factory primed **OR** Baked enamel **OR** Powder coat **OR** High performance, organic, **as directed**.
 - 1) Color and Gloss: As indicated by manufacturer's designations **OR** As selected from manufacturer's full range, **as directed**.
3. Cold-Formed Steel Window Members: Provide frame and ventilator members mechanically formed from metallic-coated, low-carbon, cold-rolled steel sheet complying with ASTM A 653/A 653M. For combined weight of frame and ventilator members and front-to-back depth of frame or ventilator members, comply with the following requirements:
 - a. Commercial and Industrial Windows: Not less than 2.75 lb/ft. (4.09 kg/m) in combined weight, and not less than 1-1/4 inches (32 mm) deep.
 - b. Window Finish: Baked enamel **OR** Powder coat, **as directed**.
 - 1) Color and Gloss: As indicated by manufacturer's designations **OR** As selected from manufacturer's full range, **as directed**.

C. Glazing

1. Glass and Glazing System: See Division 08 Section "Glazing" for glass units and glazing requirements for steel windows.

D. Hardware

1. General: Provide manufacturer's standard nonremovable, **as directed**, solid bronze **OR** malleable iron **OR** die-cast metal, **as directed**, hardware, with operating components of stainless steel, carbon steel complying with AAMA 907, brass, bronze, or other corrosion-resistant material designed to operate smoothly, to close tightly, and to lock steel window ventilators securely. Provide hardware of sufficient strength to accommodate size and weight of ventilator for which it is intended.
2. Sill Cap/Track: Designed to comply with performance requirements indicated and to drain to the exterior.
3. Locks and Latches: Designed to allow unobstructed movement of the sash across adjacent sash in direction indicated and to operate from the inside only.
4. Roller Assemblies: Low-friction design.
5. Friction Shoes: Adjustable friction shoes of bronze, brass, nylon, or other nonabrasive, nonstaining, noncorrosive, durable material.
6. Hinges: Four-bar friction hinges complying with AAMA 904.
7. Limit Device: Provide concealed friction adjustor/stay-bar **OR** friction adjustor/stay-bar with release key or tool **OR** support arms with adjustable, limited hold-open, **as directed**, limit devices designed to restrict sash or ventilator opening.
8. Gear-Type Rotary Operators: Comply with AAMA 901 when tested according to ASTM E 405, Method A.
 - a. Operator shall operate all ventilators simultaneously, securely closing them at both jambs without use of additional manually controlled locking devices.
9. Pole Operators: Tubular-shaped, anodized aluminum; with rubber-capped lower end and standard push-pull hook at top to match hardware design; of sufficient length to operate window without reaching more than **60 inches (1500 mm)** above floor; one pole operator and pole hanger per room that has operable windows more than **72 inches (1800 mm)** above floor.
10. Casement Windows: Provide the following operating hardware:
 - a. Operating Device: Gear-type rotary operator located on the jamb at the sill.
OR
Operating Device: Combination lever-handle and cam-type latch.
 - b. Hinges: Concealed, four-bar friction hinges with adjustable slide shoes; two per ventilator.
OR
Hinges: Heavy duty, three-knuckle butt hinges with nylon bushings; two per ventilator.
OR
Hinges: Provide standard-duty, concealed, four-bar friction egress hinges with adjustable slide shoes; two per ventilator where indicated. Provide hinge designed to achieve 90-degree ventilator opening.
OR
Hinges: Extension hinges or pivots, nonfriction type; two per ventilator.
 - c. Lock: Lift-type, cam-action lock.
 - d. Limit Device: Stay bar with an adjustable hold-open device.
11. Double **OR** Single, **as directed**, Hung Windows: Provide the following operating hardware:
 - a. Sash Balances: Two per sash.
 - b. Counterbalance and Pulley: Two per sash to operate ventilators in unison with stainless-steel-cable sash cord.
 - 1) Single-Hung Upper Sash Retainer: Manufacturer's standard.
 - c. Self-Closing Device for Single-Hung, Fire-Rated Windows: Fusible link **OR** Electrically operated, resettable thermal link, labeled and tested per UL 33, **as directed**.
 - d. Handle(s): Lift **OR** Pull-down, **as directed**, handle; one **OR** two, **as directed**, per sash.
 - e. Lock: Cam-action sweep lock and keeper on meeting rail; one **OR** two, **as directed**, per sash.
12. Horizontal-Sliding Windows: Provide the following operating hardware:

- a. Rollers: Steel, lubricated, ball-bearing rollers.
 - b. Lock: Manufacturer's standard.
 - c. Limit Device: Manufacturer's standard.
 - d. Pull Handle: Manufacturer's standard.
 - e. Automatic Closer for Fire-Rated Steel Sash: Heat- **OR** Heat- and electrically, **as directed**, activated spring-driven closer.
13. Pivoting Windows: Provide the following operating hardware:
- a. Pivot Assembly: Manganese-bronze pivot assembly designed for center **OR** off-center, **as directed**, axis pivoting.
 - b. Lock: Internal, key-operated, limited-access locks; one **OR** two, **as directed**, per jamb.
 - 1) Bronze safety drop bolts.
 - 2) Bronze cam fasteners.
 - c. Limit device.
14. Projected Windows: Provide the following operating hardware:
- a. Operating Device: Gear-type rotary **OR** Push-bar-type, **as directed**, underscreen, **as directed**, ventilator operator located at the sill.
 - b. Hinges: Concealed, four-bar friction hinges with adjustable slide shoes; two per ventilator.
OR
Hinges: Balance arms with adjustable, nonabrasive friction pivots; two per ventilator.
OR
Hinges: Balance arms with adjustable, nonabrasive friction shoes; two per ventilator.
 - 1) Provide ventilator operation that permits cleaning of the outside glass face from the interior.
 - 2) Provide jamb-mounted, sliding, brass friction shoes with screw adjusters.
 - c. Lock: Cam-action, sweep lock handle with surface-mounted strike.
OR
Lock: Key-operated security lock and keeper.
OR
Lock: Pole-operated, spring catch lock.
OR
Lock: Pole-operated, cam-action, sweep lock handle and keeper.

E. Group Window Operating Systems

- 1. Provide window operating system for window groups as indicated. Coordinate operating system design with window fabrication and hardware selections to ensure smooth, durable operation of ventilators.
- 2. Operation Function: All ventilators move simultaneously and close securely at sash frames without using additional manually controlled locking devices.
- 3. Operating System: Complete with shafts, brackets, levers, rods, oil-encased gear boxes, and standard fittings and accessories for operation indicated.
 - a. Rack-and-Pinion Operating System: Torsion-type with steel pipe torsion shaft and factory-sealed, oil-encased gear box. Provide system with rack-and-pinion sets and operating arms. Provide standard fittings and accessories for operation indicated. Space support bearings at **10 feet (3 m)** o.c. maximum.
 - 1) Space operating arms not more than **60 inches (1500 mm)** o.c.
 - 2) Provide one operating arm for each operating vent.
 - b. Horizontal-Movement Operating System: Tension-type with steel rod or cable transmission lines operating in conduit between ventilator operators, factory-sealed lubricated rotary thrust unit, and toggle-type operator arms. Provide standard fittings and accessories for operation indicated. Provide support bracket at each operator, at bends, and not more than **10 feet (3 m)** o.c. elsewhere.
 - 1) Space operating arms not more than **10 feet (3 m)** o.c. along each continuous unit.
 - 2) Provide one operating arm for each operating vent.
- 4. Operation: Manual, with chain-wheel operator on each gear box shaft; with chain loops terminated **24 inches (600 mm)** above floor.

OR

Operation: Manual, with crank-type operator on each gear box shaft; with removable crank and oil-enclosed miter gear box. Where necessary, extend crankshaft with universal joints and support brackets to a suitable crank-operator mounting location not more than **44 inches (1115 mm)** above floor.

5. Operation: Electric, with factory-assembled electric operator designed for operating windows of type, size, weight, construction, use, and operating frequency indicated.
 - a. Electric Operator: Provide operating system complying with NFPA 70; of size and capacity and with features, characteristics, and accessories suitable for Project conditions recommended in writing by window manufacturer; complete with operating system indicated, electric motor and factory-prewired motor controls with limit switches, remote-control stations, power disconnect switches, enclosures to protect controls and all operating parts, and accessories required for reliable operation. Include wiring from motor controls to motor. Coordinate operator wiring requirements and electrical characteristics with building electrical system.
 - 1) Control Equipment: Comply with NEMA ICS 1, NEMA ICS 2, and NEMA ICS 6.
 - 2) Electric Motor: Comply with NEMA MG 1; with thermal-overload protection; sized to start and operate size and weight of window sash ventilators under any conditions; one per each gear-box shaft.
 - a) Motor Characteristics: Single phase, sized by electric operator manufacturer, 60 Hz.
 - 3) Remote Controls: Electric controls with NEMA ICS 6, Type 1 enclosure and momentary-contact, single push-button-operated control **OR** three-position, push-button-operated control with open, close, and stop functions, **as directed**.
 - 4) Limit Switches: Adjustable switches, interlocked with motor controls and set to automatically stop sash ventilators at fully opened and fully closed positions.

F. Insect Screens

1. Design windows and hardware to accommodate screens in a tight-fitting, removable arrangement, with a minimum of exposed fasteners and latches. Fabricate insect screens to fully integrate with window frame, with mitered or coped joints or corner extrusions, concealed fasteners, adjustable rollers, **as directed**, and removable PVC spline/anchor concealing edge of frame. Locate screens on inside **OR** outside, **as directed**, of window and provide for each operable exterior sash or ventilator.
 - a. Screen Frames: Fabricate frames of tubular-shaped, extruded- **OR** formed-, **as directed**, aluminum members of **0.04-inch (1.0-mm)** minimum wall thickness.
 - 1) Finish: Anodized aluminum **OR** Baked-on organic coating, **as directed**, in manufacturer's standard color.

OR

Finish: Anodized aluminum **OR** Baked-on organic coating, **as directed**, in color selected from manufacturer's full range.

OR

Finish: Manufacturer's standard.
 - b. Screen Frames: Fabricate frames of tubular-shaped, nonmagnetic stainless-steel members of **0.02-inch (0.5-mm)** minimum wall thickness.
 - 1) Finish: No. 2B bright mill finish **OR** Match steel window finish, **as directed**.
 - c. Screen Frames (inside only): Fabricate frames of tubular-shaped, steel sheet members of **0.03-inch (0.8-mm)** minimum wall thickness. Finish the frames to match window units.
2. Glass-Fiber Mesh Fabric: ASTM D 3656, 18-by-14 or 18-by-16 **OR** 20-by-20 or 20-by-30, **as directed**, count per **sq. in. (645 sq. mm)** mesh of PVC-coated, glass-fiber threads; woven and fused to form a fabric mesh resistant to corrosion, shrinkage, stretch, impact damage, and weather deterioration.
 - a. Mesh Color: Gray.
3. Aluminum Wire Fabric: 18-by-16 count per **sq. in. (645 sq. mm)** mesh of **0.011-inch- (0.28-mm-)** diameter, coated aluminum wire.
 - a. Wire-Fabric Finish: Natural bright **OR** Charcoal gray **OR** Black, **as directed**.

4. Copper Wire Fabric: 16-by-16 count per sq. in. (645 sq. mm) mesh of 0.011-inch- (0.28-mm-) diameter copper wire.
5. Bronze Wire Fabric: 18-by-14 count per sq. in. (645 sq. mm) mesh of 0.011-inch- (0.28-mm-) diameter bronze wire with a clear varnish finish.
6. Stainless-Steel Wire-Fabric: 18-by-16 **OR** 18-by-18, **as directed**, count per sq. in. (645 sq. mm) mesh of 0.009-inch- (0.2-mm-) minimum diameter, nonmagnetic stainless-steel wire, Type 304 or 316.
7. Solar-Screening Mesh Fabric: 17-by-15 **OR** 40-by-40, **as directed**, count per sq. in. (645 sq. mm) mesh of PVC-coated, glass-fiber threads; woven and fused to form a fabric mesh resistant to corrosion, shrinkage, stretch, impact damage, and weather deterioration. Comply with ASTM D 3656.
8. Wickets: Provide sliding or hinged wickets, framed and trimmed for a tight fit and durability during handling.

G. Accessories

1. General: Provide manufacturer's standard accessories that comply with indicated standards.
2. Window Cleaner Anchor Bolts: Provide window cleaner anchor bolts of standard design, complying with requirements of authorities having jurisdiction. Fabricate bolts of nonmagnetic stainless steel.
 - a. Reinforce window units or mullions to receive bolts and provide additional anchorage of units at bolt locations.

H. Fabrication

1. General: Fabricate steel windows of type and in sizes indicated to comply with SWI standards. Include a complete system for assembly of components and anchorage of window units.
 - a. Provide units that are reglazable without dismantling ventilator framing.
 - b. Prepare window ventilators for site glazing **OR** factory glazing, **as directed**.
2. Mullions: Formed of hot-rolled **OR** cold-formed, **as directed**, steel matching window units; with anchors for support to structure and for installation of window units and having sufficient strength to withstand design pressure indicated. Provide mullions of profile indicated and with cover plates. Allow for erection tolerances and provide for movement of window units due to thermal expansion and building deflections.
3. Subframes and Operable Ventilators: Formed of hot-rolled **OR** cold-formed, **as directed**, steel of profile indicated. Miter or cope corners, and mechanically fasten and seal joints **OR** weld and dress joints smooth, **as directed**.
4. Provide weep holes and internal water passages to conduct infiltrating water to the exterior.
5. Provide water-shed members above casement **OR** horizontal-sliding, **as directed**, ventilators.
6. Glazing Stops: Provide screw-applied **OR** snap-on, **as directed**, glazing stops; coordinate with Division 08 Section "Glazing" and with glazing system indicated. Provide glazing stops to match panel frames. Finish glazing stops to match window units if fabricated of steel; otherwise, provide manufacturer's standard finish.
7. Glazing Clips: Where face glazing (without glazing stops) is indicated, furnish glazing clips for concealment in glazing compound.

I. Metallic-Coated Steel Sheet Finishes

1. Surface Preparation: Clean surfaces with nonpetroleum solvent so surfaces are free of oil and other contaminants. After cleaning, apply a conversion coating suited to the organic coating to be applied over it. Clean welds, mechanical connections, and abraded areas and apply galvanizing repair paint complying with SSPC-Paint 20 and ASTM A 780.
2. Factory Prime Finish: Apply manufacturer's standard primer immediately after cleaning and pretreating.
3. Baked-Enamel or Powder-Coat Finish: Immediately after cleaning and pretreating, apply manufacturer's standard two-coat, baked-on finish consisting of prime coat and thermosetting topcoat, with a minimum dry film thickness of 1 mil (0.025 mm) for topcoat. Comply with coating

manufacturer's written instructions for applying and baking to achieve a minimum dry film thickness of **2 mils** (0.05 mm).

J. Steel Finishes

1. Surface Preparation: Remove mill scale and rust, if present, from uncoated steel, complying with SSPC-SP 5/NACE No. 1, "White Metal Blast Cleaning" **OR** SSPC-SP 8, "Pickling", **as directed**. After cleaning, apply a conversion coating suited to the organic coating to be applied over it, **as directed**.
2. Galvanized Finish: Hot-dip galvanize per ASTM A 123.
3. Steel and Galvanized-Steel Prime Finish: Apply manufacturer's standard primer immediately after cleaning and pretreating.
4. Baked-Enamel or Powder-Coat Finish: Immediately after cleaning and pretreating, apply manufacturer's standard two-coat, baked-on finish consisting of prime coat and thermosetting topcoat. Comply with coating manufacturer's written instructions for applying and baking to achieve a minimum dry film thickness of **2 mils** (0.05 mm).
5. High-Performance Organic Finish: Two-coat fluoropolymer finish containing not less than 50 **OR** 70, **as directed**, percent PVDF resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.

1.3 EXECUTION

A. Examination

1. Examine openings, substrates, structural support, anchorage, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work. Verify rough opening dimensions, levelness of sill plate, accurate locations of connections to building electrical system, **as directed**, and operational clearances. Examine wall flashings, vapor retarders, water and weather barriers, and other built-in components to ensure a coordinated, weathertight window installation.
 - a. Masonry Surfaces: Visibly dry and free of excess mortar, sand, and other construction debris.
 - b. Wood Frame Walls: Dry, clean, sound, well nailed, free of voids, and without offsets at joints. Ensure that nail heads are driven flush with surfaces in opening and within **3 inches** (76 mm) of opening.
 - c. Metal Surfaces: Dry, clean, and free of grease, oil, dirt, rust, corrosion, and welding slag; without sharp edges or offsets at joints.
2. Proceed with installation only after unsatisfactory conditions have been corrected.

B. Installation

1. Comply with manufacturer's written instructions for installing windows, hardware, operators, accessories, and other components.
2. Install windows level, plumb, square, true to line, without distortion or impediment to thermal movement, anchored securely in place to structural support, and in proper relation to wall flashing and other adjacent construction.
3. Set sill members in bed of sealant or with gaskets, as indicated, to provide weathertight construction.
4. Install windows and components to drain condensation, water-penetrating joints, and moisture migrating within windows to the exterior.
5. Separate corrodible surfaces from sources of corrosion or electrolytic action at points of contact with other materials according to ASTM E 2112, Section 5.12 "Dissimilar Materials."

C. Field Quality Control

1. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
2. Tests and Inspections:

- a. Testing Methodology: Testing of windows for air-penetration resistance and water resistance will be performed according to AAMA 502, Test Method A **OR** B, **as directed**, by applying same test pressures required for performance.
- b. Testing Extent: Three windows as selected by the Owner and a qualified independent testing and inspecting agency. Windows shall be tested immediately after installation.
3. Window will be considered defective if it does not pass tests and inspections.
4. Prepare test and inspection reports according to AAMA 502. Testing agency will interpret test results and state in each report whether tested work complies with or deviates from requirements.

D. Adjusting, Cleaning, And Protection

1. Adjust operating sashes and ventilators, screens, hardware, operators, **as directed**, and accessories for a tight fit at contact points and weather stripping for smooth operation and weathertight closure. Lubricate hardware and moving parts.
2. Clean factory-finished steel surfaces immediately after installing windows. Comply with manufacturer's written recommendations for final cleaning and maintenance. Avoid damaging protective coatings and finishes.
3. Clean glass immediately after installing windows. Comply with manufacturer's written recommendations for final cleaning and maintenance. Remove nonpermanent labels, and clean surfaces.
4. Remove and replace glass that has been broken, chipped, cracked, abraded, or damaged during construction period.
5. Protect window surfaces from contact with contaminating substances resulting from construction operations. Remove contaminants immediately according to manufacturer's written recommendations.
6. Refinish or replace windows with damaged finish.

E. Demonstration

1. Train Owner's maintenance personnel to adjust, operate, and maintain group window operating system for steel windows.

END OF SECTION 08 51 23 00

SECTION 08 51 69 00 - ALUMINUM STORM WINDOWS

DESCRIPTION OF WORK

This specification covers the furnishing and installation of materials for aluminum storm windows. Products shall be as directed by the Owner. Installation procedures shall be in accordance with the product manufacturer's recommendations. Demolition and removal of materials shall be as required to support the work.

GENERAL

Definitions

1. Aluminum Storm Window Configuration and Performance Classes: ANSI/AAMA 1002.10:
 - a. VWE (15): Vertically operating insulating storm window for external application, Performance Class 15.
 - b. VWE (45): Vertically operating insulating storm window for external application, Performance Class 45.
 - c. HWE (15): Horizontally operating insulating storm window for external application, Performance Class 15.
 - d. FWE (15): Fixed removable insulating storm window for exterior application, Performance Class 15.
 - e. FWI (15): Fixed removable insulation window for internal application, Performance Class 15.
 - f. HWI (15): Horizontally operating insulating window for internal application, Performance Class 15.
2. Type of Stainless Steel Screens (Frames and Screening): Medium, and Heavy Types: As defined by and comply with requirements of ANSI/SMA 6001.
3. Supply and Delivery Only: Include supply and delivery to site(s) FOB destination Freight prepaid. Unless otherwise specified or scheduled, unloading and handling at site is by the Owner.

System Description

4. Performance Requirements: Comply with following:
 - a. Storm Windows: HUD UM 39a.
 - b. Storm Windows: ANSI/SMA 6001.
 - 1) Exterior Mounted Aluminum storm Windows for Normal Usage: Specification FWE, HWE, or VWE as applicable and Performance Class 15.
 - 2) Interior Mounted Aluminum Storm Windows for Normal Usage: Specification FWI, HWI, or VWI as applicable and Performance Class 15.
 - 3) High Rise Storm Windows: Specification VWE and Performance Class 45.

Submittals

5. Product Data.
6. Shop Drawings:
 - a. Indicate fabrication of parts, metal thickness, installation details, fastening and sealing.
 - b. Include sections of typical members and details of latching devices.
7. Samples: Submit full set of finish color samples for color selection.
 - a. For Supply and Deliver Only Contract: Submit one full size sample of each type of storm window with specified finish for acceptance.
8. Quality Assurance/Control Submittals:
 - a. Certificates: Manufacturer's written third party certification that storm windows meet or exceed HUD UM 39a, ANSI/AAMA 1102.10, and other specified requirements.
 - b. Manufacturer's installation instructions.

9. Closeout Submittals:
 - a. Operation and maintenance data.
 - b. Special warranty.

Quality Assurance

10. Regulatory Requirements:
 - a. Glazing Materials: Comply with CPSC 16 CFR 1201 or ANSI Z97.1.
 - b. Egress Requirements: Comply with applicable codes and regulations.
 - c. Provide emergency egress, single point locking release, and bit key lock fire entry from exterior as and where required by applicable codes and regulations.
 - d. Accessibility:
 - 1) Architectural Barriers Act of 1968 as amended (42 USC 4152-4157) and HUD implementing regulations (24 CFR Part 40).
 - a) Uniform Federal Accessibility Standards (UFAS).
 - 2) Section 504 of the Rehabilitation Act of 1973 as amended (29 USC 794) and HUD implementing regulations 24 CFR Part 8.
 - 3) Fair Housing Accessibility Guidelines (24 CFR Chapter 1).
 - 4) Americans with Disabilities Act of 1990 (ADA) (28 CFR Part 35).
11. Certifications: Comply with HUD UM 39a, ANSI Z34.1, and HUD 24 CFR 200.935.
12. Mock-ups: For Supply and Install Contract: Install one full size mock-up of each type of storm window with specified finish for acceptance.
 - a. Location: As directed.
 - b. Approved Mock-up: Standard for rest of work.
 - c. Approved Mock-up: May remain part of completed project.

Delivery, Storage, And Handling

13. Packing, Shipping, Handling, and Unloading: Pack materials at manufacturing plant to prevent damage during shipping.
 - a. Aluminum Storm Windows: Label in accordance with HUD UM 39a attached signifying compliance with ANSI/AAMA 1002.10 performance requirements.
14. Acceptance at Site: Inspect storm windows upon delivery. Replace damaged or defective materials before installation.
15. Storage and Protection: Store storm windows in manner to protect from weather and other damage.

Project Conditions

16. Field Measurements: Field measure openings for storm windows before start of fabrication.

Scheduling And Sequencing

17. Scheduling and Completion: Comply with requirements of Detailed Scope of Work.

Warranty

18. Special Warranty: Provide one year written covering materials and installation for storm windows.
 - a. Warranty: Include coverage of inserts, hardware, and latches.
 - 1) Screening and glazing riot included.
 - 2) Defects resulting from vandalism not included.
 - b. For Supply and Delivery Only Contract:
 - 1) Contractor: Agrees to supply and deliver to the Owner, free of charge, any required replacement parts that can be readily installed by the Owner without special tools.
 - 2) Contractor: Agrees to supply and deliver free of charge, complete replacement window, when defective part or parts cannot be installed without use of special tools.
 - c. For Supply and Install Contract:
 - 1) Contractor: Agrees to supply and install, free of charge, any required replacement parts or complete replacement window.

PRODUCTS

Aluminum Storm Windows

19. General: Type(s) and size(s) indicated, specified, or scheduled with necessary hardware, anchors, and equipment.
20. Materials: ANSI/AAMA 1002.10.
 - a. Extruded Aluminum: ASTM B 221, Alloy 60630-TS or stronger.
 - b. Carbon Steel (reinforcing members): ASTM A 36, zinc coated in accordance with ASTM B 633 or cadmium coated in accordance with ASTM B 766.
 - c. Stainless Steel: ASTM A 167, Type 302.
 - d. Anti-galling Devices: Manufacturers standard non-corrosive material compatible with aluminum.
 - e. Channel Gaskets: Manufacturer's standard flexible vinyl.
 - f. Welding Filler Rods: AWS A5.3.
21. Glazing Materials: Comply with CPSC 16 CFR 1201 or ANSI Z97.1.
 - a. Glass: ASTM C 1036, Type 1, Class 1, Glazing B Quality.
 - b. Tempered Glass: ASTM C 1048, Kind FT, Condition A, Type 1, Class 1, Glazing B Quality.
 - c. Plastic: Extruded polycarbonate clear sheets, minimum 4.5 mm (0.177 inch) thick with following characteristics:
 - 1) Impact Resistance: ASTM D 256, Method A, 12-18 foot-pound per inch.
 - 2) Elongation/Modulus of Elasticity: ASTM D 638, 110 percent maximum/340,000 PSI.
 - 3) Heat Deflection: ASTM D 648, 132.2 degrees C (270 degrees F) at 264 PSI.
 - 4) Abrasion Resistance: Coated on both surfaces to produce abrasion resistance of 3-19 percent maximum haze increase for 500 revolutions of CS-1 OF wheel per ASTM D 1044.
 - d. Glass Thickness: Determined in accordance with ANSI/AAMA 1002.10 Appendix, minimum 3 mm (1/8 inch) (DS).
 - 1) Design Wind Pressures: Determined in accordance with applicable codes and regulations.
 - e. Glass: Labeled to show name of manufacturer and type.
22. Insert Insect Screens: Provide storm windows with Screens as indicated, specified, or scheduled in manufacturer's standard approved design, applicable to specific storm windows.
 - a. Screen Frames: Roll form aluminum frames of suitable alloy and of sufficient rigidity, crossbraces, as required, to lie flat against window and to prevent excessive bow in frame members and sag in screening.
 - 1) Frame Corners: Firmly joined in secured and rigid manner.
 - b. Screening: One of following as indicated, specified, or scheduled:
 - 1) Vinyl Coated Fibrous Glass Yam: ASTM D 3656, Class 1, 18 by 16 mesh, 0.29 mm (0.0115 inch) diameter yam.
 - 2) Polyvinylidene Chloride or Polypropylene Filament: FS L-S-12513, Type I or III, Class 1 or 2, 18 by 18 mesh, 0.31 mm (0.012 inch) or 0.38 mm (0.015 inch) diameter filament.
 - 3) Aluminum: FS RR-W-365, Type VII, 18 x 16 or 18 by 18 regular, 0.28 mm (0.011 inch) diameter wire.
 - 4) Stainless Steel Medium: ANSI/SMA 6001 Medium Type, 12 x 12 mesh type 304 stainless steel 0.58 mm (0.023 inch) diameter wire.
 - 5) Stainless Steel Heavy: ANSI/SMA 6001 Heavy Type, 12 x 12 mesh type 304 high tensile strength stainless steel 0.71 mm (0.028 inch) diameter wire.
 - c. Screening: Fastened to frame in manner to permit replacement of screening.
 - d. Screens: Provide with fastening devices, suited particularly for application to specific window made of aluminum or materials compatible with aluminum and of sufficient strength to perform satisfactorily.
 - e. Screens: Comply with applicable fire codes for egress and fireman access.
 - 1) Provide single point release as and where required by applicable codes and regulations.

- 2) Provide bit key lock fire entry from exterior if required by applicable codes and regulations.
- f. Window Screens: Include warning label indicating that screen will not stop child from falling out of window in accordance with SMA 7001.

Accessories

- 23. Joint Sealant: AAMA 800, Type 808.3 Exterior Perimeter Sealing Compound.

Fabrication

- 24. General:
 - a. Storm Windows: Conform to approved Shop Drawings.
 - b. Storm Windows: Assembled securely to assure neat, weather resistant construction.
 - c. Glazed Sash: Fabricated to permit reglazing without special tools.
 - d. Remove flux and grind welds, flush with exposed surfaces, and polish to blend with ad surfaces.
 - e. Sills: Provide weep holes to provide means for water to flow to exterior.
 - f. Inserts:
 - 1) Removable to inside.
 - 2) Not operable or removable from outside when in closed and latched position.
 - 3) Glass Inserts: Weatherstripped to prevent metal-to-metal contact with main frame.
 - g. Storm Windows: Comply with applicable fire codes for egress.
- 25. Vertically Sliding Storm Windows: Provide following features:
 - a. Aluminum two-track or triple-track, self-storing, vertical-sliding combination storm and screen units with two glass insert panels and one screen insert panel, and two-track storm windows.
 - b. Master Frame: Afford clearance for operation of prime window hardware.
 - c. Equip units over 1 143 mm (45 inches) wide, 2 032 mm (80 inches) high or 3 175 mm (125 united inches) with extruded aluminum tie bar to ensure rigidity to main frame.
 - d. Provide self-activating locks or latches designed to hold sash secure in locked and ventilating positions.
- 26. Horizontally Operating Storm Windows: Provide following features:
 - a. Aluminum triple track, self-storing, horizontally operating, combination storm and screen unit.
 - b. Glass Insert Panels: Operable and slide on rollers, rigid PVC or nylon glides.
 - c. Equip with security lock to latch closed when in locked position.
 - d. Master Frame: Afford clearance for operation of prime window hardware.
 - e. Fixed Aluminum Vertical Tie Bar at Meeting Rails of Inserts: Ensure rigidity to main frame.
- 27. Fixed Picture Storm Windows: Provide following features:
 - a. Divider on Storm Windows: Locate over meeting rail or prime window.
 - b. When window is larger than 1500 mm (60 inches) in height or width, separate glass area into sections with one or more aluminum muntins to join pieces of glass.
 - c. Picture Windows: Fixed but removable inserts either from inside or from outside.
 - 1) Glazing: Wrapped around marine type vinyl or drop in.

Finishes

- 28. Finish:
 - a. Aluminum Finish: Provide one of following as specified or scheduled:
 - 1) Factory applied pigmented organic coating. AAMA 603-8.
 - a) Color: As selected from manufacturer's standard colors.
 - 2) Clear Anodized: Factory applied anodic coating, AAMA 607.1, Class 1.
 - b. Exposed Surfaces of Aluminum Members: Clean and free from serious surface blemishes.
 - c. Dress and finish exposed welded joints.

Source Quality Control

29. Testing: Performed under Third Party Administrator who is in compliance with HUD UM 39a, ANSI Z34.1, and HUD 24 CFR 200.935.

EXECUTION

Examination

30. Site Verification of Conditions: indicated on Shop Drawings.
- a. Field Measurements: Verify field measurements are as
 - b. Existing Conditions: Examine openings before beginning installation.
 - c. Verify that surfaces to receive storm windows are clean.
 - d. Do not proceed with installation until conditions are satisfactory.

Preparation

31. Protection: Protect adjacent elements from damage and disfiguration in accordance with Detailed Scope of Work.
- a. Contractor: Responsible for damage to grounds, plantings, buildings and any other facilities or property caused by construction operations.
 - b. Repair or replace damaged elements in accordance with Detailed Scope of Work.
32. Existing Storm Windows: Remove existing storm windows and debris from site in accordance with Detailed Scope of Work.
33. Preparation: Prepare openings and existing frames in accordance with ASTM E 737.
- a. Prime Window Jambs of Existing Prime Windows: Prepare as necessary to provide for straight, plumb, level, tight and aesthetically appealing installation of new storm windows.
 - b. Preparatory Work: Include, but not limited to repair of jambs, filling holes and/or dents, removing peeling and scaling paint, etc.

Installation

34. General: Install in accordance with ASTM E 737, manufacturer's recommendations, Reference Standards, and approved Shop Drawings.
- a. Securely fasten storm windows in place to straight, plumb and level condition, without distortion of window or window frame, and make final adjustments for proper operation and satisfactory weatherstrip contact and seal.
 - b. Comply with applicable codes and regulations regarding egress requirements and fireman entry.
35. Joint Sealants: Apply in accordance with manufacturers recommendations.
- a. Surfaces to be Sealed: Clean, dry and free of any foreign matter that would degrade adhesion. Remove existing calking and joint sealants from areas to receive new joint sealant.
 - b. Prime cleaned surfaces in accordance with sealant manufacturers recommendations.
 - c. Protect surfaces adjacent to joints by masking tape before applying sealant. Remove tape upon finishing sealing work.
 - d. Seal joints between perimeter of window frame and underlying or surrounding construction with joint sealant to accomplish weather-tight installation.
 - e. Maximum Width of Sealed Joint: 13 mm (1/2 Inch).
36. Dissimilar Materials: Isolate materials from incompatible materials as necessary to prevent deterioration.
- a. Separate dissimilar metals with bituminous paint, suitable sealant, nonabsorptive plastic or elastomeric tape, or gasket between surfaces.
 - b. Coat aluminum in direct contact with concrete, masonry, steel, or other non-compatible materials with bituminous paint, zinc chromate primer, or other suitable insulating material.

Adjusting And Cleaning

37. Adjusting: At completion of job, check, adjust, and lubricate hardware as required and leave storm windows and hardware in proper operating condition.
38. Cleaning: Comply with requirements of Detailed Scope of Work.



- a. Clean storm windows after installation is completed to remove foreign matter and surface blemishes.
- b. Scratched or Abraded Surfaces: Touch-up with rust inhibitor primer and enamel paint compatible with factory finish.

Protection

- 39. Installed Work: Protect storm windows from damage after installation

END OF SECTION 08 51 69 00

NOT FOR BID



Task	Specification	Specification Description
08 51 69 00	08 11 63 13a	Security Window Screens and Doors
08 51 69 00	08 51 13 00	Aluminum Windows
08 52 11 00	08 01 52 61	Wood Windows
08 52 16 00	08 01 52 61	Wood Windows
08 52 66 00	08 01 52 61	Wood Windows

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SECTION 08 53 13 00 - VINYL WINDOWS

1.1 GENERAL

A. Description Of Work

1. This specification covers the furnishing and installation of material for fixed and operable vinyl framed windows. Products shall be as follows or as directed by the Owner. Installation procedures shall be in accordance with the products manufacturer's recommendations. Demolition and removal of materials shall be as required to support the work.

B. Summary

1. This Section includes fixed and operable vinyl-framed windows.

C. Definitions

1. Performance class designations according to AAMA/WDMA 101/I.S.2/NAFS:
 - a. AW: Architectural.
 - b. HC: Heavy Commercial.
 - c. C: Commercial.
 - d. LC: Light Commercial.
 - e. R: Residential.
2. Performance grade number according to AAMA/WDMA 101/I.S.2/NAFS:
 - a. Design pressure number in **pounds force per square foot (pascals)** used to determine the structural test pressure and water test pressure.
3. Structural Test Pressure: For uniform load structural test, is equivalent to 150 percent of the design pressure.
4. Minimum Test Size: Smallest size permitted for performance class (gateway test size). Products must be tested at minimum test size or at a size larger than minimum test size to comply with requirements for performance class.

D. Performance Requirements

1. General: Provide vinyl windows capable of complying with performance requirements indicated, based on testing manufacturer's windows that are representative of those specified, and that are of test size indicated below:
 - a. Size required by AAMA/WDMA 101/I.S.2/NAFS for gateway performance **OR** optional performance grade, **as directed**.
 - b. Size indicated on Drawings **OR** in a schedule, **as directed**.
2. Structural Performance: Provide vinyl windows capable of withstanding the effects of the following loads, based on testing units representative of those indicated for Project that pass AAMA/WDMA 101/I.S.2/NAFS, Uniform Load Structural Test:
 - a. Design Wind Loads: Determine design wind loads applicable to Project from basic wind speed indicated in **miles per hour (meters per second)** at **33 feet (10 m)** above grade, according to ASCE 7, Section 6.5, "Method 2-Analytical Procedure," based on mean roof heights above grade indicated on Drawings.
 - 1) Basic Wind Speed: **85 mph (38 m/s) OR 90 mph (40 m/s), as directed**.
 - 2) Importance Factor.
 - 3) Exposure Category: **A OR B OR C OR D, as directed**.
3. Windborne-Debris Resistance: Provide glazed windows capable of resisting impact from windborne debris, based on the pass/fail criteria as determined from testing glazed windows identical to those specified, according to ASTM E 1886 and testing information in ASTM E 1996 or AAMA 506 and requirements of authorities having jurisdiction.

E. Submittals

1. Product Data: For each type of vinyl window indicated.

2. Shop Drawings: Include plans, elevations, sections, details, hardware, attachments to other work, operational clearances, and installation details.
3. Samples: For each exposed finish.
4. Product Schedule: Use same designations indicated on Drawings.
5. Product test reports.
6. Maintenance data.
7. Warranty: Special warranty specified in this Section.

F. Quality Assurance

1. Installer: A qualified installer, approved by manufacturer to install manufacturer's products.
2. Fenestration Standard: Comply with AAMA/WDMA 101/I.S.2/NAFS, "North American Fenestration Standard Voluntary Performance Specification for Windows, Skylights and Glass Doors," for definitions and minimum standards of performance, materials, components, accessories, and fabrication unless more stringent requirements are indicated.
 - a. Provide AAMA **OR** WDMA, **as directed**, -certified vinyl windows with an attached label.
3. Glazing Publications: Comply with published recommendations of glass manufacturers and with GANA's "Glazing Manual" unless more stringent requirements are indicated.
4. Preinstallation Conference: Conduct conference at Project site.

G. Warranty

1. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace vinyl windows that fail in materials or workmanship within specified warranty period.
 - a. Failures include, but are not limited to, the following:
 - 1) Failure to meet performance requirements.
 - 2) Structural failures including excessive deflection, water leakage, air infiltration, or condensation.
 - 3) Faulty operation of movable sash and hardware.
 - 4) Deterioration of vinyl, other materials, and finishes beyond normal weathering.
 - 5) Failure of insulating glass.
 - b. Warranty Period:
 - 1) Window: Two **OR** Three **OR** 10, **as directed**, years from date of Final Completion.
 - 2) Glazing: Five **OR** 10, **as directed**, years from date of Final Completion.
 - 3) Vinyl Finish: Five years from date of Final Completion.

1.2 PRODUCTS

A. Materials

1. Vinyl Extrusions: Rigid (unplasticized) hollow PVC extrusions, formulated and extruded for exterior applications, complying with AAMA/WDMA 101/I.S.2/NAFS and the following:
 - a. PVC Resins: 100 percent virgin resin.
 - b. PVC Formulation: High impact, low heat buildup, lead free, nonchalking, and color and UV stabilized.
 - c. Extrusion Wall Thickness: Not less than **0.060 inch (1.5 mm) OR 0.090 inch (2.3 mm) OR 0.125 inch (3.2 mm), as directed**.
 - d. Multichamber Extrusions: Profile designed with two chambers **OR** three chambers **OR** multichambers, **as directed**, between interior and exterior faces of the extrusions.
2. Vinyl Trim and Glazing Stops: Material and finish to match frame members.
3. Fasteners: Aluminum, nonmagnetic stainless steel, epoxy adhesive, or other materials warranted by manufacturer to be noncorrosive and compatible with vinyl window members, cladding, trim, hardware, anchors, and other components.
 - a. Exposed Fasteners: Unless unavoidable for applying hardware, do not use exposed fasteners. For application of hardware, use fasteners that match finish of member or hardware being fastened, as appropriate.

4. Anchors, Clips, and Accessories: Aluminum, nonmagnetic stainless steel, or zinc-coated steel or iron complying with ASTM B 633 for SC 3 severe service conditions; provide sufficient strength to withstand design pressure indicated.
5. Reinforcing Members: Aluminum, or nonmagnetic stainless steel, or nickel/chrome-plated steel complying with ASTM B 456 for Type SC 3 severe service conditions, or zinc-coated steel or iron complying with ASTM B 633 for SC 3 severe service conditions; provide sufficient strength to withstand design pressure indicated.
6. Compression-Type Weather Stripping: Provide compressible weather stripping designed for permanently resilient sealing under bumper or wiper action, and for complete concealment when vinyl window is closed.
 - a. Weather-Stripping Material: Elastomeric cellular preformed gaskets complying with ASTM C 509.
 - b. Weather-Stripping Material: Dense elastomeric gaskets complying with ASTM C 864.
 - c. Weather-Stripping Material: Manufacturer's standard system and materials complying with AAMA/WDMA 101/I.S.2/NAFS.
7. Sliding-Type Weather Stripping: Provide woven-pile weather stripping of wool, polypropylene, or nylon pile and resin-impregnated backing fabric. Comply with AAMA 701/702.
 - a. Weather Seals: Provide weather stripping with integral barrier fin or fins of semirigid, polypropylene sheet or polypropylene-coated material. Comply with AAMA 701/702.
8. Replaceable Weather Seals: Comply with AAMA 701/702.

B. Window

1. Window Type: Casement **OR** Double hung **OR** Fixed **OR** Horizontal sliding **OR** Projected awning **OR** Single hung **OR** Bay **OR** Bow **OR** Specialty product **OR** As indicated on Drawings **OR** As indicated on a schedule, **as directed**.
2. AAMA/WDMA Performance Requirements: Provide vinyl windows of performance indicated that comply with AAMA/WDMA 101/I.S.2/NAFS unless more stringent performance requirements are indicated.
 - a. Performance Class and Grade: R15 **OR** R20 **OR** R25, **as directed**.
 - b. Performance Class and Grade: LC25 **OR** LC30 **OR** LC35, **as directed**.
 - c. Performance Class and Grade: C30 **OR** C35 **OR** C40, **as directed**.
 - d. Performance Class and Grade: HC40 **OR** HC45 **OR** HC50, **as directed**.
 - e. Performance Class and Grade: AW40 **OR** AW45 **OR** AW50, **as directed**.
 - f. Performance Class and Grade: As indicated.
 - g. Performance Class (if test performance method is selected for specifying windows and designating a performance class does not conflict with basic wind speed and performance testing indicated): R **OR** LC **OR** C **OR** HC **OR** AW, **as directed**.
3. Condensation-Resistance Factor (CRF): Provide vinyl windows tested for thermal performance according to AAMA 1503, showing a CRF of 45 **OR** 52 **OR** 65, **as directed**.
4. Thermal Transmittance: Provide vinyl windows with a whole-window, U-factor maximum indicated at 15-mph (24-km/h) exterior wind velocity and winter condition temperatures when tested according to AAMA 1503 **OR** ASTM E 1423 **OR** NFRC 100, **as directed**.
 - a. U-Factor: 0.35 Btu/sq. ft. x h x deg F (2.0 W/sq. m x K) **OR** 0.40 Btu/sq. ft. x h x deg F (2.3 W/sq. m x K) **OR** 0.43 Btu/sq. ft. x h x deg F (2.5 W/sq. m x K) **OR** 0.60 Btu/sq. ft. x h x deg F (3.4 W/sq. m x K), **as directed**, or less.
5. Solar Heat-Gain Coefficient (SHGC): Provide vinyl windows with a whole-window SHGC maximum of 0.40 **OR** 0.50 **OR** 0.55, **as directed**, determined according to NFRC 200 procedures.
6. Sound Transmission Class (STC): Provide glazed windows rated for not less than 26 **OR** 30 **OR** 35, **as directed**, STC when tested for laboratory sound transmission loss according to ASTM E 90 and determined by ASTM E 413.
7. AAMA/WDMA 101/I.S.2/NAFS, Air Infiltration Test.
 - a. Maximum Rate: 0.3 cfm/sq. ft. (5 cu. m/h x sq. m) of area at an inward test pressure of 1.57 lbf/sq. ft. (75 Pa) which is equivalent to 25-mph (40-km/h) wind speed and is typically used to test R, C, and LC performance classes.

- b. Maximum Rate: **0.3 cfm/sq. ft. (5 cu. m/h x sq. m)** of area at an inward test pressure of **6.24 lbf/sq. ft. (300 Pa)** which is equivalent to a 50-mph (80-km/h) wind speed and is typically used to test HC and AW performance classes.
 8. Water Resistance: No water leakage as defined in AAMA/WDMA referenced test methods at a water test pressure equaling that indicated, when tested according to AAMA/WDMA 101/I.S.2/NAFS, Water Resistance Test.
 - a. Test Pressure: 15 percent of positive design pressure, but not less than **2.86 lbf/sq. ft. (140 Pa)** or more than **15 lbf/sq. ft. (720 Pa)**.
 - b. Test Pressure: 20 percent of positive design pressure, but not more than **15 lbf/sq. ft. (720 Pa)**.
 9. Forced-Entry Resistance: Comply with Performance Grade 10 **OR** 20 **OR** 30 **OR** 40, **as directed**, requirements when tested according to ASTM F 588.
 10. Life-Cycle Testing: Test according to AAMA 910 and comply with AAMA/WDMA 101/I.S.2/NAFS.
 11. Operating Force and Auxiliary (Durability) Tests: Comply with AAMA/WDMA 101/I.S.2/NAFS for operating window types indicated.
- C. Glazing
 1. Glass: Clear, insulating-glass units **OR** Clear, insulating-glass units, with low-E coating pyrolytic on second surface or sputtered on second or third surface, **OR** Clear, insulating-glass units, argon gas filled, with low-E coating pyrolytic on second surface or sputtered on second or third surface, **as directed**, complying with Division 08 Section "Glazing".
 2. Glazing System: Manufacturer's standard factory-glazing system that produces weathertight seal **OR** Manufacturer's standard factory-glazing system that produces weathertight seal and complies with requirements for windborne-debris resistance **OR** Manufacturer's standard factory-glazing system as indicated in Division 08 Section "Glazing", **as directed**.
- D. Hardware
 1. General: Provide manufacturer's standard hardware fabricated from aluminum, stainless steel, carbon steel complying with AAMA 907, or other corrosion-resistant material compatible with vinyl; designed to smoothly operate, tightly close, and securely lock vinyl windows, and sized to accommodate sash or ventilator weight and dimensions. Do not use aluminum in frictional contact with other metals. Where exposed, provide solid bronze **OR** extruded, cast, or wrought aluminum **OR** die-cast zinc with special coating finish **OR** nonmagnetic stainless steel, **as directed**.
 2. Counterbalancing Mechanism: Comply with AAMA 902.
 - a. Sash-Balance Type: Concealed, tape-spring **OR** spiral-tube **OR** spring-loaded, block-and-tackle, **as directed**, type, of size and capacity to hold sash stationary at any open position.
 3. Sill Cap/Track: Extruded-aluminum track with natural anodized finish **OR** Rigid PVC or other weather-resistant plastic track with manufacturer's standard integral color, **as directed**, of thickness, dimensions, and profile indicated; designed to comply with performance requirements indicated and to drain to the exterior.
 4. Locks and Latches: Designed to allow unobstructed movement of the sash across adjacent sash in direction indicated and operated from the inside only. Provide custodial locks, **as directed**.
 5. Roller Assemblies: Low-friction design.
 6. Push-Bar Operators: Provide telescoping-type, push-bar operator designed to open and close ventilators with fixed screens.
 7. Gear-Type Rotary Operators: Comply with AAMA 901 when tested according to ASTM E 405, Method A.
 - a. Operation Function: All ventilators move simultaneously and securely close at both jams without using additional manually controlled locking devices.
 8. Four- or Six-Bar Friction Hinges: Comply with AAMA 904.
 - a. Locking mechanism and handles for manual operation.
 - b. Friction Shoes: Provide friction shoes of nylon or other nonabrasive, nonstaining, noncorrosive, durable material.

9. Limit Devices: Provide concealed friction adjustor, adjustable stay bar **OR** concealed support arms with adjustable, limited, hold-open, **as directed**, limit devices designed to restrict sash or ventilator opening.
 - a. Safety Devices: Limit clear opening to **4 inches (100 mm) OR 6 inches (150 mm)**, **as directed**, for ventilation; with custodial key release.
 10. Pole Operators: Tubular-shaped anodized aluminum; with rubber-capped lower end and standard push-pull hook at top to match hardware design; of sufficient length to operate window without reaching more than **60 inches (1500 mm)** above floor; 1 pole operator and pole hanger per room that has operable windows more than **72 inches (1800 mm)** above floor.
- E. Insect Screens
1. General: Design windows and hardware to accommodate screens in a tight-fitting, removable arrangement, with a minimum of exposed fasteners and latches. Fabricate insect screens to fully integrate with window frame. Locate screens on inside **OR** outside, **as directed**, of window and provide for each operable exterior sash or ventilator.
 - a. Aluminum Tubular Frame Screens: Comply with SMA 1004, "Specifications for Aluminum Tubular Frame Screens for Windows," Residential R-20 **OR** Architectural C-24 **OR** Monumental M-32, **as directed**, class.
 2. Aluminum Insect Screen Frames: Manufacturer's standard aluminum alloy complying with SMA 1004. Fabricate frames with mitered or coped joints or corner extrusions, concealed fasteners, adjustable rollers, **as directed**, and removable PVC spline/anchor concealing edge of frame.
 - a. Aluminum Tubular Framing Sections and Cross Braces: Roll formed from aluminum sheet with minimum wall thickness as required for class indicated.
 - b. Finish: Anodized aluminum **OR** Baked-on organic coating, **as directed**, in manufacturer's standard color.
 - c. Finish: Anodized aluminum **OR** Baked-on organic coating, **as directed**, in color selected from manufacturer's full range.
 - d. Finish: Manufacturer's standard.
 3. Glass-Fiber Mesh Fabric: **18-by-14 (1.1-by-1.4-mm)** or **18-by-16 (1.0-by-1.1-mm) OR 20-by-20 (0.85-by-0.85-mm)** or **20-by-30 (0.85-by-0.42-mm)**, **as directed**, mesh of PVC-coated, glass-fiber threads; woven and fused to form a fabric mesh resistant to corrosion, shrinkage, stretch, impact damage, and weather deterioration, in the following color. Comply with ASTM D 3656.
 - a. Mesh Color: Charcoal gray **OR** Silver gray **OR** Aquamarine, **as directed**.
 4. Aluminum Wire Fabric: **18-by-16 (1.1-by-1.3-mm)** mesh of **0.011-inch- (0.28-mm-)** diameter, coated aluminum wire.
 - a. Wire-Fabric Finish: Natural bright **OR** Charcoal gray **OR** Black, **as directed**.
 5. Wickets: Provide sliding **OR** hinged, **as directed**, wickets, framed and trimmed for a tight fit and for durability during handling.
- F. Accessories
1. Dividers (False Muntins): Provide dividers in designs indicated for each sash lite, one per sash, removable from the exposed surface of interior lite of the sash **OR** two per sash, removable from the exposed surfaces of interior and exterior lites of the sash **OR** one permanently located between glazing lites in the airspace, **as directed**.
 - a. Material: Extruded, rigid PVC **OR** Aluminum, **as directed**.
 - b. Design: Rectangular **OR** Diamond, **as directed**.
 - c. Color: White **OR** Beige, **as directed**.
- G. Fabrication
1. Fabricate vinyl windows in sizes indicated. Include a complete system for assembling components and anchoring windows.
 - a. Welded Frame and Sash/Ventilator Corners: Miter-cut and fusion **OR** chemically, **as directed**, welded.
 - b. Mechanically Fastened Frame and Sash/Ventilator Corners: Double-butt coped and fastened with concealed screws, **as directed**.

2. Fabricate vinyl windows that are reglazable without dismantling sash or ventilator framing.
3. Weather Stripping: Provide full-perimeter weather stripping for each operable sash and ventilator, unless otherwise indicated.
 - a. Double-Hung Windows: Provide weather stripping only at horizontal rails of operable sash.
4. Mullions: Provide mullions and cover plates as shown, compatible with window units, complete with anchors for support to structure and installation of window units. Allow for erection tolerances and provide for movement of window units due to thermal expansion and building deflections, as indicated. Provide mullions and cover plates capable of withstanding design loads of window units. Provide manufacturer's standard finish to match window units.
5. Subframes: Provide subframes with anchors for window units as shown, of profile and dimensions indicated but not less than **0.062-inch- (1.6-mm-)** thick extruded aluminum. Miter or cope corners, and weld and dress smooth with concealed mechanical joint fasteners. Provide manufacturer's standard finish to match window units. Provide subframes capable of withstanding design loads of window units.
6. Factory-Glazed Fabrication: Except for light sizes in excess of **100 united inches (2500 mm width plus length)**, glaze vinyl windows in the factory where practical and possible for applications indicated. Comply with requirements in Division 08 Section "Glazing" and with AAMA/WDMA 101/I.S.2/NAFS.
7. Glazing Stops: Provide nailed or snap-on glazing stops coordinated with Division 08 Section "Glazing" and glazing system indicated. Provide glazing stops to match sash and ventilator frames.
8. Hardware: Mount hardware through double walls of vinyl extrusions or provide corrosion-resistant steel reinforcement complying with requirements for reinforcing members, or do both.
9. Bow **OR** Bay, **as directed**, Windows: Provide vinyl windows in configuration indicated. Provide window frames, fixed and operating sash, operating hardware, and other trim and components necessary for a complete, secure, and weathertight installation, including the following:
 - a. Angled mullion posts with interior and exterior trim.
 - b. Angled interior and exterior extension and trim.
 - c. Clear pine head and seat boards.
 - d. Top and bottom plywood platforms.
 - e. Exterior head and sill casings and trim.
 - f. Support brackets.
10. Complete fabrication, assembly, finishing, hardware application, and other work in the factory to greatest extent possible. Disassemble components only as necessary for shipment and installation. Allow for scribing, trimming, and fitting at Project site.

H. Vinyl Finishes

1. Integral Finish and Color: Uniform, solid, homogeneous white **OR** beige, **as directed**, interior and exterior.
2. Organic Pigmented Finish: Manufacturer's standard finish, interior and exterior, complying with AAMA 613 **OR** AAMA 615, **as directed**, and paint manufacturer's written specifications for cleaning and painting.
 - a. Color: As indicated by manufacturer's designations **OR** Match sample **OR** As selected from manufacturer's full range, **as directed**.

1.3 EXECUTION

A. Installation

1. Comply with Drawings, Shop Drawings, and manufacturer's written instructions for installing windows, hardware, accessories, and other components.
2. Install windows level, plumb, square, true to line, without distortion or impeding thermal movement, anchored securely in place to structural support, and in proper relation to wall flashing and other adjacent construction.
3. Set sill members in bed of sealant or with gaskets, as indicated, for weathertight construction.

4. Separate aluminum and other corrodible surfaces from sources of corrosion or electrolytic action at points of contact with other materials.
- B. Adjusting, Cleaning, And Protection
1. Adjust operating sashes and ventilators, screens, hardware, and accessories for a tight fit at contact points and weather stripping for smooth operation and weathertight closure. Lubricate hardware and moving parts.
 2. Clean exposed surfaces immediately after installing windows. Avoid damaging protective coatings and finishes. Remove excess sealants, glazing materials, dirt, and other substances.
 3. Clean factory-glazed glass immediately after installing windows. Comply with manufacturer's written recommendations for final cleaning and maintenance. Remove nonpermanent labels, and clean surfaces.
 4. Remove and replace glass that has been broken, chipped, cracked, abraded, or damaged during construction period.
 5. Protect window surfaces from contact with contaminating substances resulting from construction operations. In addition, monitor window surfaces adjacent to and below exterior concrete and masonry surfaces during construction for presence of dirt, scum, alkaline deposits, stains, or other contaminants. If contaminating substances do contact window surfaces, remove contaminants immediately according to manufacturer's written recommendations.

END OF SECTION 08 53 13 00

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Task	Specification	Specification Description
08 53 66 00	08 53 13 00	Vinyl Windows

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SECTION 08 56 19 00 - SECURITY WINDOWS

1.1 GENERAL

A. Description Of Work

1. This specification covers the furnishing and installation of material for security windows. Products shall be as follows or as directed by the Owner. Installation procedures shall be in accordance with the products manufacturer's recommendations. Demolition and removal of materials shall be as required to support the work.

B. Summary

1. Section Includes:
 - a. Vision security windows.
 - b. Fixed, transaction security windows.
 - c. Sliding, transaction security windows.

C. Performance Requirements

1. Ballistics-Resistance Performance: Provide units identical to those tested for compliance with requirements indicated, and as follows:
 - a. Listed and labeled as bullet resisting according to UL 752.
 - b. Tested for ballistics resistance according to UL 752 **OR** ASTM F 1233 **OR** HPW-TP-0500.03 **OR** NIJ STD-0108.01, **as directed**, by a testing agency acceptable to authorities having jurisdiction.
 - c. Certified as complying with SD-STD-01.01, by the U.S. State Department, for ballistics resistance when tested by a qualified testing agency.
2. Forced-Entry-Resistance Performance: Provide units identical to those tested for compliance with requirements indicated, and as follows:
 - a. Tested for forced-entry resistance according to HPW-TP-0500.03 **OR** ASTM F 1233, **as directed**, by a testing agency acceptable to authorities having jurisdiction.
 - b. For Federal Government Work: Certified as complying with SD-STD-01.01, by the U.S. State Department, for forced-entry resistance when tested by a qualified testing agency.
3. Windborne-Debris-Impact-Resistance-Test Performance: Provide automatic entrances that pass large missile-impact and cyclic-pressure tests of ASTM E 1996 according to the IBC.
4. Structural Performance: Security windows shall withstand the effects of wind loads determined as follows, with no permanent deformation or breakage within window assembly when tested according to ASTM E 330:
 - a. Basic Wind Speed: As indicated in **miles per hour (meters per second)** at **33 feet (10 m)** above grade. Determine wind loads and resulting design pressures applicable to Project according to SEI/ASCE 7, "Minimum Design Loads for Buildings and Other Structures," Section 6.4.2, "Analytic Procedure," based on mean roof heights above grade as indicated on Drawings.
5. Air Infiltration for Operable Windows: Not more than **0.370 cfm/ft. (0.573 L/s per m)** **OR** **0.500 cfm/ft. (0.774 L/s per m)**, **as directed**, of operable sash joint at an inward test pressure of **1.56 lbf/sq. ft. (75 Pa)** when tested according to ASTM E 283.
6. Air Infiltration for Fixed Windows: Not more than **0.010 cfm/ft. (0.015 L/s per m)** **OR** **0.060 cfm/ft. (0.093 L/s per m)**, **as directed**, of crack length at an inward test pressure of **1.56 lbf/sq. ft. (75 Pa)** when tested according to ASTM E 283.
7. Water Penetration: No water penetration as defined in test method at an inward test pressure of **1.56 lbf/sq. ft. (75 Pa)** **OR** **2.86 lbf/sq. ft. (137 Pa)** **OR** **6.24 lbf/sq. ft. (300 Pa)**, **as directed**, when tested according to ASTM E 331.

D. Submittals

1. Product Data: For each type of product indicated.
2. Shop Drawings.

3. Samples: For each type of exposed finish required.
4. Welding certificates.
5. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for each type of security window and accessory indicated as ballistics **OR** forced-entry, **as directed**, resistant.
6. Configuration Disclosure Drawing: For each type of forced-entry-resistant security window, complying with ASTM F 1233.
7. Warranty: Sample of special warranty.

E. Quality Assurance

1. Testing Agency Qualifications: Qualified according to ASTM E 699 and experienced in ballistics- and forced-entry-resistance testing.
2. Welding Qualifications: Qualify procedures and personnel according to the following:
 - a. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
 - b. AWS D1.2/D1.2M, "Structural Welding Code - Aluminum."
 - c. AWS D1.3, "Structural Welding Code - Sheet Steel."
 - d. AWS D1.6, "Structural Welding Code - Stainless Steel."
3. Preinstallation Conference: Conduct conference at Project site.

F. Delivery, Storage, And Handling

1. Pack security windows in wood crates for shipment. Crate glazing separate from frames unless factory glazed.
2. Label security window packaging with location in Project **OR** drawing designation, **as directed**.
3. Store crated security windows on raised blocks to prevent moisture damage.

G. Warranty

1. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace security windows that fail in materials or workmanship within three years from date of Final Completion.

1.2 PRODUCTS

A. Materials

1. Aluminum Extrusions: **ASTM B 221 (ASTM B 221M)**. Provide alloy and temper recommended by manufacturer for strength, corrosion resistance, and application of required finish, but not less than **22,000-psi (150-MPa)** ultimate tensile strength and not less than **0.125 inch (3.2 mm)** thick at any location for main frame and sash members.
2. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.
3. Hot-Rolled Steel Sheet: ASTM A 1011/A 1011M, CS (Commercial Steel), Type B; free of scale, pitting, or surface defects; pickled and oiled.
4. Cold-Rolled Steel Sheet: ASTM A 1008/A 1008M, CS (Commercial Steel), Type B.
5. Metallic-Coated Steel Sheet: ASTM A 653/A 653M, CS (Commercial Steel), Type B; with **G60 (Z180)** zinc (galvanized) or **A60 (ZF180)** zinc-iron-alloy (galvannealed) coating designation.
6. Stainless-Steel Sheet, Strip, Plate, and Flat Bars: ASTM A 240/A 240M or ASTM A 666, austenitic stainless steel, Type 304 **OR** Type 316, **as directed**, stretcher-leveled standard of flatness.
7. Concealed Bolts: ASTM A 307, Grade A unless otherwise indicated.
8. Cast-in-Place Anchors in Concrete: Fabricated from corrosion-resistant materials capable of sustaining, without failure, a load equal to four times the load imposed, as determined by testing per ASTM E 488, conducted by a qualified testing agency.
 - a. Threaded or wedge type; galvanized ferrous castings, either ASTM A 27/A 27M cast steel or ASTM A 47/A 47M malleable iron. Provide bolts, washers, and shims as required; hot-dip galvanized per ASTM A 153/A 153M or ASTM F 2329.

9. Embedded Plate Anchors: Fabricated from steel shapes and plates, minimum **3/16 inch (4.8 mm)** thick; with minimum **1/2-inch- (12.7-mm-)** diameter, headed studs welded to back of plate.
 10. Welding Rods and Bare Electrodes: Select according to AWS specifications for metal alloy welded.
 11. Bituminous Paint: Cold-applied, asphalt-mastic paint complying with SSPC-Paint 12 requirements except containing no asbestos; formulated for **30-mil (0.76-mm)** thickness per coat.
 12. Sealants: For sealants required within fabricated security windows, provide type recommended by manufacturer for joint size and movement. Sealant shall remain permanently elastic, nonshrinking, and nonmigrating.
- B. Window Components
1. Glazing: Comply with requirements in Division 08 Section "Security Glazing" for performance indicated.
 - a. Comply with requirements of UL listing for ballistics-resistance level.
 2. Compression-Type Glazing Strips and Weather Stripping: Unless otherwise indicated, provide compressible stripping for glazing and weather stripping, such as molded EPDM or neoprene gaskets complying with ASTM D 2000, Designations 2BC415 to 3BC620; molded PVC gaskets complying with ASTM D 2287; or molded, expanded EPDM or neoprene gaskets complying with ASTM C 509, Grade 4.
 3. Miscellaneous Glazing Materials: Provide material, size, and shape complying with requirements of glass manufacturers, and with a proven record of compatibility with surfaces contacted in installation.
 - a. Cleaners, Primers, and Sealers: Type recommended by sealant or gasket manufacturer.
 - b. Setting Blocks: Elastomeric material with a Type A Shore durometer hardness of 85, plus or minus 5.
 - c. Spacers: Elastomeric blocks or continuous extrusions with a Type A Shore durometer hardness required by glass manufacturer to maintain glass lites in place for installation indicated.
 - d. Edge Blocks: Elastomeric material of hardness needed to limit glass lateral movement (side walking).
 4. Anchors, Clips, and Window Accessories: Stainless steel; hot-dip, zinc-coated steel or iron, complying with ASTM B 633; provide sufficient strength to withstand design pressure indicated.
- C. Vision Security Windows
1. Vision Security Windows: Provide fixed vision security windows with framing on four sides and no operable sash or ventilator.
 2. Ballistics Resistance:
 - a. Level 1 **OR** Level 2 **OR** Level 3 **OR** Level 4 **OR** Level 5 **OR** Level 6 **OR** Level 7 **OR** Level 8, **as directed**, when tested according to UL 752.
 - b. HG1 **OR** HG2 **OR** HG3 **OR** HG4 **OR** SMG **OR** R1 **OR** R2 **OR** R3 **OR** R4-AP **OR** SH1 **OR** SH2, **as directed**, when tested according to ASTM F 1233.
 - c. A **OR** B **OR** C **OR** D **OR** E, **as directed**, when tested according to HPW-TP-0500.03.
 - d. S **OR** R **OR** AP **OR** SH, **as directed**, when tested according to SD-STD-01.01.
 - e. Level I **OR** Level IIA **OR** Level II **OR** Level IIIA **OR** Level III **OR** Level IV, **as directed**, when tested according to NIJ STD-0108.01.
 3. Forced-Entry Resistance:
 - a. Level I **OR** Level II **OR** Level III **OR** Level IV **OR** Level V, **as directed**, when tested according to HPW-TP-0500.03.
 - b. Class I **OR** Class II **OR** Class III **OR** Class IV **OR** Class V, **as directed**, when tested according to ASTM F 1233.
 - c. Five **OR** 15 **OR** 60, **as directed**, -minute protection level when tested according to SD-STD-01.01.
 4. Framing: Fabricate perimeter framing, mullions, and glazing stops from metal sheet as follows:
 - a. Material:
 - 1) Cold-rolled steel sheet, factory primed for field-painted finish **OR** with baked-enamel finish, **as directed**.

- 2) Galvanized-steel sheet, factory primed for field-painted finish.
 - 3) Stainless-steel sheet with No. 4 finish.
 - 4) Aluminum-clad steel sheet with Class I, clear anodized **OR** Class II, clear anodized **OR** Class I, color anodized **OR** Class II, color anodized **OR** baked-enamel, **as directed**, finish.
 - 5) Material: Extruded aluminum with Class I, clear anodized **OR** Class II, clear anodized **OR** Class I, color anodized **OR** Class II, color anodized **OR** baked-enamel, **as directed**, finish.
 - b. Profile: Manufacturer's standard **OR** Narrow, **as directed**, with minimum face dimension indicated.
 - c. Minimum Face Dimension: **2 inches (50 mm)** **OR** **1-1/4 inches (32 mm)** **OR** As indicated on Drawings, **as directed**.
 - d. Framing Depth:
 - 1) Manufacturer's standard.
 - 2) Adjustable for varying wall thicknesses by use of a two-piece, split frame that is attached to wall by clamping action induced by tightening screws.
 - 3) As indicated on Drawings.
 - e. Framing Orientation: Vertical **OR** Incline subframe 5 degrees to vertical, with top of frame slanted away from protected side of window, **as directed**.
- D. Fixed, Transaction Security Windows
1. Fixed, Transaction Security Windows: Provide fixed, framed transaction windows with operable sash or ventilator capable of allowing transfer of currency and documents.
 2. Configuration: One fixed-glazed panel **OR** Multiple fixed-glazed panels **OR** As indicated on Drawings, **as directed**.
 3. Ballistics Resistance:
 - a. Level 1 **OR** Level 2 **OR** Level 3 **OR** Level 4 **OR** Level 5 **OR** Level 6 **OR** Level 7 **OR** Level 8, **as directed**, when tested according to UL 752.
 - b. HG1 **OR** HG2 **OR** HG3 **OR** HG4 **OR** SMG **OR** R1 **OR** R2 **OR** R3 **OR** R4-AP **OR** SH1 **OR** SH2, **as directed**, when tested according to ASTM F 1233.
 - c. A **OR** B **OR** C **OR** D **OR** E, **as directed**, when tested according to HPW-TP-0500.03.
 - d. S **OR** R **OR** AP **OR** SH, **as directed**, when tested according to SD-STD-01.01.
 - e. Level I **OR** Level IIA **OR** Level II **OR** Level IIIA **OR** Level III **OR** Level IV, **as directed**, when tested according to NIJ STD-0108.01.
 4. Forced-Entry Resistance:
 - a. Level I **OR** Level II **OR** Level III **OR** Level IV **OR** Level V, **as directed**, when tested according to HPW-TP-0500.03.
 - b. Class I **OR** Class II **OR** Class III **OR** Class IV **OR** Class V, **as directed**, when tested according to ASTM F 1233.
 - c. Five **OR** 15 **OR** 60, **as directed**, -minute protection level when tested according to SD-STD-01.01.
 5. Framing: Fabricate perimeter framing, mullions, and glazing stops from metal sheet as follows:
 - a. Material:
 - 1) Cold-rolled steel sheet, factory primed for field-painted finish **OR** with baked-enamel finish, **as directed**.
 - 2) Stainless-steel sheet with No. 4 finish.
 - 3) Aluminum-clad steel sheet with Class I, clear anodized **OR** Class II, clear anodized **OR** Class I, color anodized **OR** Class II, color anodized **OR** baked-enamel, **as directed**, finish.
 - 4) Extruded aluminum with Class I, clear anodized **OR** Class II, clear anodized **OR** Class I, color anodized **OR** Class II, color anodized **OR** baked-enamel, **as directed**, finish.
 - b. Profile: Manufacturer's standard **OR** Narrow, **as directed**, with minimum face dimension indicated.

- c. Minimum Face Dimension: **2 inches (50 mm) OR 1-1/4 inches (32 mm) OR** As indicated on Drawings, **as directed**.
- d. Framing Depth:
 - 1) Manufacturer's standard.
 - 2) Adjustable for varying wall thicknesses by use of a two-piece, split frame that is attached to wall by clamping action induced by tightening screws.
 - 3) As indicated on Drawings.
- e. Provide thermally improved construction for aluminum framing.
- 6. Head and Jamb Framing: Designed for sealant glazing **OR** gasket glazing **OR** voice communication by speech at normal volume, **as directed**.
- 7. Channel-Frame Sill: Formed from stainless steel and designed for sealant glazing.
 - a. Transaction Counter: Stainless steel, **12 inches (305 mm) OR 18 inches (457 mm)**, **as directed**, deep by width of security window, with integral deal tray centered in opening **OR** as indicated on Drawings, **as directed**.
 - b. Transaction Counter: Stainless steel, **21 inches (533 mm)** deep by width of security window, with operable deal tray centered in opening **OR** as indicated on Drawings, **as directed**.
- 8. Voice-Communication-Type Sill: Formed from stainless steel and designed to allow passage of speech at normal speaking volume without distortion.
 - a. Sill Depth: **12 inches (305 mm)** deep **OR 18 inches (457 mm)** deep with **6-inch (152-mm)** deep projection on nonsecure side **OR 21 inches (533 mm)** deep with **6-inch (152-mm)** deep projection on both sides, **as directed**.
 - b. Transaction Counter: Stainless steel, **12 inches (305 mm) OR 18 inches (457 mm)**, **as directed**, deep by width of security window, with integral deal tray centered in opening **OR** as indicated on Drawings, **as directed**.
 - c. Integral Transaction-Drawer Sill: Formed from stainless steel **OR** framing to match head and jamb framing, **as directed**; with transaction drawer integrated into framing and contained in a stainless-steel housing that forms a transaction counter on secure side **OR** nonsecure side **OR** both sides, **as directed**, of opening. Drawer front shall be flush with housing when drawer is closed.
- E. Sliding, Transaction Security Windows
 - 1. Sliding, Transaction Security Windows: Provide horizontal-sliding, transaction security windows.
 - 2. Configuration: One fixed-glazed panel and one horizontal-sliding glazed panel **OR** Two glazed panels that slide horizontally and meet at center of security window **OR** As indicated on Drawings, **as directed**.
 - 3. Ballistics Resistance:
 - a. Level 1 **OR** Level 2 **OR** Level 3 **OR** Level 4 **OR** Level 5 **OR** Level 6 **OR** Level 7 **OR** Level 8, **as directed**, when tested according to UL 752.
 - b. HG1 **OR** HG2 **OR** HG3 **OR** HG4 **OR** SMG **OR** R1 **OR** R2 **OR** R3 **OR** R4-AP **OR** SH1 **OR** SH2, **as directed**, when tested according to ASTM F 1233.
 - c. A **OR** B **OR** C **OR** D **OR** E, **as directed**, when tested according to HPW-TP-0500.03.
 - d. S **OR** R **OR** AP **OR** SH, **as directed**, when tested according to SD-STD-01.01.
 - e. Level I **OR** Level IIA **OR** Level II **OR** Level IIIA **OR** Level III **OR** Level IV, **as directed**, when tested according to NIJ STD-0108.01.
 - 4. Forced-Entry Resistance:
 - a. Level I **OR** Level II **OR** Level III **OR** Level IV **OR** Level V, **as directed**, when tested according to HPW-TP-0500.03.
 - b. Class I **OR** Class II **OR** Class III **OR** Class IV **OR** Class V, **as directed**, when tested according to ASTM F 1233.
 - c. Five **OR** 15 **OR** 60, **as directed**, -minute protection level when tested according to SD-STD-01.01.
 - 5. Framing: Fabricate perimeter framing, mullions, and glazing stops from metal sheet as follows:
 - a. Material:
 - 1) Cold-rolled steel sheet, factory primed for field-painted finish **OR** with baked-enamel finish, **as directed**.

- 2) Material: Stainless-steel sheet with No. 4 finish.
- 3) Material: Aluminum-clad steel sheet with Class I, clear anodized **OR** Class II, clear anodized **OR** Class I, color anodized **OR** Class II, color anodized **OR** baked-enamel, **as directed**, finish.
- 4) Material: Extruded aluminum with Class I, clear anodized **OR** Class II, clear anodized **OR** Class I, color anodized **OR** Class II, color anodized **OR** baked-enamel, **as directed**, finish.
- b. Profile: Manufacturer's standard **OR** Narrow, **as directed**, with minimum face dimension indicated.
- c. Minimum Face Dimension: **2 inches (50 mm) OR 1-1/4 inches (32 mm) OR** As indicated on Drawings, **as directed**.
- d. Framing Depth:
 - 1) Manufacturer's standard.
 - 2) Adjustable for varying wall thicknesses by use of a two-piece, split frame that is attached to wall by clamping action induced by tightening screws.
 - 3) As indicated on Drawings.
- e. Provide thermally improved construction for aluminum framing.
6. Head and Jamb Framing: Designed for sealant **OR** gasket, **as directed**, glazing.
7. Glazing Meeting Edges: Polished glazing.
8. Sill: Stainless-steel channel frame designed for sealant **OR** gasket, **as directed**, glazing.
 - a. Shelf: Stainless steel, **12 inches (305 mm) OR 18 inches (457 mm)**, **as directed**, deep by width of security window, with integral deal tray.
9. Sliding Window Hardware: Provide roller track designed for overhead support of two- or four-wheel carriage supporting horizontal-sliding glazed panel. Provide manufacturer's standard pull and lock with two keys for each horizontal-sliding glazed panel.
 - a. Provide weather stripping for exterior horizontal-sliding, transaction security windows.

F. Accessories

1. Recessed Deal Trays: Formed from stainless steel with sliding stainless-steel cover, **as directed**; fabricated in curved shape with exposed flanges for recessed installation into horizontal surface.
 - a. Clear Opening Size: **12 inches wide by 8 inches deep by 1-1/2 inches high (305 mm wide by 203 mm deep by 38 mm high) OR 12 inches wide by 11 inches deep by 1-1/2 inches high (305 mm wide by 279 mm deep by 38 mm high) OR 16 inches wide by 11 inches deep by 1-1/2 inches high (406 mm wide by 279 mm deep by 38 mm high)**, **as directed**.
2. Recessed, Nonricochet Deal Trays: Formed from stainless steel; fabricated with recessed bullet trap to ricochet bullets away from secure side, with exposed flanges for recessed installation into horizontal surface, and with sliding stainless-steel cover, **as directed**.
 - a. Clear Opening Size: **10 inches wide by 7 inches deep by 1-1/2 inches high (254 mm wide by 178 mm deep by 38 mm high) OR 12 inches wide by 8 inches deep by 1-1/2 inches high (305 mm wide by 203 mm deep by 38 mm high) OR 12 inches wide by 11 inches deep by 1-1/2 inches high (305 mm wide by 279 mm deep by 38 mm high) OR 16 inches wide by 11 inches deep by 1-1/2 inches high (406 mm wide by 279 mm deep by 38 mm high)**, **as directed**.
 - b. Bullet Trap Location: Secure side **OR** Both sides, **as directed**.
 - c. Ballistics Resistance: UL Level 1 **OR** UL Level 3 **OR** Same as security window, **as directed**.
 - d. Listed and labeled as bullet resisting according to UL 752.
3. Rotating Deal Trays: Formed from stainless steel, with rotating recessed deal tray on each side of secure opening and with handle that rotates deal trays 180 degrees.
 - a. Mounting: Drop in **OR** Countertop, **as directed**.
 - b. Ballistics Resistance: UL Level 1 **OR** UL Level 3 **OR** Same as security window, **as directed**.
 - c. Listed and labeled as bullet resisting according to UL 752.

4. Transaction Drawers: Formed from stainless steel **OR** steel **OR** bullet-resistant armoring, **as directed**; with ball-bearing, telescoping sliding mechanism; with cover on secure side of top of drawer that automatically closes when drawer is extended to nonsecure side.
 - a. Inside Dimensions: 15-3/8 inches wide by 8-1/2 inches deep by 4-3/8 inches high (390 mm wide by 216 mm deep by 111 mm high) **OR** 13 inches wide by 22 inches deep by 6-1/2 inches high (330 mm wide by 559 mm deep by 165 mm high), **as directed**.
 - b. Operation:
 - 1) Manual.
 - 2) Electric, with sliding handle for emergency manual operation during lack of power. Provide individual switches for power and drawer movement on secure side and call button on nonsecure side.
 - c. Ballistics Resistance: UL Level 1 **OR** UL Level 3 **OR** Same as security window, **as directed**.
 - d. Listed and labeled as bullet resisting according to UL 752.
 5. Speaking Apertures: Fabricate from stainless steel **OR** security glazing, **as directed**, designed to allow passage of speech at normal speaking volume without distortion.
 - a. Shape: Circular **OR** Square, **as directed**.
 - b. Ballistics Resistance: UL Level 1 **OR** UL Level 3 **OR** Same as security window, **as directed**.
 - c. Listed and labeled as bullet resisting according to UL 752.
- G. Fabrication
1. General: Fabricate security windows to provide a complete system for assembly of components and anchorage of window units.
 - a. Provide units that are reglazable from the secure side without dismantling the nonsecure side of framing.
 - b. Prepare security windows for glazing unless preglazing at the factory is indicated.
 2. Provide weep holes and internal water passages for exterior security windows to conduct infiltrating water to the exterior.
 3. Framing: Miter or cope corners the full depth of framing; weld and dress smooth.
 - a. Fabricate framing with manufacturer's standard, internal opaque armoring in thicknesses required for security windows to comply with ballistics-resistance performance indicated.
 4. Glazing Stops: Finish glazing stops to match security window framing.
 - a. Secure-Side (Exterior) Glazing Stops: Welded or integral to framing.
 - b. Nonsecure-Side (Interior) Glazing Stops: Removable, coordinated with glazing indicated.
 5. Welding: Weld components to comply with referenced AWS standard. To greatest extent possible, weld before finishing and in concealed locations to minimize distortion or discoloration of finish. Remove weld spatter and welding oxides from exposed surfaces by descaling or grinding.
 6. Metal Protection: Separate dissimilar metals to protect against galvanic action by painting contact surfaces with primer or by applying sealant or tape recommended by manufacturer for this purpose.
 7. Factory-cut openings in glazing for speaking apertures.
 8. Preglazed Fabrication: Preglaze window units at factory, where required for applications indicated. Comply with requirements in Division 08 Section "Security Glazing".
 9. Weather Stripping: Factory applied.
- H. Aluminum Finishes
1. Clear Anodic Finish: AAMA 611, AA-M12C22A41, Class I, 0.018 mm **OR** AA-M12C22A31, Class II, 0.010 mm, **as directed**, or thicker.
 2. Color Anodic Finish: AAMA 611, AA-M12C22A42/A44, Class I, 0.018 mm **OR** AA-M12C22A32/A34, Class II, 0.010 mm, **as directed**, or thicker.
 - a. Color: Light bronze **OR** Medium bronze **OR** Dark bronze **OR** Black, **as directed**.
 3. Baked-Enamel or Powder-Coat Finish: AAMA 2603 except with a minimum dry film thickness of 1.5 mils (0.04 mm). Comply with coating manufacturer's written instructions for cleaning, conversion coating, and applying and baking finish.

- a. Color and Gloss: As selected from manufacturer's full range.

I. Metallic-Coated Steel Sheet Finishes

1. Surface Preparation: Clean surfaces with nonpetroleum solvent so surfaces are free of oil and other contaminants. After cleaning, apply a conversion coating suited to the organic coating to be applied over it. Clean welds, mechanical connections, and abraded areas and apply galvanizing repair paint, complying with SSPC-Paint 20, to comply with ASTM A 780.
2. Factory Prime Finish: Apply an air-dried primer, complying with SSPC-Paint 5, immediately after cleaning and pretreating.
3. Baked-Enamel or Powder-Coat Finish: Immediately after cleaning and pretreating, apply manufacturer's standard 2-coat, baked-on finish consisting of prime coat and thermosetting topcoat, with a minimum dry film thickness of **1 mil (0.025 mm)** for topcoat. Comply with coating manufacturer's written instructions for applying and baking to achieve a minimum dry film thickness of **2 mils (0.05 mm)**.
 - a. Color and Gloss: As selected from manufacturer's full range.

J. Stainless-Steel Finishes

1. Surface Preparation: Remove tool and die marks and stretch lines, or blend into finish.
2. Polished Finishes: Grind and polish surfaces to produce uniform finish, free of cross scratches.
 - a. Run grain of directional finishes with long dimension of each piece.
 - b. When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.
 - c. Directional Satin Finish: No. 4.

1.3 EXECUTION

A. Installation

1. Fastening to In-Place Construction: Provide anchorage devices and fasteners where necessary for securing security windows to in-place construction. Include threaded fasteners for concrete and masonry inserts, security fasteners, and other connectors.
 - a. Install an attached or integral flange to secure side of security windows extending over rough-in opening gap so that gap has same forced-entry-resistance and ballistics-resistance performance as security window.
2. Voice-Communication-Type Framing: Attach removable glass spacers to jambs and head of glazing, located not more than **6 inches (152 mm)** from each corner and spaced not more than **12 inches (305 mm)** o.c.
3. Glazed Framing: Provide sealant **OR** gasket, **as directed**, glazed framing. Comply with installation requirements in Division 08 Section "Security Glazing".
4. Removable Glazing Stops and Trim: Fasten components with security fasteners.
5. Fasteners: Install security windows using fasteners recommended by manufacturer with head style appropriate for installation requirements, strength, and finish of adjacent materials. Provide stainless-steel fasteners in stainless-steel materials, **as directed**.
6. Sealants: Comply with requirements in Division 07 Section "Joint Sealants" for installing sealants, fillers, and gaskets.
 - a. Set continuous sill members and flashing in a full sealant bed to provide weathertight construction unless otherwise indicated.
 - b. Seal frame perimeter with sealant to provide weathertight construction unless otherwise indicated.
7. Metal Protection: Where dissimilar metals will contact each other, protect against galvanic action by painting contact surfaces with primer or by applying sealant or tape recommended in writing by manufacturer for this purpose. Where aluminum will contact concrete or masonry, protect against corrosion by painting contact surfaces with bituminous paint.

B. Adjusting

1. Adjust horizontal-sliding, transaction security windows to provide a tight fit at contact points for smooth operation and a secure enclosure.
 2. Adjust transaction drawers to provide a tight fit at contact points and weather stripping for smooth operation and weathertight and secure enclosure.
 3. Remove and replace defective work, including security windows that are warped, bowed, or otherwise unacceptable.
- C. Cleaning And Protection
1. Clean surfaces promptly after installation of security windows. Take care to avoid damaging the finish. Remove excess glazing and sealant compounds, dirt, and other substances.
 - a. Lubricate sliding security window hardware.
 - b. Lubricate transaction drawer hardware.
 2. Clean glass of preglazed security windows promptly after installation. Comply with requirements in Division 08 Section "Security Glazing" for cleaning and maintenance.
 3. Provide temporary protection to ensure that security windows are without damage at time of Final Completion.

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Task	Specification	Specification Description
08 56 56 00	08 11 63 13a	Security Window Screens and Doors
08 56 56 00	08 34 53 00a	Security Grilles
08 56 59 00	01 22 16 00	No Specification Required

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SECTION 08 62 00 00 - ROOF WINDOWS

1.1 GENERAL

A. Description Of Work

1. This specification covers the furnishing and installation of material for roof windows. Products shall be as follows or as directed by the Owner. Installation procedures shall be in accordance with the products manufacturer's recommendations. Demolition and removal of materials shall be as required to support the work.

B. Summary

1. Section Includes:
 - a. Fixed (nonoperable) roof windows for exterior locations with aluminum-clad, copper-clad and fiberglass-clad exterior exposed surfaces and wood interior exposed surfaces.
 - b. Venting (with operable sash) roof windows for exterior locations with aluminum-clad, copper-clad and fiberglass-clad exterior exposed surfaces and wood interior exposed surfaces.

C. Performance Requirements

1. Structural Performance: Provide roof windows capable of withstanding the effects of gravity loads and the following loads and stresses within limits and under conditions indicated according to ASCE/SEI 7.
 - a. Wind Loads: Compliance is based on testing units representative of those indicated for Project that pass AAMA/WDMA/CSA 101/I.S.2/A440, Uniform Load Structural Test.
 - 1) Basic Wind Speed: **85 mph (38 m/s) OR 90 mph (40 m/s), as directed.**
 - 2) Importance Factor.
 - 3) Exposure Category: **B OR C OR D, as directed.**
 - b. Deflection Limits: Design glass framing system to limit lateral deflections of glass edges to less than 1/175 of glass-edge length or **3/4 inch (19 mm)**, whichever is less, at design pressure based on testing performed according to AAMA/WDMA/CSA 101/I.S.2/A440, Uniform Load Deflection Test, or structural computations.
 - c. Snow Loads.
2. Windborne-Debris Resistance: Provide glazed roof windows capable of resisting impact from windborne debris, based on the pass/fail criteria as determined from testing glazed roof windows identical to those specified, according to ASTM E 1886 and testing information in ASTM E 1996 **OR AAMA 506, as directed**, and requirements of authorities having jurisdiction.

D. Submittals

1. Product Data: For each type of product indicated. Include construction details, material descriptions, fabrication methods, dimensions of individual components and profiles, hardware, finishes, and operating instructions.
 - a. Motors: Show nameplate data, ratings, characteristics, and mounting arrangements.
2. Shop Drawings: Include plans, elevations, sections, details, hardware, attachments to other work, operational clearances, installation details, and the following:
 - a. Mullion details, including reinforcement and stiffeners.
 - b. Joinery details.
 - c. Expansion provisions.
 - d. Flashing and drainage details.
 - e. Weather-stripping details.
 - f. Glazing details.
 - g. Accessories.
 - h. Window cleaning provisions.
 - i. Window System Operators: Show locations, mounting, and details for installing operator components and controls.

- j. Window System Operators: Show locations and details for installing operator components, switches, and controls. Indicate motor size, electrical characteristics, drive arrangement, mounting, and grounding provisions.
- k. Wiring Diagrams: Power, signal, and control wiring.
- 3. Samples: For roof windows and components required, prepared on Samples of size indicated below.
 - a. Main Framing Member: **12-inch- (300-mm-)** long section with weather stripping, **as directed**, glazing bead and factory-applied color finish.
 - b. Hardware: Full-size units with factory-applied finish.
- 4. Delegated-Design Submittal: For roof windows indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation and used to determine the following:
 - a. Structural test pressures and design pressures from loads indicated.
 - b. Deflection limitations of glass framing systems.
- 5. Qualification Data: For qualified Installer, manufacturer and professional engineer.
- 6. Product Test Reports: Based on evaluation of comprehensive tests performed within the last four years by a qualified testing agency, for each class, grade, and size of roof window.
- 7. Maintenance Data: For weather stripping, operable sash, operating hardware, and finishes to include in maintenance manuals.
- 8. Warranties: Sample of special warranties.

E. Quality Assurance

- 1. Manufacturer Qualifications: A manufacturer capable of fabricating roof windows that meet or exceed performance requirements indicated and of documenting this performance by inclusion in lists and by labels, test reports, and calculations.
- 2. Installer Qualifications: An installer acceptable to roof window manufacturer for installation of units required for this Project.
 - a. Installer's responsibilities include providing professional engineering services needed to assume engineering responsibility including preparation of data for roof windows, including Shop Drawings and Designated Design Submittal, based on testing and engineering analysis of manufacturer's standard units in assemblies similar to those indicated for this Project.
- 3. Fenestration Standard: Comply with AAMA/WDMA/CSA 101/I.S.2/A440, "Standard/Specification for Windows, Doors, and Unit Skylights," for minimum standards of performance, materials, components, accessories, and fabrication. Comply with more stringent requirements if indicated.
 - a. Provide WDMA-certified units with an attached label.
- 4. Glazing Publication: Comply with published recommendations of glass manufacturers and with GANA's "Glazing Manual" unless more stringent requirements are indicated.

F. Delivery, Storage, And Handling

- 1. Protect roof windows during transit, storage, and handling to prevent damage, soiling, and deterioration. Store off ground and covered in a clean, dry, well-ventilated, protected space. Comply with manufacturer's written instructions.

G. Warranty

- 1. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace roof windows that fail in materials or workmanship within specified warranty period.
 - a. Failures include, but are not limited to, the following:
 - 1) Failure to meet performance requirements.
 - 2) Structural failures including excessive deflection.
 - 3) Water leakage or air infiltration.
 - 4) Faulty operation of movable panels and hardware.
 - 5) Deterioration of wood, metals, vinyl, other materials, and finishes beyond normal weathering.

- 6) Deterioration of insulating glass and laminated glass, **as directed**, as defined in Division 08 Section "Glazing".
- b. Warranty Period:
 - 1) Roof Window: Five **OR** 10, **as directed**, years from date of Final Completion.
 - 2) Glazing: 10 **OR** 20, **as directed**, years from date of Final Completion.
 - 3) Exterior Finish: Five years from date of Final Completion.

1.2 PRODUCTS

A. Materials

1. Wood: Clear fir or pine or another suitable fine-grained lumber; kiln-dried to a moisture content of 6 to 12 percent at time of fabrication; free of visible finger joints, blue stain, knots, pitch pockets, and surface checks larger than **1/32 inch (0.8 mm)** deep by **2 inches (51 mm)** wide; water-repellent preservative treated.
 - a. Finish: Unfinished **OR** Manufacturer's standard transparent finish **OR** Manufacturer's standard prime-painted finish complying with WDMA T.M. 11 **OR** Manufacturer's standard opaque finish complying with WDMA T.M. 12, **as directed**.
2. Aluminum: Manufacturer's standard formed sheet or extruded aluminum. Provide aluminum alloy and temper recommended by roof window manufacturer for strength, corrosion resistance, and application of required finish.
 - a. Baked-Enamel Finish: AAMA 2603 except with a minimum dry film thickness of **1.5 mils (0.04 mm)**. Comply with coating manufacturer's written instructions for cleaning, conversion coating, and applying and baking finish.
 - 1) Color and Gloss: White **OR** Bronze **OR** Brown **OR** As indicated by manufacturer's designations **OR** As selected from manufacturer's full range, **as directed**.
 - b. High-Performance Organic Finish: Two-coat fluoropolymer finish complying with AAMA 620 **OR** AAMA 2604 **OR** AAMA 2605, **as directed**, and containing not less than 50 **OR** 70, **as directed**, percent PVDF resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
 - 1) Color and Gloss: As indicated by manufacturer's designations **OR** As selected from manufacturer's full range, **as directed**.
3. Copper: ASTM B 370; Temper H00, cold rolled unless Temper 060, soft is required for forming; not less than **16 oz./sq. ft. (0.55 mm thick)**.
 - a. Finish: Manufacturer's standard **OR** As selected from manufacturer's full range, **as directed**.
4. Reinforced Thermoset Fiberglass: AAMA 305 with manufacturer's standard finish.
 - a. Color and Gloss: As indicated by manufacturer's designations **OR** As selected from manufacturer's full range, **as directed**.
5. Trim and Glazing Stops: Material and finish to match wood frame members.
6. Fasteners: Aluminum, nonmagnetic stainless steel, or other materials warranted by manufacturer to be noncorrosive for SC 3 severe service conditions and compatible with roof window members, cladding, trim, hardware, anchors, and other components.
 - a. Exposed Fasteners: Unless unavoidable for applying hardware, do not use exposed fasteners. For application of hardware, use fasteners that match finish of member or hardware being fastened, as appropriate.
7. Anchors, Clips, Mounting Brackets, and Accessories: Aluminum, nonmagnetic stainless steel, or zinc-coated steel or iron complying with ASTM B 456 or ASTM B 633 for SC 3 severe service conditions; provide sufficient strength to withstand design pressure indicated.
8. Mullions: Provide mullions and mullion casing and cover plates as shown, matching roof window units, complete with anchors for support to structure and installation of roof window units. Allow for erection tolerances and provide for movement of roof window units due to thermal expansion and building deflections, as indicated. Provide mullions and cover plates capable of withstanding design loads of roof window units.

9. Reinforcing Members: Aluminum, nonmagnetic stainless steel, nickel/chrome-plated steel complying with ASTM B 456 or zinc-coated steel or iron complying with ASTM B 633 for SC 3 severe service conditions; provide sufficient strength to withstand design pressure indicated.
10. Compression-Type Weather Stripping: Provide compressible weather stripping designed for permanently resilient sealing under bumper or wiper action, and completely concealed when roof window is closed.
 - a. Weather-Stripping Material: Closed-cell elastomeric, preformed gaskets complying with ASTM C 509.
OR
Weather-Stripping Material: Dense elastomeric gaskets complying with ASTM C 864.
OR
Weather-Stripping Material: Manufacturer's standard system and materials complying with AAMA/WDMA/CSA 101/I.S.2/A440.
11. Flashing: Manufacturer's standard flashing system for application indicated.
 - a. Material: Aluminum **OR** Copper **OR** Flexible EPDM flashing, **as directed**.
 - b. Rigid aluminum **OR** copper, **as directed**, nailing flange formed into frame.
 - c. Auxiliary Water Diverter: Provide at roof window head as back flashing.

B. Roof Window

1. AAMA/WDMA/CSA Performance Requirements: Provide roof windows of performance indicated that comply with AAMA/WDMA/CSA 101/I.S.2/A440 unless more stringent performance requirements are indicated.
 - a. Performance Class and Grade: R15 **OR** 20 **OR** 25, **as directed**.
 - b. Performance Class and Grade: C30 **OR** 35 **OR** 40, **as directed**.
 - c. Performance Class and Grade: As indicated.
2. Thermal Transmittance: Provide roof windows with a whole fenestration product U-factor maximum indicated, when tested according to AAMA 1503 **OR** determined according to ASTM E 1423 **OR** determined according to NFRC 100, **as directed**.
 - a. U-Factor: 0.35 **OR** 0.40 **OR** 0.65, **as directed**, Btu/sq. ft. x h x deg F (W/sq. m x K).
 - b. U-Factor: 0.60 Btu/sq. ft. x h x deg F (W/sq. m x K) (this is the maximum U-factor allowed by the IECC 2006 for skylights in all but climate zones 1 to 3).
3. Solar Heat-Gain Coefficient (SHGC): Provide roof windows with a whole-window SHGC maximum of 0.40 **OR** 0.50 **OR** 0.55, **as directed**, determined according to NFRC 200.
4. Air-Leakage Resistance: Maximum rate not more than indicated when tested according to AAMA/WDMA/CSA 101/I.S.2/A440, Air Leakage Resistance Test.
 - a. Maximum Rate: 0.3 cfm/sq. ft. (1.5 L/s x sq. m) of area at an inward test pressure of 1.6 lbf/sq. ft. (75 Pa) (equivalent to 25-mph (40-km/h) wind speed and typically used to test R and C performance classes).
5. Water-Penetration Resistance: No water leakage as defined in AAMA/WDMA/CSA referenced test methods at a water test pressure equaling that indicated, when tested according to AAMA/WDMA/CSA 101/I.S.2/A440, Water Penetration Resistance Test.
 - a. Test Pressure: 15 percent of positive design pressure, but not less than 2.9 lbf/sq. ft. (140 Pa) or more than 12 lbf/sq. ft. (580 Pa).
6. Forced-Entry Resistance: Comply with Performance Grade 10 (lowest recognized by ASTM F 588 and is mandatory if AAMA/WDMA/CSA 101/I.S.2/A440 is the method selected for specifying roof window performance) requirements when tested according to ASTM F 588.
7. Operating Force and Auxiliary (Durability) Tests: According to and complying with AAMA/WDMA/CSA 101/I.S.2/A440.

C. Glazing

1. Glass and Glazing System: Comply with Division 08 Section "Glazing" for glass, insulating-glass units, laminated glass, and glazing requirements applicable to glazed roof windows.

D. Hardware

1. Comply with AAMA/WDMA/CSA 101/I.S.2/A440 for fixed skylights.

2. General: Provide manufacturer's standard hardware, fabricated from a corrosion-resistant material compatible with wood and aluminum cladding **OR** and copper cladding, **as directed**, complying with AAMA 907; designed to smoothly operate, tightly close, and securely lock sliding wood-framed roof windows; and sized to accommodate sash weight and dimensions. Do not use aluminum in frictional contact with other metals.
 - a. Hardware Finish: Manufacturer's standard **OR** Match cladding appearance, **as directed**.
 3. Gear-Type Rotary Operators: Comply with AAMA 901 when tested according to ASTM E 405, Method A.
 4. Pole Operator: Manufacturer's standard manual **OR** motorized, **as directed**, pole for operating venting units that are more than **72 inches (1800 mm)** above floor.
 5. Motor Operator: Manufacturer's standard electric motor and remote control for operating venting units that are more than **72 inches (1800 mm)** above floor.
 - a. Provide rain sensor that automatically closes venting unit when water is detected.
OR
Provide motor operator with wireless remote-control device.
 6. Roof Window Operation:
 - a. Operator and Control: Gear-type rotary operator with plastic or metal cable that uncoils and stiffens to open sash; with locking mechanism.
 - 1) Operation: Crank handle **OR** Pole, **as directed**, for manual operation.
 - 2) Operation: Electric.**OR**
 Operator and Control: Gear-type rotary operator with arm(s) that scissors or swings to open sash; with locking mechanism.
 - 1) Operation: Crank handle **OR** Pole, **as directed**, for manual operation.
 - 2) Operation: Electric.**OR**
 Operator and Control: Spring-assisted, counter-balanced operator that allows sash to remain open in any position; with lever-handle-operated latches and lock for manual operation.
 - b. Hinge: Continuous.
OR
Hinges: Pivot **OR** Manufacturer's standard, **as directed**; two per operable sash.
- E. Accessories
1. Insect Screens: Manufacturer's standard removable screen; aluminum or vinyl frame with mitered or coped joints and with ASTM D 3656 mesh of plastic-coated glass-fiber threads. Provide frame in manufacturer's standard finish and mesh in manufacturer's standard color.
 2. Shades: Manufacturer's standard of type indicated and in color and pattern selected from manufacturer's full range.
 - a. Type: Pleated **OR** Venetian blind **OR** Roll up, **as directed**.
 - b. Pole Operation: Provide manual **OR** motorized, **as directed**, pole for operating shades that are more than **72 inches (1800 mm)** above floor.
OR
Motorized Operation: Provide manufacturer's standard electric motor and remote control for operating shades with wireless remote-control device, **as directed**.
- F. Fabrication
1. Fabricate roof windows in sizes indicated. Include a complete system for assembling components and anchoring and flashing windows.
 2. Fabricate roof windows that are reglazable without dismantling sash framing.
 3. Weather Stripping: Provide full-perimeter weather stripping for each operable sash.
 4. Provide condensation gutter or other means to hold condensed moisture or drain it to exterior.
 5. Complete fabrication, assembly, finishing, hardware application, and other work in the factory to greatest extent possible. Disassemble components only as necessary for shipment and installation. Allow for scribing, trimming, and fitting at Project site.

6. Factory-Glazed Fabrication: Glaze roof windows in the factory. Comply with requirements in Division 08 Section "Glazing" and with AAMA/WDMA/CSA 101/I.S.2/A440.

1.3 EXECUTION

A. Examination

1. Examine openings, substrates, structural support, anchorage, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of work. Verify rough opening dimensions, slope of roof construction, and operational clearances. Examine roof decks, vapor retarders, water and weather barriers, and other built-in components to ensure a coordinated, weathertight roof window installation.
2. Proceed with installation only after unsatisfactory conditions have been corrected.

B. Installation

1. Comply with manufacturer's written installation instructions for installing roof windows, hardware, **as directed**, motor operators, **as directed**, accessories, and other components.
2. Install roof windows square, true, and without distortion, warp, or rack of frames and sash. Securely anchor windows to structural support without impeding thermal movement and in proper relation to adjacent construction.
3. Install flashing to provide a watertight and weathertight seal.
4. Separate aluminum, copper, and other corrodible surfaces from sources of corrosion or electrolytic action at points of contact with other materials according to recommendations in ASTM E 2112.

C. Adjusting, Cleaning, And Protection

1. Lubricate hardware and moving parts.
2. Adjust operating sash, operators, **as directed**, screens, and accessories for a tight fit at contact points and for smooth operation and weathertight closure.
3. Adjust hardware for proper alignment, smooth operation, and proper latching without unnecessary force or excessive clearance.
4. Adjust shades to hang true to line without rack. Provide unencumbered operation.
5. Clean frame surfaces immediately after installing roof windows. Comply with manufacturer's written instructions for final cleaning and maintenance. Avoid damaging protective coatings and finishes.
6. Inspect drainage holes for blockage. Clean and free holes of any obstructions to allow drainage.
7. Clean glass immediately after installing roof windows. Comply with manufacturer's written instructions for final cleaning and maintenance. Remove nonpermanent labels and clean surfaces.
8. Remove and replace glass that has been broken, chipped, cracked, abraded, or damaged during construction period.
9. Protect roof window surfaces from contact with contaminating substances resulting from construction operations. If contaminating substances contact roof window surfaces, remove contaminants immediately according to manufacturer's written instructions.
10. Refinish or replace roof windows that have damaged finishes.
11. Replace damaged components.

END OF SECTION 08 62 00 00



Task	Specification	Specification Description
08 62 23 00	08 62 00 00	Roof Windows
08 63 13 00	08 62 00 00	Roof Windows
08 66 00 00	08 45 23 00	Unit Skylights

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SECTION 08 71 11 00 - DETENTION DOOR HARDWARE

1.1 GENERAL

A. Description Of Work

1. This specification covers the furnishing and installation of material for detention door hardware. Products shall be as follows or as directed by the Owner. Installation procedures shall be in accordance with the products manufacturer's recommendations. Demolition and removal of materials shall be as required to support the work.

B. Summary

1. Section Includes:
 - a. Detention door hardware for the following:
 - 1) Swinging detention doors.
 - 2) Sliding detention doors.
 - b. Detention cylinders for doors specified in other Sections.

C. Performance Requirements

1. Swinging Detention Door Assemblies: Provide detention door hardware as part of a detention door assembly that complies with security grade indicated, when tested according to ASTM F 1450, based on testing manufacturer's standard units in assemblies similar to those indicated for this Project.
 - a. Bullet Resistance: Comply with Level 3 rating when tested according to UL 752; where indicated.
 - 1) Listed and labeled as bullet resisting by a testing agency acceptable to authorities having jurisdiction.
 - b. Tool-Attack Resistance: Comply with small-tool-attack-resistance rating when tested according to UL 1034 and UL 437.
2. Detention Door Hardware Functional Performance: Provide detention door hardware with features, functions, and internal equipment required to perform control and monitoring functions indicated in Division 28 Section "Plc Electronic Detention Monitoring And Control Systems".

D. Submittals

1. Product Data: For each type of product indicated.
2. Shop Drawings: For each type of detention door hardware.
 - a. Wiring Diagrams: For power, signal, and control wiring; differentiate between manufacturer-installed and field-installed wiring for electrified and pneumatic, **as directed**, detention door hardware.
 - b. Compressed-Air System Diagrams: For compressed-air piping for door control systems; differentiate between manufacturer-installed and field-installed piping for pneumatic detention door hardware.
 - c. Detail interface between electrified detention door hardware and perimeter security, detention monitoring and control, fire-alarm, and building control, **as directed**, system.
 - d. Detail interface between pneumatic detention door hardware and perimeter security, detention monitoring and control, fire-alarm, and building control, **as directed**, system.
3. Other Action Submittals:
 - a. Door Hardware Schedule: Prepared by or under the supervision of supplier, detailing fabrication and assembly of door hardware, as well as procedures and diagrams. Coordinate the final Door Hardware Schedule with detention doors, frames, and related work to ensure proper size, thickness, hand, function, and finish of door hardware.
 - 1) Integrate detention door hardware indicated in "Detention Door Hardware Sets" Article into the Door Hardware Schedule, and indicate complete designations of every item required for each door and opening.

- b. Keying Schedule: Comply with requirements specified in Division 08 Section "Door Hardware". Coordinate detention keying with other door hardware in the final Keying Schedule.
 - 1) Indicate each lock and type of key using the following prefixes: "P" for paracentric, "M" for mogul, "HS" for high security, and "C" for commercial.
- c. Operation and Maintenance Data: For electrified and pneumatic, **as applicable**, detention door hardware to include in emergency, operation, and maintenance manuals.
- 4. Warranties: Sample of special warranties.

E. Quality Assurance

- 1. Installer Qualifications: An employer of workers trained and approved by manufacturer and an authorized representative of detention door hardware manufacturer for installation and maintenance of units required for this Project.
- 2. Supplier Qualifications: Detention door hardware supplier with warehousing facilities in Project's vicinity and who is or employs a qualified Architectural Hardware Consultant, available during the course of the Work to consult with Contractor, Architect, and the Owner about detention door hardware and keying.
 - a. Detention Door Hardware Supplier Qualifications: An experienced detention door hardware supplier who has completed projects with electrified and pneumatic, **as directed**, detention door hardware similar in material, design, and extent to that indicated for this Project, whose work has resulted in construction with a record of successful in-service performance, and who is acceptable to manufacturer of primary materials.
 - 1) Engineering Responsibility: Prepare data for electrified and pneumatic, **as directed**, detention door hardware, including Shop Drawings, based on testing and engineering analysis of manufacturer's standard units in assemblies similar to those indicated for this Project.
 - b. Scheduling Responsibility: Preparation of door hardware and keying schedules.
- 3. Architectural Hardware Consultant Qualifications: A person who is currently certified by DHI as an Architectural Hardware Consultant **OR** one who meets the requirements necessary for certification, **as directed**, and who is experienced in providing consulting services for detention door hardware installations that are comparable in material, design, and extent to that indicated for this Project.
 - a. Detention Door Hardware Consultant Qualifications: Experienced in providing consulting services for electrified and pneumatic, **as directed**, detention door hardware installations.
- 4. Source Limitations for Detention Door Hardware: Obtain each type of detention door hardware from single source from single manufacturer.
 - a. Provide electrified and pneumatic, **as directed**, detention door hardware from same manufacturer as mechanical detention door hardware unless otherwise indicated.
- 5. Regulatory Requirements: Comply with provisions of the following:
 - a. Where indicated to comply with accessibility requirements, comply with the U.S. Architectural & Transportation Barriers Compliance Board's ADA-ABA Accessibility Guidelines and ICC/ANSI A117.1, **as directed**, as follows:
 - 1) Handles, Pulls, Latches, Locks, and other Operating Devices: Shape that is easy to grasp with one hand and does not require tight grasping, tight pinching, or twisting of the wrist.
 - 2) Security Door Closers: Comply with the following maximum opening-force requirements indicated:
 - a) Interior Hinged Doors: **5 lbf (22 N)** applied perpendicular to door.
 - b) Sliding Doors: **5 lbf (22 N)** applied parallel to door at latch.
 - c) Fire Doors: Minimum opening force allowable by authorities having jurisdiction.
 - b. NFPA 101: Comply with the following for means-of-egress doors:
 - 1) Latches and Locks: Not more than **15 lbf (67 N)** to release the latch.
 - 2) Security Door Closers: Not more than **30 lbf (133 N)** to set door in motion and not more than **15 lbf (67 N)** to open door to minimum required width.

- 3) Sliding Detention Door Devices: Not more than **50 lbf (222 N)** to slide door to its fully open position with a perpendicular force of **50 lbf (222 N)** against door.
 - c. Electrified and Pneumatic, **as directed**, Door Hardware: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
 6. Fire-Rated Detention Door Assemblies: Provide detention door hardware for assemblies complying with NFPA 80 that are listed and labeled by a qualified testing agency, for fire-protection ratings indicated, based on testing at positive pressure **OR** as close to neutral pressure as possible, **as directed**, according to NFPA 252 **OR** UBC Standard 7-2 **OR** UL 10B **OR** UL 10C, **as directed**.
 7. Keying Conference: Conduct conference at Project site. Incorporate keying conference decisions into the final Keying Schedule after reviewing detention door hardware keying system including, but not limited to, the following:
 - a. Function of building, flow of traffic, purpose of each area, degree of security required, and plans for future expansion.
 - b. Preliminary key system schematic diagram.
 - c. Requirements for key-control system including key exclusivity and duplication control.
 - d. Address for delivery of keys.
 8. Preinstallation Conference: Conduct conference at Project site.
- F. Delivery, Storage, And Handling
1. Inventory detention door hardware on receipt and provide secure lockup for detention door hardware delivered to Project site.
 2. Tag each item or package separately with identification related to the final Door Hardware Schedule, and include basic installation instructions with each item or package.
 3. Deliver keys to the Owner by registered mail or overnight package service.
- G. Warranty
1. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of detention door hardware that fail in materials or workmanship within specified warranty period.
 - a. Failures include, but are not limited to, the following:
 - 1) Structural failures including excessive deflection, cracking, or breakage.
 - 2) Faulty operation of operators and detention door hardware.
 - 3) Deterioration of metals, metal finishes, and other materials beyond normal weathering or detention use.
 2. Warranty Period: Three years from date of Final Completion.
 3. Warranty Period for Continuous-Pin Detention Hinges: 10 years from date of Final Completion.
 4. Warranty Period for Security Door Closers: 10 years from date of Final Completion.
- H. Maintenance Service
1. Maintenance Tools and Instructions: Furnish a complete set of specialized tools and maintenance instructions as needed for the Owner's continued adjustment, maintenance, and removal and replacement of detention door hardware.
 2. Initial Maintenance Service: Beginning at Final Completion, provide three **OR** six **OR** nine **OR** 12, **as directed**, months' full maintenance by skilled employees of detention door hardware Installer. Include monthly preventive maintenance, repair or replacement of worn or defective components, lubrication, cleaning, and adjusting as required for proper detention door hardware operation. Provide parts and supplies the same as those used in the manufacture and installation of original equipment.

1.2 PRODUCTS

A. Security Fasteners

1. General: Operable only by tools produced for use on specific type of fastener by fastener manufacturer or other licensed fabricator. Drive-system type, head style, material, and protective coating as required for assembly, installation, and strength, and as follows:
 - a. Drive-System Types: Pinned Torx-Plus **OR** Pinned Torx, **as directed**.
 - b. Fastener Strength: **120,000 psi (827 MPa)**.
 - c. Socket Button Head Fasteners:
 - 1) Heat-treated alloy steel, **ASTM F 835 (ASTM F 835M)**.
 - 2) Stainless steel, **ASTM F 879 (ASTM F 879M)**, Group 1 CW.
 - d. Socket Flat Countersunk Head Fasteners:
 - 1) Heat-treated alloy steel, **ASTM F 835 (ASTM F 835M)**.
 - 2) Stainless steel, **ASTM F 879 (ASTM F 879M)**, Group 1 CW.
 - e. Socket Head Cap Fasteners:
 - 1) Heat-treated alloy steel, **ASTM A 574 (ASTM A 574M)**.
 - 2) Stainless steel, **ASTM F 837 (ASTM F 837M)**, Group 1 CW.
 - f. Protective Coatings for Heat-Treated Alloy Steel:
 - 1) Zinc and clear trivalent chromium where indicated.
 - 2) Zinc phosphate with oil, ASTM F 1137, Grade I, or black oxide unless otherwise indicated.

B. Detention Hinges, General

1. Standard for Electric Detention Hinges: UL 634.
2. Quantity: Provide the following unless otherwise indicated:
 - a. Two Detention Hinges: For detention doors with heights up to **60 inches (1524 mm)**.
 - b. Three Detention Hinges: For detention doors with heights **61 to 90 inches (1549 to 2286 mm)**.
 - c. Four Detention Hinges: For detention doors with heights **91 to 120 inches (2311 to 3048 mm)**.
 - d. For detention doors with heights more than **120 inches (3048 mm)**, provide four detention hinges, plus one detention hinge for every **30 inches (762 mm)** of detention door height greater than **120 inches (3048 mm)**.
3. Size: Provide the following, unless otherwise indicated, with detention hinge widths sized for **2-inch (51-mm)** detention door thickness and clearances required:
 - a. Doors up to **42 inches (1067 mm)** Wide: Minimum **4-1/2 inches (114 mm)** wide by **0.180 inches (4.6 mm)** thick or **5 inches (127 mm)** wide by **0.190 inches (4.8 mm)** thick.
 - b. Doors Greater Than **42 inches (1067 mm)** Wide: Minimum **6 inches (152 mm)** wide by **0.203 inches (5.2 mm)** thick.
4. Detention Doors with Security Closers: Unless otherwise indicated, provide antifriction-bearing detention hinges.
5. Detention Hinge Base Metal: Unless otherwise indicated, provide the following:
 - a. Exterior Detention Hinges: Stainless steel, with stainless-steel pin.
 - b. Interior Detention Hinges: Steel, with steel pin **OR** Stainless steel, with stainless-steel pin, **as directed**.
 - c. Detention Hinges for Fire-Rated Assemblies: Steel, with steel pin **OR** Stainless steel, with stainless-steel pin, **as directed**.
6. Electrified Functions for Detention Hinges: Comply with the following:
 - a. Electrical Contact: Exposed electrical contacts for transfer of power.
 - b. Power Transfer: Concealed PTFE-jacketed wires, secured at each leaf and continuous through detention hinge knuckle.
 - c. Monitoring: Concealed electrical monitoring switch.
7. Fastening: Comply with the following:
 - a. Welding: Where indicated, weld hinges to detention doors and frames with continuous fillet weld around three sides of hinge perimeter.
 - b. Security Fasteners: Provide socket flat countersunk head machine screws; finish screw heads to match surface of detention hinges. Install into drilled and tapped holes.

C. Detention Hinges

1. Utility-Door Detention Hinges DH-1: Heavy weight, plain bearing; fabricated from cast iron or steel; **3/8-inch- (9.5-mm-)** diameter, case-hardened, fully welded, **as directed**, steel hinge pin; full surface.
 - a. Leaves: Drilled for countersunk security fasteners **OR Solid, as directed**.
 - b. Size: Minimum **3 by 4 inches by 0.200 inch (75 by 100 by 5 mm)**.
 - c. Security Grade: **1 OR 2 OR 3 OR 4, as directed**, according to ASTM F 1758.
 - d. Finish: BHMA 600.
2. Food-Pass Detention Hinges DH-2: Heavy weight, plain bearing; fabricated from cast iron or steel; **3/8-inch- (9.5-mm-)** diameter, case-hardened, fully welded, **as directed**, steel hinge pin; with applied stop preventing door from opening more than 90 degrees and supporting door in horizontal position as a shelf; full surface.
 - a. Leaves: Drilled for countersunk security fasteners **OR Solid, as directed**.
 - b. Size: Minimum **3 by 4 inches by 0.200 inch (75 by 100 by 5 mm)**.
 - c. Security Grade: **1 OR 2 OR 3 OR 4, as directed**, according to ASTM F 1758.
 - d. Finish: BHMA 600.
3. Full-Surface Detention Hinges DH-3: Extra heavy weight; two heavy-duty thrust bearings with hardened-steel ball bearings; fabricated from steel plate; **3/4-inch- (19-mm-)** diameter, case-hardened, fully welded, steel hinge pin.
 - a. Leaves: Drilled for countersunk security fasteners **OR Solid, as directed**.
 - b. Size: Minimum **5 by 5-1/4 inches by 1/2 inch (127 by 133 by 13 mm)**.
 - c. Security Grade: **1 OR 2 OR 3 OR 4, as directed**, according to ASTM F 1758.
 - d. Finish: BHMA 600.
4. Half-Surface Detention Hinges DH-4: Extra heavy weight; two heavy-duty thrust bearings with hardened-steel ball bearings; fabricated from steel plate; **3/4-inch- (19-mm-)** diameter, case-hardened, fully welded, steel hinge pin.
 - a. Leaves: Drilled for countersunk security fasteners **OR Solid, as directed**.
 - b. Size: Minimum **5 by 5-1/4 inches by 1/2 inch (127 by 133 by 13 mm)**.
 - c. Security Grade: **1 OR 2 OR 3 OR 4, as directed**, according to ASTM F 1758.
 - d. Finish: BHMA 600.
5. Gap-Mounted Detention Hinges DH-5: Extra heavy weight; two heavy-duty thrust bearings with hardened-steel ball bearings; fabricated from steel plate; **3/4-inch- (19-mm-)** diameter, case-hardened, fully welded, steel hinge pin.
 - a. Leaves: Drilled for countersunk security fasteners **OR Solid, as directed**.
 - b. Size: Minimum **5 by 6 inches by 1/2 inch (127 by 152 by 13 mm)**.
 - c. Security Grade: **1 OR 2 OR 3 OR 4, as directed**, according to ASTM F 1758.
 - d. Finish: BHMA 600.
6. Continuous-Pin Detention Hinges DH-6: Minimum **0.109-inch- (2.78-mm-)** thick, stainless-steel hinge leaves with minimum overall width of **4 inches (100 mm)**; with **1/4-inch- (6-mm-)** diameter continuous pin; fabricated to full height of detention door and frame. Finish components after milling and drilling are complete. Fabricate continuous-pin detention hinges to template screw locations.
 - a. Security Grade: **1 OR 2 OR 3 OR 4, as directed**, according to ASTM F 1758.

D. Detention Locks And Latches, General

1. Swinging Detention Door Lock and Latch Performance: Provide detention door locks and latches that comply with security grade indicated, when tested according to ASTM F 1577, based on testing manufacturer's standard units in assemblies similar to those indicated for this Project.
2. Detention Lock Functions: Provide function numbers and descriptions indicated in detention door hardware sets complying with ASTM F 1577.
3. Detention Lock Construction: Fabricate detention lock case and cover plate from steel plate. Fabricate bolts from solid sections; laminated construction unacceptable.
4. Detention Lock Throw: Comply with testing requirements for length of bolts to comply with labeled fire door requirements, and as follows:
 - a. Latchbolts for Detention Food Pass **OR Security Access Doors, as directed**: Minimum **5/8-inch (16-mm)** latchbolt throw.

- b. Latchbolts: Minimum **3/4-inch (19-mm)** latchbolt throw.
- c. Deadbolts: Minimum **1-inch (25-mm)** bolt throw.
- 5. Detention Lock Trim:
 - a. Levers: Solid stainless steel.
 - b. Knobs: Stainless steel **OR** Brass, **as directed**.
 - c. Escutcheons for Paracentric Locks: **0.125-inch- (3.18-mm-)** thick, **3-inch- (75-mm-)** diameter stainless steel with BHMA 626 **OR** brass with BHMA 606, **as directed**, finish. Attach with security fasteners.
 - 1) Style: Single wing **OR** Double wing **OR** Single or double wing as required by lock function **OR** As indicated, **as directed**.
 - 2) Provide escutcheons unless otherwise **OR** where, **as directed**, indicated.
 - d. Cylinder Shields for Paracentric Locks: **0.125-inch- (3.18-mm-)** thick, **3-inch- (75-mm-)** diameter stainless steel with BHMA 626 **OR** brass with BHMA 606, **as directed**, finish and swinging cover to protect keyhole. Attach with security fasteners.
 - 1) Style: Single wing **OR** Double wing **OR** Single or double wing as required by lock function **OR** As indicated, **as directed**.
 - 2) Provide cylinder shields unless otherwise **OR** where, **as directed**, indicated.
- 6. Pneumatic Detention Locks and Latches: Operate when supplied with air between **40 psig (275 kPa)** minimum and **100 psig (690 kPa)** maximum. Factory install quick-connect air fitting and factory-wired plug connector with **6-inch (150-mm)** wire pigtail.
 - a. Provide security ring for installation of pneumatic detention lock in hollow-metal detention frame, welded to frame or access cover unless otherwise **OR** where, **as directed**, indicated.

E. Mechanical Detention Locks And Latches

- 1. General: Provide mechanical detention lock mountings as follows:
 - a. Hollow-Metal Detention Doors: Mount detention lock to back of **0.179-inch (4.56-mm)** nominal-thickness steel **OR** **0.183-inch (4.65-mm)** nominal-thickness galvanized-steel, **as directed**, cover plate for installation in lock pocket fabricated into detention door. Attach cover plate to hollow-metal detention door with security fasteners.
 - b. Bar-Grille Detention Doors: Mount detention lock to back of galvanized, **as directed**, steel enclosure welded to flat horizontal bars of bar-grille detention door; cover with **0.179-inch (4.56-mm)** nominal-thickness steel **OR** **0.183-inch (4.65-mm)** nominal-thickness galvanized-steel, **as directed**, plate. Attach plate with security fasteners.
 - c. Steel-Plate Detention Doors: Mount detention lock to inside surface of **0.179-inch (4.56-mm)** nominal-thickness steel **OR** **0.134-inch (3.42-mm)** nominal-thickness steel **OR** **0.183-inch (4.65-mm)** nominal-thickness galvanized-steel **OR** **0.138-inch (3.50-mm)** nominal-thickness galvanized-steel, **as directed**, enclosure with integrally formed mounting flanges. Attach enclosure to steel-plate detention door with security fasteners **OR** rivets, **as directed**.
- 2. Utility-Door Mechanical Deadlocks, Paracentric ML-1: For use on small swinging doors, such as access panels, plumbing space doors, electric panel doors, and hatches that are infrequently used.
 - a. Function: Lockbolt retracted and extended by five **OR** six, **as directed**,-tumbler paracentric cylinder; keyed one side **OR** two sides, **as directed**.
 - b. Lockbolt: **1-1/2 inches high by 3/4 inch (38 mm high by 19 mm)** thick; **5/8-inch (16-mm)** throw.
 - c. Security Grade: **1 OR 2 OR 3 OR 4**, **as directed**.
- 3. Utility-Door Mechanical Deadlocks, Mogul ML-2: For use on small swinging doors, such as access panels, plumbing space doors, electric panel doors, and hatches that are infrequently used.
 - a. Function: Lockbolt retracted and extended by mogul cylinder; keyed one side **OR** two sides, **as directed**.
 - b. Lockbolt: **1-1/2 inches high by 3/4 inch (38 mm high by 19 mm)** thick; **5/8-inch (16-mm)** throw.

- c. Security Grade: 1 **OR** 2 **OR** 3 **OR** 4, **as directed**.
4. Mechanical Snaplatches, Paracentric ML-3: For use on small swinging doors, such as food-pass doors, observation panels, gun locker doors, and other small doors where snaplocking is needed and deadlocking is not required.
 - a. Function: Automatic snaplatch when door is closed; latchbolt retracted by five **OR** six, **as directed**,-tumbler paracentric cylinder; keyed one side **OR** two sides, **as directed**.
 - b. Latchbolt: 1 inch high by 7/16 inch (25 mm high by 11 mm) thick; 5/16-inch (8-mm) throw.
 - c. Security Grade: 1 **OR** 2 **OR** 3 **OR** 4, **as directed**.
5. Mechanical Snaplatches, Mogul ML-4: For use on small swinging doors, such as food-pass doors, observation panels, gun locker doors, and other small doors where snaplocking is needed and deadlocking is not required
 - a. Function: Automatic snaplatch when door is closed; latchbolt retracted by mogul cylinder; keyed one side **OR** two sides, **as directed**.
 - b. Latchbolt: 1 inch high by 7/16 inch (25 mm high by 11 mm) thick; 5/16-inch (8-mm) throw.
 - c. Security Grade: 1 **OR** 2 **OR** 3 **OR** 4, **as directed**.
6. Mechanical Concealed Snaplatches ML-5: For use on small swinging doors, such as observation panels, wickets, covers, and other small doors.
 - a. Function: Automatic snaplatch when door is closed; latchbolt retracted by five-tumbler paracentric cylinder; keyed one side. When closed, latch is concealed within lock case.
 - b. Latchbolt: 1 inch high by 7/16 inch (25 mm high by 11 mm) thick; 7/16-inch (11-mm) throw.
 - c. Provide angled strike.
 - d. Security Grade: 1 **OR** 2 **OR** 3 **OR** 4, **as directed**.
7. Sliding Door Mechanical Deadlatches ML-6: For use on sliding doors, such as entrance, safety vestibule, and corridor doors.
 - a. Function: Hookbolt snaplatches and automatically deadlocks through action of plunger pin when door is closed (slam locking); hookbolt raised by five **OR** six, **as directed**,-tumbler paracentric cylinder; keyed one side **OR** two sides, **as directed**.
 - b. Hookbolt: 1/2-inch- (13-mm-) thick, case-hardened steel; 5/8-inch (16-mm) lift.
 - c. Provide case-hardened-steel deadlock plunger pin.
 - d. Security Grade: 1 **OR** 2 **OR** 3 **OR** 4, **as directed**.
8. Sliding Door Mechanical Deadlocks ML-7: For use on sliding doors, such as entrance, safety vestibule, corridor, and inmate cell doors.
 - a. Function: Hookbolt raised and lowered by five **OR** six, **as directed**,-tumbler paracentric cylinder (no slam locking); keyed one side **OR** two sides, **as directed**.
 - b. Hookbolt: 1/2-inch- (13-mm-) thick, case-hardened steel; 5/8-inch (16-mm) lift.
 - c. Security Grade: 1 **OR** 2 **OR** 3 **OR** 4, **as directed**.
9. Mechanical Snaplatches ML-8: For use on swinging doors, such as corridor, dining room, and recreational area doors.
 - a. Function: Automatic snaplatch when door is closed (slam locking); latchbolt retracted by half turn and extended by full turn in opposite direction of five **OR** six, **as directed**,-tumbler paracentric cylinder; keyed one side **OR** two sides, **as directed**.
 - 1) Knob operation retracts latchbolt unless deadlocked. Locate knobs on one side **OR** two sides, **as directed**.
 - b. Latchbolt: 2-inch-high by 3/4-inch- (50-mm-high by 19-mm-) thick steel, with two case-hardened-steel insert pins; 3/4-inch (19-mm) throw; 1/2-inch (13-mm) **OR** 1-1/4-inch (32-mm), **as directed**, bolt projection when retracted.
 - c. Listed and labeled for use on fire doors.
 - d. Security Grade: 1 **OR** 2 **OR** 3 **OR** 4, **as directed**.
10. Mechanical Deadlatches/Deadlocks ML-9: For use on swinging doors, such as day room, dining room, and recreational area doors.
 - a. Function: Automatic snaplatch and automatic deadlock through action of actuator when door is closed (slam locking); latchbolt retracted by five **OR** six, **as directed**,-tumbler paracentric cylinder; keyed one side **OR** two sides, **as directed**.
 - b. Latchbolt: 2-inch-high by 3/4-inch- (50-mm-high by 19-mm-) thick steel, with two case-hardened-steel insert pins; 3/4-inch (19-mm) throw; 1/2-inch (13-mm) **OR** 1-1/4-inch (32-mm), **as directed**, bolt projection when retracted.

- c. Deadlock Actuator: **3/4-inch-high by 3/4-inch-** (19-mm-high by 19-mm-) thick steel; **1/2-inch** (13-mm) throw.
- d. Listed and labeled for use on fire doors.
- e. Security Grade: 1 **OR** 2 **OR** 3 **OR** 4, **as directed**.
- 11. Mechanical Deadlocks ML-10: For use on swinging doors where slam locking is not required, such as holding cell, segregation cell, control room, armory, key cabinet, storage, utility, and hollow-metal access doors.
 - a. Function: Deadlocked in both locked and unlocked position; latchbolt retracted and extended by five **OR** six, **as directed**,-tumbler paracentric cylinder; keyed one side **OR** two sides, **as directed**.
 - b. Latchbolt: **2-inch-high by 3/4-inch-** (50-mm-high by 19-mm-) thick steel, with two case-hardened-steel insert pins; **3/4-inch** (19-mm) throw; **1/2-inch** (13-mm) **OR** **1-1/4-inch** (32-mm), **as directed**, bolt projection when retracted.
 - c. Security Grade: 1 **OR** 2 **OR** 3 **OR** 4, **as directed**.
- 12. Cremone Bolt Mechanical Snaplatches ML-11: For use on swinging doors or active leaf of pairs of swinging doors where slam locking is needed.
 - a. Function: Automatic snaplatch and deadlocking when door is closed (slam locking); latchbolt retracted and extended by five-tumbler paracentric cylinder; keyed one side **OR** two sides, **as directed**. Lever operation one side **OR** two sides, **as directed**, retracts head and foot rods, unless deadlocked, for three-point locking.
 - b. Latchbolt: **2-inch-high by 3/4-inch-** (50-mm-high by 19-mm-) thick steel, with two case-hardened-steel insert pins; **3/4-inch** (19-mm) throw.
 - c. Security Grade: 1 **OR** 2 **OR** 3 **OR** 4, **as directed**.
- 13. Cremone Bolt Mechanical Deadlocks, Paracentric ML-12: For use on swinging doors or active leaf of pairs of swinging doors where doors may be subject to mass attack. Delete inactive leaf for single door.
 - a. Function: Active leaf deadlocks when door is closed (no slam locking); active-leaf deadbolt retracted and extended by five **OR** six, **as directed**,-tumbler paracentric cylinder; keyed one side **OR** two sides, **as directed**. Active-leaf lever operation one side **OR** two sides, **as directed**, retracts active-leaf head and foot bolts unless deadlocked.
 - 1) Inactive Leaf: Head and foot bolts deadlocked by five **OR** six, **as directed**,-tumbler, inactive-leaf paracentric cylinder. Inactive-leaf lever operation one side **OR** two sides, **as directed**, retracts inactive-leaf head and foot bolts unless deadlocked.
 - b. Deadbolt: **2-inch-high by 3/4-inch-** (50-mm-high by 19-mm-) thick steel, with two case-hardened-steel insert pins; **3/4-inch** (19-mm) throw.
 - c. Head and Foot Bolts: **7/8-inch** (22-mm) diameter; **3/4-inch** (19-mm) throw.
 - d. Provide foot bolt receptacle(s).
 - e. Security Grade: 1 **OR** 2 **OR** 3 **OR** 4, **as directed**.
- 14. Mechanical Head and Foot Bolts ML-14: For use on the inactive leaf of pairs of swinging doors.
 - a. Function: Bolt retracted and extended by spanner-type key **OR** five-tumbler paracentric cylinder, **as directed**; enclosed in iron or steel case with steel cover (not applicable for hollow-metal doors).
 - b. Latchbolt: **1-inch-** (25-mm-) diameter steel; **3/4-inch** (19-mm) throw.
 - c. Footbolt Receptacle: Spring-loaded mechanism; brass.
 - d. Security Grade: 1 **OR** 2 **OR** 3 **OR** 4, **as directed**.

F. Electromechanical Detention Locks And Latches

- 1. General: Provide electromechanical detention locks and latches with factory-wired plug connector with **6-inch** (152-mm) wire pigtail.
 - a. Provide security ring for installation of electromechanical detention lock in hollow-metal detention frame, welded to frame or access cover, unless otherwise **OR** where, **as directed**, indicated.
 - b. Equip direct-current solenoid-operated detention locks and latches with diode transient voltage protection at each locking device.

2. Solenoid-Operated Deadlatches, Paracentric EL-1: For use on swinging doors, such as entrance, sally port, corridor, and inmate cell doors, that are to be unlocked from remote locations.
 - a. Function: Remote switch activates electric solenoid that retracts latchbolt; automatic latching and deadlocking when door is closed (slam locking). Latchbolt can be mechanically retracted by five **OR** six, **as directed**,-tumbler paracentric cylinder; keyed one side **OR** two sides, **as directed**; if latchbolt is retracted by key, it remains retracted until relocked by key.
 - 1) Latchback: Latchbolt remains retracted until door is opened **2 inches (50 mm)**, then releases **OR** as long as control switch is activated; latchbolt extends when power is discontinued, **as directed**.
 - 2) If power fails, latchbolt automatically deadlocks (fail secure).
 - b. Latchbolt: **2-inch-high by 3/4-inch- (50-mm-high by 19-mm-)** thick hardened steel; **3/4-inch (19-mm)** throw.
 - c. Provide internal deadlock indicator switch.
 - d. Provide roller-type deadlock actuator.
 - e. Voltage: 120-V ac.
 - f. Listed and labeled for use on fire doors.
 - g. Security Grade: **1 OR 2 OR 3 OR 4, as directed**.
3. Motor-Operated Deadlatches, Paracentric EL-2: For use on swinging doors, such as entrance, sally port, corridor, and inmate cell doors, that are to be unlocked from remote locations.
 - a. Function: Remote switch activates electric motor that retracts latchbolt; automatic latching and deadlocking when door is closed (slam locking). Latchbolt can be mechanically retracted by five **OR** six, **as directed**,-tumbler paracentric cylinder; keyed one side **OR** two sides, **as directed**; if latchbolt is retracted by key, it remains retracted until relocked by key.
 - 1) Latchback: Latchbolt remains retracted until door is opened **2 inches (50 mm)**, then releases **OR** as long as control switch is activated; latchbolt extends when power is discontinued, **as directed**.
 - 2) If power fails, latchbolt automatically deadlocks (fail-secure).
 - b. Latchbolt: **2-inch-high by 3/4-inch- (50-mm-high by 19-mm-)** thick hardened steel; **3/4-inch (19-mm)** throw.
 - c. Provide internal deadlock indicator switch.
 - d. Provide roller-type deadlock actuator.
 - e. Voltage: 120-V ac **OR** 24-V dc, **as directed**.
 - f. Listed and labeled for use on fire doors.
 - g. Security Grade: **1 OR 2 OR 3 OR 4, as directed**.
4. Sliding Door Motor-Operated Deadlatches EL-3: For use on sliding doors, such as entrance, sally port, corridor, and inmate cell doors, that are to be unlocked from remote locations.
 - a. Function: Remote switch activates electric motor that raises hookbolt; spring-loaded actuator pin pushes door open **1 to 3 inches (25 to 75 mm)**; automatic latching and deadlocking when door is closed (slam locking). Hookbolt can be mechanically raised by five **OR** six, **as directed**,-tumbler paracentric cylinder; keyed one side **OR** two sides, **as directed**; if hookbolt is raised by key, it remains raised until relocked by key.
 - 1) Latchback: Hookbolt remains raised until door is opened **2 inches (50 mm)**, then lowers **OR** as long as control switch is in open position; hookbolt lowers when control switch is moved to locked position, **as directed**.
 - 2) If power fails, hookbolt automatically deadlocks (fail-secure).
 - b. Hookbolt: **1-3/4- by 1/2-inch- (44- by 13-mm-)** thick, case-hardened steel; **3/4-inch (19-mm)** throw.
 - c. Provide internal deadlock indicator switch.
 - d. Provide case-hardened-steel deadlock actuator.
 - e. Voltage: 120-V ac.
 - f. Security Grade: **1 OR 2 OR 3 OR 4, as directed**.
5. Solenoid-Operated Deadlatches, Mogul EL-4: For use on swinging doors, such as entrance, sally port, corridor, and inmate cell doors, that are to be unlocked from remote locations.

- a. Function: Remote switch activates electric solenoid that retracts latchbolt; automatic latching and deadlocking when door is closed (slam locking). Latchbolt can be mechanically retracted by mogul cylinder; keyed one side **OR** two sides, **as directed**.
 - 1) Latchback: Latchbolt remains retracted until door is opened **2 inches (50 mm)**, then releases **OR** as long as control switch is activated; latchbolt extends when power is discontinued, **as directed**.
 - 2) Local Electric Key (LEK): Inmate key operates lock electrically when enabled; staff key always operates lock manually and electrically; where indicated.
 - 3) Key Holdback: If latchbolt is retracted by key, it remains retracted until relocked by key (listing for use on fire doors is not available).
 - 4) Knob operation retracts latchbolt; always active.
 - 5) If power fails, latchbolt automatically deadlocks (fail-secure).
 - b. Latchbolt: **1-1/2-inch-high by 3/4-inch- (38-mm-high by 19-mm-)** thick hardened steel; **1-inch (25-mm)** throw.
 - c. Provide internal deadlock indicator switch.
 - d. Provide roller-type deadlock actuator.
 - e. Voltage: 120-V ac.
 - f. Listed and labeled for use on fire doors.
 - g. Security Grade: **1 OR 2 OR 3 OR 4, as directed**.
6. Motor-Operated Deadlatches, Mogul EL-5: for use on swinging doors, such as entrance, sally port, corridor, and inmate cell doors, that are to be unlocked from remote locations.
- a. Function: Remote switch activates electric motor that retracts latchbolt; automatic latching and deadlocking when door is closed (slam locking). Latchbolt can be mechanically retracted by mogul cylinder; keyed one side **OR** two sides, **as directed**.
 - 1) Latchback: Latchbolt remains retracted until door is opened **2 inches (50 mm)**, then releases **OR** as long as control switch is in open position; latchbolt extends when control switch is moved to locked position, **as directed**.
 - 2) Local Electric Key (LEK): Inmate key operates lock electrically when enabled; staff key always operates lock manually and electrically; where indicated.
 - 3) Key Holdback: If latchbolt is retracted by key, it remains retracted until relocked by key (listing for use on fire doors is not available).
 - 4) Knob operation retracts latchbolt; always active.
 - 5) If power fails, latchbolt automatically deadlocks (fail-secure).
 - b. Latchbolt: **1-1/2-inch-high by 3/4-inch- (38-mm-high by 19-mm-)** thick hardened steel; **1-inch (25-mm)** throw.
 - c. Provide internal deadlock indicator switch.
 - d. Provide roller-type deadlock actuator.
 - e. Voltage: 120-V ac **OR** 24-V dc, **as directed**.
 - f. Listed and labeled for use on fire doors.
 - g. Security Grade: **1 OR 2 OR 3 OR 4, as directed**.
7. Solenoid-Operated Deadlatches, Commercial EL-6: For use on swinging doors, hung in standard 2-inch (50-mm) hollow-metal frames, that are to be unlocked from remote locations.
- a. Function: Remote switch activates electric solenoid that retracts latchbolt; automatic latching and deadlocking when door is closed (slam locking). Latchbolt can be mechanically retracted by high-security, **as directed**, commercial cylinder; keyed one side **OR** two sides, **as directed**.
 - 1) Latchback: Latchbolt remains retracted until door is opened **2 inches (50 mm)**, then releases **OR** as long as control switch is activated; latchbolt extends when power is discontinued, **as directed**.
 - 2) Local Electric Key (LEK): Inmate key operates lock electrically when enabled; staff key always operates lock manually and electrically; where indicated.
 - 3) If power fails, latchbolt automatically deadlocks (fail-secure).
 - b. Latchbolt: **1-1/2-inch-high by 5/8-inch- (38-mm-high by 16-mm-)** thick hardened steel; **3/4-inch (19-mm)** throw.
 - c. Provide internal deadlock indicator switch.

- d. Deadlock Actuator: Stainless steel.
- e. Strike: Stainless steel.
- f. Voltage: 24-V dc.
- g. Listed and labeled for use on fire doors.
- h. Security Grade: 1 **OR** 2 **OR** 3 **OR** 4, **as directed**.
8. Motor-Operated Deadlatches, Commercial EL-7: For use on swinging doors, hung in standard 2-inch (50-mm) hollow-metal frames, that are to be unlocked from remote locations.
 - a. Function: Remote switch activates electric motor that retracts latchbolt; automatic latching and deadlocking when door is closed (slam locking). Latchbolt can be mechanically retracted by high-security, **as directed**, commercial cylinder; keyed one side **OR** two sides, **as directed**.
 - 1) Latchback: Latchbolt remains retracted until door is opened **2 inches (50 mm)**, then releases **OR** as long as control switch is in open position; latchbolt extends when control switch is moved to locked position, **as directed**.
 - 2) Local Electric Key (LEK): Inmate key operates lock electrically when enabled; staff key always operates lock manually and electrically; where indicated.
 - 3) If power fails, latchbolt automatically deadlocks (fail-secure).
 - b. Latchbolt: **1-1/2-inch-high by 5/8-inch- (38-mm-high by 16-mm-)** thick hardened steel; **3/4-inch (19-mm)** throw.
 - c. Provide internal deadlock indicator switch.
 - d. Deadlock Actuator: Stainless steel.
 - e. Strike: Stainless steel.
 - f. Voltage: 24-V dc.
 - g. Listed and labeled for use on fire doors.
 - h. Security Grade: 1 **OR** 2 **OR** 3 **OR** 4, **as directed**.
9. Solenoid-Operated Gate Locks, Paracentric EL-8: For use on swinging and sliding gates that are to be unlocked from remote locations.
 - a. Function: Remote switch activates electric solenoid that raises an internal bolt; automatic deadlocking when gate is closed. Bolt can be mechanically retracted by five **OR** six, **as directed**,-tumbler paracentric cylinder; keyed one side **OR** two sides, **as directed**.
 - 1) Latchback: Bolt remains raised until gate is closed.
 - 2) If power fails, latchbolt automatically deadlocks (fail-secure).
 - b. Bolt: **5/8-inch- (16-mm-)** diameter stainless steel; **1-inch (25-mm)** throw.
 - c. Provide internal deadlock indicator switch.
 - d. Voltage: 120-V ac.
 - e. Finish: Galvanized.
 - f. Mounting: Mount lock to gate post; mount locking tongue to gate frame.
 - g. Security Grade: 1 **OR** 2 **OR** 3 **OR** 4, **as directed**.
- G. Pneumatic Detention Locks And Latches
 1. General: Provide pneumatic detention locks and latches that operate when supplied with air between **40 psig (275 kPa)** minimum and **100 psig (690 kPa)** maximum.
 2. Factory install quick-connect air fitting and factory-wired plug connector with **6-inch (150-mm)** wire pigtail.
 - a. Provide security ring for installation of pneumatic detention lock in hollow-metal detention frame, welded to frame or access cover, unless otherwise **OR** where, **as directed**, indicated.
 3. Pneumatic Deadlatches, Paracentric PL-1: For use on swinging doors, such as entrance, sally port, corridor, and inmate cell doors, that are to be unlocked from remote locations.
 - a. Function: Remote switch activates pneumatic cylinder that retracts latchbolt; latchbolt remains retracted until door is opened **2 inches (50 mm)**, then releases **OR** as long as control switch is activated, **as directed**; automatic latching and deadlocking when door is closed (slam locking). Latchbolt can be mechanically retracted by five **OR** six, **as directed**,-tumbler paracentric cylinder; keyed one side **OR** two sides, **as directed**.
 - 1) If power fails or compressed-air system fails, latchbolt automatically deadlocks (fail-secure).

- b. Latchbolt: 2-inch-high by 3/4-inch- (50-mm-high by 19-mm-) thick hardened steel; 3/4-inch (19-mm) throw.
 - c. Provide internal deadlock indicator switch.
 - d. Provide roller-type deadlock actuator.
 - e. Voltage: 24-V dc.
 - f. Security Grade: 1 **OR** 2 **OR** 3 **OR** 4, **as directed**.
4. Pneumatic Deadlatches, Mogul PL-2: For use on swinging doors, such as entrance, sally port, corridor, and inmate cell doors, that are to be unlocked from remote locations.
- a. Function: Remote switch activates pneumatic cylinder that retracts latchbolt; latchbolt remains retracted until door is opened 2 inches (50 mm), then releases **OR** as long as control switch is activated, **as directed**; automatic latching and deadlocking when door is closed (slam locking). Latchbolt can be mechanically retracted by mogul cylinder; keyed one side **OR** two sides, **as directed**.
 - 1) Local Electric Key (LEK): Inmate key operates lock electrically when enabled; staff key always operates lock manually and electrically; where indicated.
 - 2) Knob on opposite side of cylinder retracts latchbolt.
 - 3) If power fails or compressed-air system fails, latchbolt automatically deadlocks (fail-secure).
 - b. Latchbolt: 1-1/2-inch-high by 3/4-inch- (38-mm-high by 19-mm-) thick hardened steel; 1-inch (25-mm) throw.
 - c. Provide internal deadlock indicator switch.
 - d. Provide roller-type deadlock actuator.
 - e. Voltage: 24-V dc.
 - f. Listed and labeled for use on fire doors.
 - g. Security Grade: 1 **OR** 2 **OR** 3 **OR** 4, **as directed**.
5. Pneumatic Deadlatches, Commercial PL-3: For use on swinging doors, hung in standard 2-inch (50-mm) hollow-metal frames, that are to be unlocked from remote locations.
- a. Function: Remote switch activates pneumatic cylinder that retracts latchbolt; latchbolt remains retracted until door is opened 2 inches (50 mm), then releases **OR** as long as control switch is activated, **as directed**; automatic latching and deadlocking when door is closed (slam locking). Latchbolt can be mechanically retracted by high-security, **as directed**, commercial cylinder; keyed one side **OR** two sides, **as directed**.
 - 1) Local Electric Key (LEK): Inmate key operates lock electrically when enabled; staff key always operates lock manually and electrically; where indicated.
 - 2) If power fails or compressed-air system fails, latchbolt automatically deadlocks (fail-secure).
 - b. Latchbolt: 1-1/2-inch-high by 5/8-inch- (38-mm-high by 16-mm-) thick hardened steel; 3/4-inch (19-mm) throw.
 - c. Faceplate: Stainless steel.
 - d. Provide internal deadlock indicator switch.
 - e. Provide roller-type deadlock actuator.
 - f. Voltage: 24-V dc.
 - g. Listed and labeled for use on fire doors.
 - h. Security Grade: 1 **OR** 2 **OR** 3 **OR** 4, **as directed**.

H. Cylinders And Keying

- 1. General: Subject to compliance with requirements, provide cylinders and keying for paracentric and mogul cylinders by the same manufacturer as for detention locks and latches.
- 2. Commercial (Builders' Hardware) Cylinders: As specified in Division 08 Section "Door Hardware".
- 3. Paracentric Cylinders: Manufacturer's standard lever-tumbler type, constructed from one-piece spring-tempered brass; with tumblers activated by phosphor bronze springs; five tumblers per lock unless otherwise indicated.

4. Mogul Cylinders: Manufacturer's standard pin-tumbler type, minimum **2-inch (50-mm)** diameter; body constructed from brass or bronze, stainless steel, or nickel silver; with stainless-steel tumblers and engaging cylinder balls; complying with the following:
 - a. Number of Pins: Five **OR** Six **OR** Seven, **as directed**.
 - b. Mortise Type: Threaded cylinders with rings and straight- or clover-type cam.
 - 1) High-Security Grade: Listed and labeled as complying with pick- and drill-resistant testing requirements in UL 437 (Suffix A); where indicated.
 - c. Finish: BHMA 606 **OR** BHMA 626, **as directed**.
5. Keying System: Unless otherwise indicated, provide a factory-registered keying system complying with the following requirements:
 - a. Paracentric cylinders operated by change keys only.
 - b. No Master Key System: Mogul cylinders operated by change keys only.
OR
Master Key System: Mogul cylinders operated by a change key and a master key.
OR
Grand Master Key System: Mogul cylinders operated by a change key, a master key, and a grand master key.
OR
Great-Grand Master Key System: Mogul cylinders operated by a change key, a master key, a grand master key, and a great-grand master key.
 - c. Existing System: Master key or grand master key mogul-cylinder locks to the Owner's existing system.
 - d. Existing System: Re-key the Owner's existing master key system for mogul-cylinder locks into new keying system.
6. Keys: Provide cast silicon-bronze copper alloy keys complying with the following:
 - a. Stamping: Permanently inscribe each key with a visual key-control number and include the following notation:
 - 1) Notation: "DO NOT DUPLICATE" **OR** Information to be furnished by the Owner, **as directed**.
 - b. Quantity: In addition to one extra blank key for each lock, provide the following:
 - 1) Cylinder Change Keys: Three.
OR
Master Key(s): One.
OR
Grand Master Key(s): One.
OR
Great-Grand Master Key(s): One.
- I. Switches
 1. General: Provide switches configured with type of contacts required for functions indicated, including multiple circuiting where required by functional performance of Division 28 Section "Plc Electronic Detention Monitoring And Control Systems".
 2. Concealed, Magnetic Door Position Switches: Consisting of actuating magnet mortised into detention door and switch mortised into frame; with stainless-steel faceplates; 24-V dc, factory wired with plug connector. Wire in series with lock monitors. Attach with security fasteners.
 3. Concealed, Mechanical Door Position Switches: Consisting of metal track mortised into head of detention door connected by steel actuator arm to steel actuator mortised into frame; switch fully concealed when door is in closed position; with stainless-steel faceplate; 120-V ac; factory wired with plug connector. Action of door mechanically activates switch. Wire in series with lock monitors. Attach with security fasteners.
 4. Surface-Mounted Door Position Switches: Switch enclosed in **0.134-inch (3.42-mm)** nominal-thickness steel enclosure, factory primed for painting; 120-V ac; factory wired with plug connector. Wire in series with lock monitors. Attach with security fasteners.
 - a. Galvanize enclosure for exterior locations and where indicated.

5. Strike Indicator Switches: Designed to be mortised behind strike and to indicate whether door is locked or unlocked; enclosed in metal strike box. Wire in series with door position switches. Attach with security fasteners.
 - a. Voltage: 120-V dc **OR** 240-V ac **OR** As indicated, **as directed**.
 - b. Locations: At doors with mechanical detention lock **OR** Where indicated, **as directed**.
 - c. Manufacturer: Same as detention lock.
6. Inmate Door Control Switches, as directed: Momentary **OR** Maintained-contact, **as directed**, push-button switch with metal faceplate. Attach with security fasteners.
 - a. Material and Finish: Brass with BHMA 606 **OR** Brass with BHMA 626 **OR** Stainless steel with BHMA 630, **as directed**, finish.
 - b. Operation: When activated from remote location, switch allows inmate operation of electric cell door lock.
7. Push-Button, Inmate Door Control Switches, as directed: Momentary **OR** Maintained-contact, **as directed**, push-button switch for installation without faceplate. Attach with security fasteners.
 - a. Material and Finish: Brass with BHMA 606 **OR** Brass with BHMA 626 **OR** Stainless steel with BHMA 630, **as directed**, finish.
 - b. Operation: When activated from remote location, switch allows inmate operation of electric cell door lock.

J. Detention Operating Trim

1. Standard: BHMA A156.6, Grade 1.
2. Surface-Mounted Door Pulls (not typically used inside cells): **8-3/4-inch (222-mm)** overall length and **2-1/4-inch (57-mm)** projection; attach to door with two security fasteners.
 - a. Material: Cast bronze with BHMA 606 **OR** BHMA 626, **as directed**, finish.
 - b. Material: Cast stainless steel with BHMA 630 finish.
3. Round, Surface-Mounted Door Pulls (not typically used inside cells): **7-inch (178-mm)** overall length by **1-inch (25-mm-)** diameter solid bar, with **2-1/4-inch (57-mm)** projection; attach to door with two security through fasteners.
 - a. Material: Cast or extruded bronze with BHMA 606 **OR** BHMA 626, **as directed**, finish.
 - b. Material: Cast stainless steel with BHMA 630 finish.
4. Flush Door Pulls: **5 inches high by 4 inches wide by 1 inch deep (127 mm high by 102 mm wide by 25 mm deep)**, with **1/8-inch- (3-mm-)** thick faceplate; attach to door with four security fasteners.
 - a. Material: Formed, wrought, or cast brass/bronze with BHMA 606 **OR** BHMA 626, **as directed**, finish.
 - b. Material: Formed or cast stainless steel with BHMA 630 finish.
5. Knob Pulls: **2-inch (50-mm)** diameter; fabricated from solid brass with BHMA 606 **OR** BHMA 626, **as directed**, finish. Attach with security fasteners.
6. Lever-Handle Guides: Guide track and escutcheon, **as directed**, that provides selective stopping of lever handle by use of an adjustable stop; fabricated from steel with BHMA 633 **OR** stainless steel with BHMA 630, **as directed**, finish. Attach with security fasteners.

K. Security Door Closers

1. Standard: BHMA A156.4, Grade 1.
 - a. Certified Products: Provide security door closers listed in BHMA's "Directory of Certified Products."
2. Surface-Mounted Security Door Closers:
 - a. Arms: Minimum **3/8-inch- (9.5-mm-)** thick by **1-1/8-inch- (29-mm-)** wide, rectangular steel main arm; **5/16-inch- (8-mm-)** thick by **1-inch- (25-mm-)** wide, rectangular steel secondary arm; full rack-and-pinion type; fabricated with orbital-riveted, pinned, or welded elbow and arm shoe/soffit plate joints designed to prevent disassembly with ordinary hand tools.
 - b. Cover: Heavy-duty metal, attached with four security fasteners.
 - c. Mounting: Attach security door closer with security fasteners.
3. Concealed Security Door Closers:

- a. Construction: Forged-steel arm; security roller; with track concealed in head of detention door, designed to eject foreign objects during opening and closing; fabricated with joints designed to prevent disassembly with ordinary hand tools. Closer arm and track fully concealed when door is closed.
 - b. Cover Plates: Heavy-duty metal, attached with security fasteners.
 - c. Provide door position switch integral to closer.
 4. Unit Size: Unless otherwise indicated, comply with manufacturer's written recommendations for size of security door closers depending on size of door, exposure to weather, and anticipated frequency of use. Provide factory-sized closers, adjustable to meet field conditions and requirements for opening force.
- L. Detention Door Stops
 1. Detention Floor Stops: 1-1/2-inch-high by 2-inch- (38-mm-high by 50-mm-) diameter rubber bumper mounted on steel lag bolt; BHMA A156.16; install in floor with nonshrink grout; for detention doors unless wall or other type stops are indicated. Do not mount floor stops where they will impede traffic.
 2. Silencers for Detention Door Frames: BHMA A156.16, Grade 1; neoprene or rubber, minimum 1/2-inch (13-mm) diameter; fabricated for drilled-in application to detention door frame. Attach with security fasteners.
- M. Sliding Detention Door Device Assemblies
 1. Performance Requirements: Provide sliding detention door device assemblies, including locking device, receiver, overhead door hanger, bottom door guide, lock column, and enclosure, as a complete assembly, complying with Grade 1 **OR** Grade 2, **as directed**, according to ASTM F 1643, as determined by testing manufacturers' standard units representing those indicated for Project.
 2. Assembly Construction: As follows:
 - a. Enclosure: Fabricated from 0.179-inch (4.56-mm) nominal-thickness steel plate, with 0.134-inch (3.42-mm) nominal-thickness steel removable **OR** hinged, **as directed**, cover. Baffle openings in enclosure. Provide closures for ends of housings.
 - 1) Provide sloping-top housings. Flat-top housings may be provided for operators mounted to ceiling, **as directed**.
 - b. Lock Column: Vertical tube enclosure fabricated from 0.134-inch (3.42-mm) nominal-thickness steel, providing mechanical locking control of detention sliding door at door location; operated by paracentric key. Doors shall be capable of being locked at top and bottom, at rear of door, in both open and closed positions, with no components projecting into door opening.
 - c. Receiver: Fabricated from 0.134-inch (3.42-mm) nominal-thickness steel plate.
 - d. Hanger Assembly: Extend steel carrier full width of door and door travel required for clear door opening. Provide antifriction ball-bearing steel rollers with hardened members and grease shield.
 - e. Finish: Factory prime painted.
 3. Mechanical-Locking, Manual-Door-Movement, Sliding Door Device Assemblies SDA-1: Doors are manually opened and closed and mechanically locked by means of jamb-mounted mechanical detention lock specified elsewhere in this Section.
 4. Electromechanical-Locking, Manual-Door-Movement, Sliding Door Device Assemblies SDA-2: Operated from remote-control panel that activates electric motors to unlock sliding doors. Doors spring open a small distance after unlocking and are manually opened and closed. Locks automatically deadlock when doors are moved to fully open or fully closed position. Provide factory-wired cable harness with plug connectors for each motor unit.
 - a. Single-Door Function: In an emergency or if power fails, individual doors can be unlocked using a manual-release tool and manually moved; doors relock in either fully open or fully closed position.
 - b. Multiple-Door Function: Each door can be individually unlocked locally or from a remote panel, or unlocked from a remote panel with other doors as a group. In an emergency or if power fails, door group can be manually operated from mechanical-release cabinet at end

- of cell line **OR** pilaster release adjacent to receiving jamb of each door operated by paracentric key, **as directed**; doors shall not relock in any position.
- c. Electric Key Switch: Operated by paracentric **OR** mogul, **as directed**, key and providing electric control of detention sliding door operation at door location; where indicated.
 5. Electromechanical-Locking, Electromechanical-Door-Movement, Sliding Door Device Assemblies SDA-3: Operated from remote-control panel that activates electric motors to unlock sliding doors and motorized rack-and-pinion drive mechanisms to open and close doors. Doors lock in open position and deadlock when closed. Provide factory-wired cable harness with plug connectors for each motor unit.
NOTE: Paragraph above describes Southern Folger's "Southern Steel Model 3150LX" and "Southern Steel Model 3165LX." Only the 3150LX system offers multiple door functions, such as for cell doors; the 3165LX system is for individual doors, such as for vestibules, day rooms, and corridors.
 - 1) Single-Door Function: In an emergency or if power fails, individual doors can be unlocked using a manual-release tool and manually moved; doors relock in either fully open or fully closed position.
 - 2) Multiple-Door Function: Each door can be individually unlocked locally or from a remote panel, or unlocked from a remote panel with other doors as a group. In an emergency or if power fails, door group can be manually operated from mechanical-release cabinet at end of cell line **OR** pilaster release adjacent to receiving jamb of each door operated by paracentric key, **as directed**; doors shall not relock in any position.
 - b. Electric Key Switch: Operated by paracentric **OR** mogul, **as directed**, key and providing electric control of detention sliding door operation at door location; where indicated.
 6. Electromechanical-Locking, Pneumatic-Door-Movement, Sliding Door Device Assemblies SDA-4 (for individual doors, such as for vestibules, day rooms, and corridors): Operated from remote-control panel that activates electric motors to unlock sliding doors and pneumatic system to open and close doors. Doors lock in open position and deadlock when closed. Factory install quick-connect air fitting and factory-wired cable harness with plug connectors for each motor unit; 24-V dc.
 - a. Single-Door Function: In an emergency or if pneumatic systems or electric power fails, individual doors can be unlocked using a manual-release tool and manually moved; doors relock in either fully open or fully closed position.
 - 1) Lock Control at Door: Mechanical key release adjacent to receiving jamb of each door, contained in pilaster and operated by paracentric key; where indicated.
 7. Pneumatic-Locking, Manual-Door-Movement, Sliding Door Device Assemblies SDA-5: Operated from remote-control panel that activates pneumatic cylinders to unlock doors. Doors spring open a small distance after unlocking and are manually opened and closed. Locks automatically deadlock when doors are moved to fully open or fully closed position. Factory install quick-connect air fitting and factory-wired cable harness with plug connectors for each motor unit.
 - a. Single-Door Function: In an emergency or if pneumatic systems or electric power fails, individual doors can be unlocked using a manual-release tool and manually moved; doors relock in either fully open or fully closed position.
 - 1) Lock Control at Door: Mechanical key release adjacent to receiving jamb of each door, contained in pilaster and operated by paracentric key; where indicated.
 - b. Multiple-Door Function: Each door can be individually unlocked locally or from a remote panel, or unlocked from a remote panel with other doors as a group. In an emergency or if pneumatic systems or electric power fails, door group can be operated from remotely located auxiliary pneumatic-release system **OR** pilaster release adjacent to receiving jamb of each door operated by paracentric key, **as directed**; doors shall not relock in any position.
 - c. Electric Key Switch: Operated by paracentric **OR** mogul, **as directed**, key and providing electric control of detention sliding door operation at door location; where indicated.
 8. Pneumatic-Locking, Pneumatic-Door-Movement, Sliding Door Device Assemblies SDA-6 (Paragraph below describes Southern Folger's "Southern Steel Model 8050L" and "Southern

Steel Model 8065L." Only the 8050L system offers multiple door functions, such as for cell doors; the 8065L system is for individual doors, such as for vestibules, day rooms, and corridors.); Operated from remote-control panel that activates pneumatic cylinder to unlock sliding doors and open and close doors. Doors lock in open position and deadlock when closed. Factory install quick-connect air fitting and factory-wired cable harness with plug connectors for each motor unit; 24-V dc.

- a. Single-Door Function: In an emergency or if pneumatic systems or electric power fails, individual doors can be unlocked using a manual-release tool and manually moved; doors relock in either fully open or fully closed position.
- b. Multiple-Door Function: Each door can be individually unlocked locally or from a remote panel, or unlocked from a remote panel with other doors as a group. In an emergency or if pneumatic systems or electric power fails, door group can be operated from remotely located auxiliary pneumatic-release system **OR** pilaster release adjacent to receiving jamb of each door operated by paracentric key, **as directed**; doors shall not relock in any position.
- c. Electric Key Switch: Operated by paracentric **OR** mogul, **as directed**, key and providing electric control of detention sliding door operation at door location; where indicated.
- d. Provide security ring for installation of pneumatic detention lock in hollow-metal detention frame, welded to frame or access cover, unless otherwise **OR** where, **as directed**, indicated.

N. Fabrication

1. Manufacturer's Nameplate: Do not provide products that have manufacturer's name or trade name displayed in a visible location (omit removable nameplates) except in conjunction with required fire-rated labels and as otherwise approved.
2. Base Metals: Produce detention door hardware units of base metal, fabricated by forming method indicated, using manufacturer's standard metal alloy, composition, temper, and hardness. Furnish metals of a quality equal to or greater than that of specified detention door hardware units and BHMA A156.18 finishes. Do not furnish manufacturer's standard materials or forming methods if different from specified standard.
3. Fasteners: Provide flat-head security fasteners with finished heads to match surface of detention door hardware unless otherwise indicated.
 - a. Security Fasteners: Fabricate detention door hardware using security fasteners with head style appropriate for fabrication requirements, strength, and finish of adjacent materials. Provide stainless-steel security fasteners in stainless-steel materials, **as directed**.
 - b. Concealed Fasteners: For detention door hardware units that are exposed when detention door is closed except for units already specified with concealed fasteners. Do not use through bolts for installation where bolt head or nut on opposite face is exposed unless it is the only means of securely attaching detention door hardware. Where through bolts are used on hollow-metal detention door and frame construction, provide sleeves for each through bolt.
 - c. Steel Machine Screws (for fire-rated detention door assemblies. NFPA 80 requires locks, latches, and surface-mounted top and bottom bolts to be secured with machine screws or through bolts.): For the following fire-rated applications:
 - 1) Mortise detention hinges to detention doors.
 - 2) Strike plates to detention frames.
 - 3) Security door closers to detention doors and frames.
 - d. Steel Through Bolts (for fire-rated detention door assemblies. NFPA 80 requires locks, latches, and surface-mounted top and bottom bolts to be secured with machine screws or through bolts.): For the following fire-rated applications unless door blocking is provided:
 - 1) Surface detention hinges to detention doors.
 - 2) Security door closers to detention doors and frames.
 - e. Spacers or Sex Bolts: For through bolting of hollow-metal detention doors.
 - f. Fasteners for Wood Detention Doors: Comply with DHI WDHS.2.

O. Finishes

1. Standard: Comply with BHMA A156.18.
2. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
3. BHMA Designations: Comply with base material and finish requirements indicated by the following:
 - a. BHMA 600: Primed for painting, over steel base metal.
 - b. BHMA 606: Satin brass, clear coated, over brass base metal.
 - c. BHMA 626: Satin chromium plated over nickel, over brass or bronze base metal.
 - d. BHMA 630: Stainless steel, satin, over stainless-steel base metal.
 - e. BHMA 652: Satin chromium plated over nickel, over steel base metal.

1.3 EXECUTION

A. Preparation

1. Steel Detention Doors and Frames: Comply with ANSI/DHI A115 Series.
 - a. Surface-Applied Detention Door Hardware: Drill and tap detention doors and frames according to ANSI/SDI A250.6.
2. Wood Detention Doors: Comply with DHI A115-W Series.

B. Installation

1. Mounting Heights: Mount detention door hardware units at heights indicated in the following applicable publications unless specifically indicated or required to comply with governing regulations:
 - a. Steel Detention Doors and Frames: DHI's "Recommended Locations for Builders' Hardware for Custom Steel Doors and Frames."
 - b. Wood Detention Doors: DHI WDHS.3.
2. Install each detention door hardware item to comply with Shop Drawings and manufacturer's written instructions. Where cutting and fitting are required to install detention door hardware onto or into surfaces that are later to be painted or finished in another way, coordinate removal, storage, and reinstallation of surface protective trim units with finishing work specified in Division 09. Do not install surface-mounted items until finishes have been completed on substrates involved.
 - a. Set units level, plumb, and true to line and location. Adjust and reinforce attachment substrates as necessary for proper installation and operation.
 - b. Drill and countersink units that are not factory prepared for anchorage fasteners. Space fasteners and anchors according to industry standards.
3. Install interconnecting wiring and connectors between detention door hardware devices. Terminate device wiring for detention door hardware installed in swinging doors at a plug-type connector located in lock pocket or door frame junction box and for sliding doors at a junction box in door frame.
4. Security Fasteners: Install detention door hardware using security fasteners with head style appropriate for installation requirements, strength, and finish of adjacent materials.

C. Field Quality Control

1. Inspect installed products to verify compliance with requirements. Prepare inspection reports and indicate compliance with and deviations from the Contract Documents.
2. Perform the following field tests and inspections and prepare test reports:
 - a. After installing electrified and pneumatic, **as directed**, detention door hardware and after electrical circuitry has been energized and compressed-air system is functional, **as directed**, test detention door hardware for compliance with requirements.
 - 1) Test: Operate lock of each door and group of doors in normal remote, normal local, and emergency operating modes. Verify that remote controls operate correct door locks and in correct sequence.

- b. Verify that lock bolts engage strikes with required bolt projection.
 - c. Verify that detention door hardware is installed, connected, and adjusted according to the Contract Documents.
 - d. Verify that electrical wiring installation complies with manufacturer's submittal and written installation requirements.
 3. Remove and replace detention work if inspections indicate that work does not comply with specified requirements. Remove malfunctioning units, replace with new units, and retest as specified above.
 4. Perform additional inspections to determine compliance of replaced or additional work. Prepare inspection reports.
 5. Prepare field quality-control certification endorsed by Detention Specialist, **as directed**, that states installed products and their installation comply with requirements in the Contract Documents.
 - D. Adjusting
 1. Adjust and check each operating item of detention door hardware and each detention door to ensure proper operation or function of every unit. Replace units that cannot be adjusted to operate as intended. Adjust detention door control devices to compensate for final operation of heating and ventilating equipment and to comply with referenced accessibility requirements.
 - a. Strikes: Adjust horizontal and vertical alignment of keeper to properly engage lock bolt.
 - b. Security Door Closers: Adjust sweep period so that, from an open position of 90 degrees, detention door will take at least five seconds to move to a position of 12 degrees.
 - E. Cleaning And Protection
 1. Clean adjacent surfaces soiled by detention door hardware installation.
 2. Clean operating items as necessary to restore proper function and finish.
 3. Provide final protection and maintain conditions that ensure that detention door hardware is without damage or deterioration at time of Final Completion.
- 1.4 Detention Door Hardware Sets
- Note 1: Hanging devices below include detention hinges and sliding detention door device assemblies. Indicate whether detention hinges are attached to detention doors and frames by security fasteners or by welding.
- Note 2: Securing devices (inactive leaf) below include door position switches and strike indicator switches.
- Note 3: Securing devices (active leaf) below include detention locksets and latchsets, cylinders, door position switches, strike indicator switches, and inmate door control switches.
- Note 4: Operating trim below includes detention door pulls, flush pulls, knob pulls, and lever-handle guides.
- Note 5: Closing devices below include security door closers.
- Note 6: Stops below include detention floor stops and door silencers if not specified with steel detention doors and frames.
- Note 7: Miscellaneous items that could be inserted at end of detention door hardware sets include key-control cabinets, software if not included in Division 08 Section "Door Hardware", and detention door hardware not otherwise listed.
- A. General: Provide detention door hardware for each detention door to comply with requirements in this Section and detention door hardware sets indicated in a door and frame schedule **OR** and detention door hardware sets indicated below, **as directed**.

Detention Door Hardware Set No. [#]

Single Door No. [#]; each to have the following:

*	Hanging Devices	<Insert description.>	<Insert manufacturer.>	<Insert finish.>
[#]	Securing Devices	<Insert description.>	<Insert manufacturer.>	<Insert finish.>



(inactive leaf)				
<#>	Securing Devices	<Insert description.>	<Insert manufacturer.>	<Insert finish.>
(active leaf)				
[#]	Operating Trim	<Insert description.>	<Insert manufacturer.>	<Insert finish.>
[#]	Closing Devices	<Insert description.>	<Insert manufacturer.>	<Insert finish.>
[#]	Stops	<Insert description.>	<Insert manufacturer.>	<Insert finish.>
*	Number of Hinges, as specified.			

Note 8: Insert additional requirements and sequence of operation in schedule above for electrified and pneumatic detention door hardware if required.

END OF SECTION 08 71 11 00

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Task	Specification	Specification Description
08 71 11 00	01 22 16 00	No Specification Required
08 71 11 00	06 01 40 91	Door Hardware

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SECTION 08 71 13 00 - AUTOMATIC DOOR OPERATORS

1.1 GENERAL

A. Description Of Work

1. This specification covers the furnishing and installation of material for automatic door operators. Products shall be as follows or as directed by the Owner. Installation procedures shall be in accordance with the products manufacturer's recommendations. Demolition and removal of materials shall be as required to support the work.

B. Summary

1. Section Includes:
 - a. Power door operators for swinging doors.
 - b. Low-energy door operators for swinging doors.
 - c. Power-assist door operators for swinging doors.

C. Definitions

1. Double Egress Doors: A pair of doors that simultaneously swing with the two doors moving in opposite directions with no mullion between them.
2. Double Swing Doors: A pair of doors that swing with the two doors moving in opposite directions with a mullion between them; each door functioning as a single swing door.

D. Submittals

1. Product Data: For each type of product indicated.
2. Shop Drawings: For automatic door operators. Include plans, elevations, sections, details, and attachments to other work.
3. Samples: For each exposed product and for each color and texture specified.
4. Product certificates
5. Field quality-control reports.
6. Maintenance data.
7. Warranty: Sample of special warranty.

E. Quality Assurance

1. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for installation and maintenance of units required for this Project and who employs a certified inspector, **as directed**.
2. Certified Inspector Qualifications: Certified by the AAADM.
3. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a testing agency, and marked for intended location and application.
4. Exit-Door Requirements: Comply with requirements of authorities having jurisdiction for doors with automatic door operators serving as a component of a required means of egress.
5. Preinstallation Conference: Conduct conference at Project site.

F. Warranty

1. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of automatic door operators that fail in materials or workmanship within two years from date of Final Completion.

1.2 PRODUCTS

A. Materials

1. Aluminum: Alloy and temper recommended by manufacturer for type of use and finish indicated, complying with standards indicated below:

- a. Sheet: **ASTM B 209** (**ASTM B 209M**).
 - b. Extrusions: **ASTM B 221** (**ASTM B 221M**).
 2. Stainless-Steel Sheet: ASTM A 240/A 240M or ASTM A 666, Type 304, stretcher-leveled standard of flatness, in manufacturer's standard thickness.
 3. Brass Sheet: ASTM B 36/B 36M, Alloy UNS No. C26000 (cartridge brass, 70 percent copper), in manufacturer's standard thickness.
 4. Bronze Sheet: ASTM B 36/B 36M, Alloy UNS No. C28000 (muntz metal, 60 percent copper) or Alloy UNS No. C23000 (red brass, 85 percent copper), in manufacturer's standard thickness.
 5. Expanded Aluminum Mesh: Manufacturer's standard expanded **OR** expanded and flattened, **as directed**, aluminum sheet in accordance with the geometry of ASTM F 1267.
 6. Polycarbonate: Manufacturer's standard monolithic polycarbonate sheet manufactured by extrusion process, with an average impact strength of **12 to 16 ft-lbf/in.** (**640 to 854 J/m**) of width when tested according to ASTM D 256, Method A.
 7. Fasteners and Accessories: Manufacturer's standard corrosion-resistant, nonstaining, nonbleeding fasteners and accessories compatible with adjacent materials.
- B. Automatic Door Operators, General
1. General: Provide operators of size recommended by manufacturer for door size, weight, and movement; for condition of exposure; for long-term, maintenance-free operation under normal traffic load for type of occupancy indicated; and complying with UL 325. Coordinate operator mechanisms with door operation, hinges, and activation and safety devices.
 - a. Emergency Breakaway: Where indicated for center-pivoted doors, provide emergency breakaway feature for reverse swing of doors. Equip system to discontinue power to automatic door operator when door is in emergency breakaway position, and to return to closed position after breakaway and automatically reset.
 - b. Fire-Rated Doors: Provide door operators for fire-rated door assemblies that comply with NFPA 80 for fire-rated door components and are listed and labeled by a qualified testing agency.
 - c. Wind Load: Provide door operators on exterior doors that will open and close doors and maintain them in fully closed position when subjected to wind load of **<Insert wind load>**.
 2. Electromechanical Operating System: Self-contained unit powered by permanent-magnet dc motor; with closing speed controlled mechanically by gear train and dynamically by braking action of electric motor, connections for power and activation- and safety-device wiring, and manual operation including spring closing when power is off.
 3. Electrohydraulic Operating System: Self-contained low-pressure unit; with separate cylinders for power and checking, connections for power and activation- and safety-device wiring, manual operation including spring closing when power is off.
 4. Pneumatic Operating System: Pneumatic operator, air opened and spring closed, checking in both cycles, with doors manually operable when power is off.
 - a. Power Unit: Manufacturer's standard remote compressor unit, complete with tank, compressor, motor, regulator, safety valve, pressure cutoff switch, and automatic air-line filter drain.

OR

Power Unit: As specified in Division 22 Section(s) "General-service Compressed-air Piping" AND "General-service Packaged Air Compressors And Receivers".
 5. Hinges: See Division 08 Section "Door Hardware" for type of hinge for each door that door operator shall accommodate.
 6. Housing for Overhead Concealed Operators: Fabricated from minimum **0.125-inch-** (**3.2-mm-**) thick, extruded or formed aluminum and extending full width of door opening including door jambs to conceal door operators and controls. Provide hinged or removable access panels for service and adjustment of door operators and controls. Secure panels to prevent unauthorized access.
 7. Cover for Surface-Mounted Operators: Fabricated from **0.125-inch-** (**3.2-mm-**) thick extruded or formed aluminum; manufacturer's standard width; **OR** continuous over full width of operator-controlled door opening; **OR** continuous over full width of door opening including door jambs, **as**

directed; with enclosed end caps, provision for maintenance access, and fasteners concealed when door is in closed position.

8. Brackets and Reinforcements: Manufacturer's standard, fabricated from aluminum with nonstaining, nonferrous shims for aligning system components.
9. Fire-Door Package: Consisting of UL-listed latch mechanism, power-reset box, and caution signage for fire-rated doors. Latch mechanism shall allow door to swing free during automatic operation; when fire is detected, latch actuator shall cause exit hardware to latch when door closes. Provide latch actuators with fail-secure design.

C. Power Door Operators

1. Standard: BHMA A156.10.
2. Performance Requirements:
 - a. Opening Force:
 - 1) Power-Operated Doors: Not more than 50 lbf (222 N) required to manually set door in motion if power fails; not more than 15 lbf (67 N) required to open door to minimum required width.
OR
Power-Operated Swinging Doors: Not more than 30 lbf (133 N) required to manually open door if power fails.
 - 2) Breakaway Device for Power-Operated Doors: Not more than 50 lbf (222 N) required for a door to open.
 - b. Entrapment Protection: Not more than 40 lbf (178 N) required to prevent stopped door in the last 10 degrees of opening from moving in the direction of opening; not more than 30 lbf (133 N) required to prevent stopped door from moving in direction of closing.
3. Configuration: Operator to control single swinging door **OR** pair of swinging doors, **as directed**.
 - a. Traffic Pattern: One way **OR** Two way **OR** Double swing **OR** Double egress, **as directed**.
 - b. Operator Mounting: Surface **OR** Overhead concealed, **as directed**.
4. Operation: Power opening and power-assisted, **as directed**, spring closing. Provide time delay for door to remain open before initiating closing cycle as required by BHMA A156.10.
5. Operating System: Electromechanical **OR** Electrohydraulic **OR** Pneumatic, **as directed**.
6. Microprocessor Control Unit: Solid-state controls.
7. Features:
 - a. Adjustable opening **OR** closing **OR** opening and closing, **as directed**, speed.
 - b. Adjustable opening **OR** closing, **as directed**, force.
 - c. Adjustable backcheck.
 - d. Adjustable hold-open time from zero to 30 seconds.
 - e. Adjustable time delay.
 - f. Adjustable acceleration.
 - g. Adjustable limit switch.
 - h. Obstruction recycle.
 - i. On-off/hold-open switch to control electric power to operator; key operated, **as directed**.
8. Exposed Finish: Finish exposed components with Class I, clear anodic finish **OR** Class II, clear anodic finish **OR** Class I, color anodic finish **OR** Class II, color anodic finish **OR** baked-enamel or powder coat **OR** metal cladding **OR** finish matching door and frame **OR** finish matching door hardware, **as directed**.
 - a. Color: As selected from full range of industry colors and color densities.
 - b. Metal Cladding: No. 4 directional-satin-finish stainless steel **OR** No. 8 mirrorlike reflective, nondirectional-polish-finish stainless steel **OR** Satin brass **OR** Polished brass **OR** Satin bronze **OR** Polished bronze, **as directed**.

D. Low-Energy Door Operators

1. Standard: BHMA A156.19.
2. Performance Requirements:
 - a. Opening Force if Power Fails: Not more than 15 lbf (67 N) required to release a latch if provided, not more than 30 lbf (133 N) required to manually set door in motion, and not more than 15 lbf (67 N) required to fully open door.

- b. Entrapment Protection: Not more than **15 lbf (67 N)** required to prevent stopped door from closing or opening.
- 3. Configuration: Operator to control single swinging door **OR** pair of swinging doors, **as directed**.
 - a. Traffic Pattern: One way **OR** Two way **OR** Double swing **OR** Double egress, **as directed**.
 - b. Operator Mounting: Surface **OR** Overhead concealed, **as directed**.
- 4. Operation: Power opening and power-assisted, **as directed**, spring closing. Provide time delay for door to remain open before initiating closing cycle as required by BHMA A156.19. When not in automatic mode, door operator shall function as manual door closer, with or without electrical power.
- 5. Operating System: Electromechanical **OR** Electrohydraulic **OR** Pneumatic, **as directed**.
- 6. Microprocessor Control Unit: Solid-state controls.
- 7. Features:
 - a. Adjustable opening **OR** closing **OR** opening and closing, **as directed**, speed.
 - b. Adjustable opening **OR** closing, **as directed**, force.
 - c. Adjustable backcheck.
 - d. Adjustable hold-open time from zero to 30 seconds.
 - e. Adjustable time delay.
 - f. Adjustable acceleration.
 - g. Obstruction recycle.
 - h. On-off/hold-open switch to control electric power to operator; key operated, **as directed**.
- 8. Exposed Finish: Finish exposed components with Class I, clear anodic finish **OR** Class II, clear anodic finish **OR** Class I, color anodic finish **OR** Class II, color anodic finish **OR** baked-enamel or powder coat **OR** metal cladding **OR** finish matching door and frame **OR** finish matching door hardware, **as directed**.
 - a. Color: As selected from full range of industry colors and color densities.
 - b. Metal Cladding: No. 4 directional-satin-finish stainless steel **OR** No. 8 mirrorlike reflective, nondirectional-polish-finish stainless steel **OR** Satin brass **OR** Polished brass **OR** Satin bronze **OR** Polished bronze, **as directed**.

E. Power-Assist Door Operators

- 1. Standard: BHMA A156.19.
- 2. Performance Requirements:
 - a. Opening Force:
 - 1) If Power Fails: Not more than **15 lbf (67 N)** required to release a latch if provided, not more than **30 lbf (133 N)** required to manually set door in motion, and not more than **15 lbf (67 N)** required to fully open door.
 - 2) Accessible Interior Doors: Not more than **5 lbf (22 N)** to fully open door.
 - b. Entrapment Protection: Not more than **15 lbf (67 N)** required to prevent stopped door from closing or opening.
- 3. Configuration: Operator to control single swinging door **OR** pair of swinging doors, **as directed**.
 - a. Traffic Pattern: One way **OR** Two way **OR** Double swing **OR** Double egress, **as directed**.
 - b. Operator Mounting: Surface **OR** Overhead concealed, **as directed**.
- 4. Operation: Power-assisted opening that reduces force to open door and power-assisted, **as directed**, spring closing. Pushing or pulling on door activates the operator. Provide time delay for door to remain open before initiating closing cycle as required by BHMA A156.19. When not in automatic mode, door operator shall function as manual door closer, with or without electrical power.
- 5. Operating System: Electromechanical **OR** Electrohydraulic **OR** Pneumatic, **as directed**.
- 6. Microprocessor Control Unit: Solid-state controls.
- 7. Features:
 - a. Adjustable opening **OR** closing **OR** opening and closing, **as directed**, speed.
 - b. Adjustable opening **OR** closing, **as directed**, force.
 - c. Adjustable backcheck.
 - d. Adjustable latch speed.
 - e. Adjustable hold-open time from zero to 30 seconds.

- f. Adjustable time delay.
 - g. Adjustable acceleration.
 - h. Obstruction recycle.
 - i. On-off/hold-open switch to control electric power to operator; key operated, **as directed**.
 8. Exposed Finish: Finish exposed components with Class I, clear anodic finish **OR** Class II, clear anodic finish **OR** Class I, color anodic finish **OR** Class II, color anodic finish **OR** baked-enamel or powder coat **OR** metal cladding **OR** finish matching door and frame **OR** finish matching door hardware, **as directed**.
 - a. Color: As selected from full range of industry colors and color densities.
 - b. Metal Cladding: No. 4 directional-satin-finish stainless steel **OR** No. 8 mirrorlike reflective, nondirectional-polish-finish stainless steel **OR** Satin brass **OR** Polished brass **OR** Satin bronze **OR** Polished bronze, **as directed**.
- F. Activation And Safety Devices
1. General: Provide activation and safety devices in accordance with BHMA standards, for condition of exposure and for long-term, maintenance-free operation under normal traffic load for type of occupancy indicated. Coordinate activation and safety devices with door operation and door operator mechanisms.
 2. Motion Sensors: Self-contained, K-band-frequency, microwave-scanner units; adjustable to provide detection field sizes and functions required by BHMA A156.10.
 - a. Provide capability for switching between bidirectional and unidirectional detection.
 - b. For one-way traffic, sensor on egress side shall not be active when doors are fully closed.
 3. Presence Sensors: Self-contained, infrared-scanner units; adjustable to provide detection field sizes and functions required by BHMA A156.10. Sensors shall remain active at all times.
 4. Combination Motion/Presence Sensors: Self-contained units consisting of both motion and presence sensors in a single housing; adjustable to provide detection field sizes and functions required by BHMA A156.10.
 - a. Motion Sensor: K-band-frequency, microwave-scanner units.
 - 1) Provide capability for switching between bidirectional and unidirectional detection.
 - 2) For one-way traffic, sensor on egress side shall not be active when doors are fully closed.
 - b. Presence Sensor: Infrared-scanner units that remain active at all times.
 5. Photoelectric Beams: Pulsed infrared, sender-receiver assembly for recessed mounting. Beams shall not be active when doors are fully closed.
 6. Control Mats: ~~1/2-inch-~~ (13-mm-) thick, synthetic-rubber or flexible-plastic mat in safety-ribbed surface pattern, with extruded-aluminum frame; with pressure switches for low-voltage control wiring; and complying with performance requirements in BHMA A156.10.
 - a. Frame: Recessed to fit flush with floor, with concealed anchors **OR** Surface mounted, with tapered safety edge, **as directed**.
 - b. Size: As indicated, but not smaller than required by BHMA A156.10 including Appendix A.
 - c. Color: As selected from full range of industry colors and color densities.
 7. Push-Plate Switch: Momentary-contact door control switch with flat push-plate actuator with contrasting-colored, engraved message, **as directed**.
 - a. Configuration: Round **OR** Square, **as directed**, push plate with ~~4-by-4-inch~~ (100-by-100-mm) junction box.
 - 1) Mounting: Recess mounted, semiflush in wall **OR** Surface mounted on wall **OR** As indicated on Drawings, **as directed**.
 - b. Configuration: Rectangular push plate with ~~2-by-4-inch~~ (50-by-100-mm) junction box.
 - 1) Mounting: Recess mounted, semiflush in wall **OR** Recess mounted in door jamb **OR** Surface mounted on wall **OR** Surface mounted on post **OR** Surface mounted on guide rail **OR** As indicated on Drawings, **as directed**.
 - c. Push-Plate Material: Stainless steel **OR** Plastic, **as directed**, as selected from manufacturer's full range.
 - d. Message: Plain face with no message **OR** "Push to Open" **OR** International symbol of accessibility **OR** International symbol of accessibility and "Push to Open", **as directed**.

8. Push-Button Switch: Momentary-contact door control switch with one red-button actuator; enclosed in nominal **2-by-4-inch (50-by-100-mm)** OR **4-by-4-inch (100-by-100-mm)**, **as directed**, junction box.
 - a. Provide faceplate engraved with "Press to Open" text and international symbol of accessibility, **as directed**, in contrasting color.
 - b. Provide blue plastic cover engraved with "Press Button to Open" in white text and international symbol of accessibility.
 - c. Mounting: Surface mounted on wall OR Surface mounted on post OR Surface mounted on guide rail OR Recess mounted in wall OR As indicated on Drawings, **as directed**.
 - d. Faceplate Material: Stainless steel OR Painted metal, **as directed**, as selected from manufacturer's full range.
9. Key Switch: Recess-mounted, door control switch with key-controlled actuator; enclosed in **2-by-4-inch (50-by-100-mm)** junction box. Provide faceplate engraved with text indicating switch functions.
 - a. Faceplate Material: Stainless steel OR Painted metal, **as directed**, as selected from manufacturer's full range.
 - b. Functions: On-off, momentary contact OR On-off, maintained contact OR Two-way automatic, hold open, one-way exit, and off OR Two-way automatic, hold open, one-way exit, off, full open, and partial open, **as directed**.
 - c. Mounting: Recess mounted, semiflush in wall OR Recess mounted in door jamb OR Surface mounted on wall OR Surface mounted on post OR As indicated on Drawings, **as directed**.
10. Wireless or Remote Radio-Control Switch: Manufacturer's standard radio-control system consisting of header-mounted receiver and wall-mounted OR hand-held, battery-operated, **as directed**, transmitter switch.
 - a. Wall-Mounted Transmitter Switch: One red-button, momentary-contact actuator enclosed in **4-by-4-inch (100-by-100-mm)** junction box. Provide blue plastic cover engraved with "Press Button to Open" in white text and international symbol of accessibility.
11. Electrical Interlocks: Unless units are equipped with self-protecting devices or circuits, provide electrical interlocks to prevent activation of operator when door is locked, latched, or bolted.

G. Fabrication

1. Factory fabricate automatic door operators to comply with indicated standards.
2. Fabricate exterior components to drain water passing joints and condensation and moisture occurring or migrating within operator enclosure to the exterior.
3. Form aluminum shapes before finishing.
4. Use concealed fasteners to greatest extent possible. Where exposed fasteners are required, use countersunk Phillips flat-head machine screws, finished to match operator.
5. Provide metal cladding, completely cladding visible surfaces before shipment to Project site. Fabricate cladding with concealed fasteners and connection devices, with accurately fitted joints with ends coped or mitered to produce hairline joints free of burrs and distortion, and with allowance for thermal expansion at exterior doors.

H. Accessories

1. Signage: As required by cited BHMA standard for the type of operator.
 - a. Application Process: Decals OR Silk-screened OR Door manufacturer's standard process, **as directed**.
 - b. Provide sign materials with instructions for field application when operators are installed.
2. Guide Rails: Anodized aluminum OR Baked-enamel or powder-coated aluminum OR Stainless steel, **as directed**, fabricated from bars OR tubing, **as directed**, minimum **30 inches (762 mm)** high, and finished to match doors unless otherwise indicated; positioned and projecting from face of door jamb for distance as indicated, but not less than that required by BHMA A156.10 for type of door and direction of travel; with filler panel.
 - a. Filler Panel: Expanded aluminum mesh OR Polycarbonate plastic, **as directed**.

- 1) Orient expanded aluminum mesh with long dimension of diamonds parallel to top rail **OR** perpendicular to top rail **OR** horizontal **OR** vertical, **as directed**.
 - 2) Color: As selected from manufacturer's full range.
 - b. Provide intermediate guide rail suitable for supporting photoelectric beams.
 - c. Mounting: Jamb and floor **OR** Floor, freestanding, **as directed**.
- OR**
Guide Rails: See Division 05 Section(s) "Metal Fabrications" **OR** "Pipe And Tube Railings" **OR** "Decorative Metal", **as directed**.

I. General Finish Requirements

1. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
2. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
3. Apply organic and anodic finishes to formed metal after fabrication unless otherwise indicated.
4. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

J. Aluminum Finishes

1. Clear Anodic Finish: AAMA 611, AA-M12C22A41, Class I, 0.018 mm **OR** AA-M12C22A31, Class II, 0.010 mm, **as directed**, or thicker.
2. Color Anodic Finish: AAMA 611, AA-M12C22A42/A44, Class I, 0.018 mm **OR** AA-M12C22A32/A34, Class II, 0.010 mm, **as directed**, or thicker.
3. Baked-Enamel or Powder-Coat Finish: AAMA 2603. Comply with coating manufacturer's written instructions for cleaning, conversion coating, application, and baking.

1.3 EXECUTION

A. Installation

1. General: Install complete automatic door operators according to manufacturer's written instructions, including activation and safety devices, control wiring, and remote power units if any; connection to the building's power supply; and signage.
 - a. Do not install damaged components. Fit joints to produce hairline joints free of burrs and distortion.
 - b. Install operators true in alignment with established lines and door geometry without warp or rack. Anchor securely in place.
 - c. Power Door Operator Installation Standard: BHMA A156.10.
 - d. Low-Energy Door Operator Installation Standard: BHMA A156.19.
2. Power Connection: See Division 26 for connection to electrical power distribution system and see Division 22 for connection to compressed-air distribution piping, **as directed**.
3. Activation and Safety Devices: Install devices and wiring according to manufacturer's written instructions and cited BHMA standard for type of operator and direction of pedestrian travel. Connect activation- and safety-device wiring according to Division 26 Section "Low-voltage Electrical Power Conductors And Cables".
4. Access-Control System: Connect operators to access-control system as specified in Division 28 Section "Access Control".
5. Signage: Apply on both sides of each door as required by cited BHMA standard for type of door operator and direction of pedestrian travel.
6. Guide Rails: Install according to BHMA A156.10 including Appendix A and manufacturer's written instructions unless otherwise indicated.

B. Field Quality Control

1. Inspection: Engage Installer's certified inspector to test and inspect automatic door operators and prepare test and inspection reports.

- a. Certified inspector shall test and inspect each automatic door operator to determine compliance of installed systems with applicable BHMA standards.
- b. Inspection Report: Certified inspector shall submit report in writing to the Owner and Contractor within 24 hours after inspection.
2. Work will be considered defective if it does not pass tests and inspections.

C. Adjusting

1. Adjust automatic door operators to function smoothly, and lubricate as recommended by manufacturer; comply with requirements of applicable BHMA standards.
 - a. Adjust operators on exterior doors for weathertight closure.
2. After completing installation of exposed, factory-finished automatic door operators, inspect exposed finishes on doors and operators. Repair damaged finish to match original finish.
3. Readjust automatic door operators after repeated operation of completed installation equivalent to three days' use by normal traffic (100 to 300 cycles).
4. Occupancy Adjustment: When requested within 12 months of date of Final Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to two visits to Project during other-than-normal occupancy hours for this purpose.

END OF SECTION 08 71 13 00



Task	Specification	Specification Description
08 72 33 00	06 48 13 00	Wood Doors
08 72 33 00	08 05 13 00a	Flush Wood Doors
08 72 33 00	06 01 40 91	Door Hardware
08 72 43 00	06 01 40 91	Door Hardware
08 75 13 00	06 01 40 91	Door Hardware
08 75 13 00	08 71 13 00	Automatic Door Operators
08 78 00 00	08 71 11 00	Detention Door Hardware
08 81 23 13	07 42 13 19	Glazing
08 81 23 23	07 42 13 19	Glazing

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SECTION 08 83 13 00 - MIRRORS

1.1 GENERAL

A. Description Of Work

1. This specification covers the furnishing and installation of material for mirrors. Products shall be as follows or as directed by the Owner. Installation procedures shall be in accordance with the products manufacturer's recommendations. Demolition and removal of materials shall be as required to support the work.

B. Summary

1. Section includes the following types of silvered flat glass mirrors:
 - a. Annealed monolithic glass mirrors.
 - b. Film-backed, Laminated and Tempered glass mirrors qualifying as safety glazing.

C. Submittals

1. Product Data: For each type of product indicated.
 - a. Mirrors. Include description of materials and process used to produce each type of silvered flat glass mirror specified that indicates sources of glass, glass coating components, edge sealer, and quality-control provisions.
2. Shop Drawings: Include mirror elevations, edge details, mirror hardware, and attachments to other work.
3. Samples: For each type of the following products:
 - a. Mirrors: **12 inches (300 mm)** square, including edge treatment on two adjoining edges.
 - b. Mirror Clips: Full size.
 - c. Mirror Trim: **12 inches (300 mm)** long.
4. Qualification Data: For qualified Installer.
5. Product Certificates: For each type of mirror and mirror mastic, from manufacturer.
6. Preconstruction Test Reports: From mirror manufacturer indicating that mirror mastic was tested for compatibility and adhesion with mirror backing paint **OR** film, **as directed**, and substrates on which mirrors are installed.
7. Maintenance Data: For mirrors to include in maintenance manuals.
8. Warranty: Sample of special warranty.

D. Quality Assurance

1. Installer Qualifications: A qualified installer who employs glass installers for this Project who are certified under the National Glass Association's Certified Glass Installer Program.
2. Source Limitations for Mirrors: Obtain mirrors from single source from single manufacturer.
3. Source Limitations for Mirror Accessories: Obtain mirror glazing accessories from single source.
4. Glazing Publications: Comply with the following published recommendations:
 - a. GANA's "Glazing Manual" unless more stringent requirements are indicated. Refer to this publication for definitions of glass and glazing terms not otherwise defined in this Section or in referenced standards.
 - b. GANA Mirror Division's "Mirrors, Handle with Extreme Care: Tips for the Professional on the Care and Handling of Mirrors."
5. Safety Glazing Products: For film-backed, laminated and tempered mirrors, provide products complying with testing requirements in 16 CFR 1201 for Category II materials.
6. Preconstruction Mirror Mastic Compatibility Test: Submit mirror mastic products to mirror manufacturer for testing to determine compatibility of mastic with mirror backing paint **OR** film, **as directed**, and substrates on which mirrors are installed.

E. Delivery, Storage, And Handling

1. Protect mirrors according to mirror manufacturer's written instructions and as needed to prevent damage to mirrors from moisture, condensation, temperature changes, direct exposure to sun, or other causes.
2. Comply with mirror manufacturer's written instructions for shipping, storing, and handling mirrors as needed to prevent deterioration of silvering, damage to edges, and abrasion of glass surfaces and applied coatings. Store indoors.

F. Project Conditions

1. Environmental Limitations: Do not install mirrors until ambient temperature and humidity conditions are maintained at levels indicated for final occupancy.

G. Warranty

1. Special Warranty: Manufacturer's standard form in which mirror manufacturer agrees to replace mirrors that deteriorate within specified warranty period. Deterioration of mirrors is defined as defects developed from normal use that are not attributed to mirror breakage or to maintaining and cleaning mirrors contrary to manufacturer's written instructions. Defects include discoloration, black spots, and clouding of the silver film.
 - a. Warranty Period: Five years from date of Final Completion.

1.2 PRODUCTS

A. Silvered Flat Glass Mirrors

1. Glass Mirrors, General: ASTM C 1503; manufactured using copper-free, low-lead mirror coating process, **as directed**.
2. Clear Glass: Mirror Select **OR** Glazing, **as directed**, Quality; ultraclear (low-iron) float glass with a minimum 91 percent visible light transmission, **as directed**.
 - a. Nominal Thickness: 3.0 mm **OR** 4.0 mm **OR** 5.0 mm **OR** 6.0 mm **OR** As indicated, **as directed**.
3. Tinted Glass: Mirror Glazing Quality.
 - a. Nominal Thickness: 3.0 mm **OR** 4.0 mm **OR** 5.0 mm **OR** 6.0 mm **OR** As indicated, **as directed**.
 - b. Tint Color: Blue **OR** Black **OR** Bronze **OR** Gold **OR** Gray **OR** Green **OR** Peach **OR** Pink, **as directed**.
4. Tempered Clear **OR** Tinted, **as directed**, Glass: Mirror Glazing Quality, for blemish requirements; and comply with ASTM C 1048 for Kind FT, Condition A, tempered float glass before silver coating is applied.
 - a. Nominal Thickness: 3.0 mm **OR** 4.0 mm **OR** 5.0 mm **OR** 6.0 mm **OR** As indicated, **as directed**.
 - b. Tint Color: Blue **OR** Black **OR** Bronze **OR** Gold **OR** Gray **OR** Green **OR** Peach **OR** Pink, **as directed**.
5. Laminated Mirrors: ASTM C 1172, Kind LM.
 - a. Clear Glass for Outer Lite: Mirror Select **OR** Glazing, **as directed**, Quality; ultraclear (low-iron) float glass with a minimum 91 percent visible light transmission, **as directed**.
 - b. Tinted Glass for Outer Lite: Mirror Glazing Quality.
 - 1) Tint Color: Blue **OR** Black **OR** Bronze **OR** Gold **OR** Gray **OR** Green **OR** Peach **OR** Pink, **as directed**.
 - c. Nominal Thickness for Outer Lite: 3.0 mm **OR** 4.0 mm **OR** 5.0 mm **OR** 6.0 mm **OR** As indicated, **as directed**.
 - d. Glass for Inner Lite: Annealed float glass; ASTM C 1036, Type I (transparent flat glass), Quality-Q3; Class 1 (clear).
OR
Glass for Inner Lite: Heat-treated float glass; ASTM C 1048 Type I; Quality-Q3; Class I (clear) Kind HS, Condition A.
OR

Glass for Inner Lite: Tempered float glass; ASTM C 1048 Type I; Quality-Q3; Class I (clear), Kind FT, Condition A.

- e. Nominal Thickness for Inner Lite: 3.0 mm **OR** 4.0 mm **OR** 5.0 mm **OR** 6.0 mm **OR** As indicated, **as directed**.
- f. Interlayer: Mirror manufacturer's standard **0.030-inch- (0.76-mm-)** thick, clear polyvinyl-butyl interlayer with a proven record of showing no tendency to delaminate from, or cause damage to, silver coating.

B. Miscellaneous Materials

1. Setting Blocks: Elastomeric material with a Shore, Type A durometer hardness of 85, plus or minus 5.
2. Edge Sealer: Coating compatible with glass coating and approved by mirror manufacturer for use in protecting against silver deterioration at mirrored glass edges.
3. Mirror Mastic: An adhesive setting compound, asbestos-free, produced specifically for setting mirrors and certified by both mirror manufacturer and mastic manufacturer as compatible with glass coating and substrates on which mirrors will be installed.
4. Film Backing for Safety Mirrors: Film backing and pressure-sensitive adhesive; both compatible with mirror backing paint as certified by mirror manufacturer.

C. Mirror Hardware

1. Top and Bottom Aluminum J-Channels: Aluminum extrusions with a return deep enough to produce a glazing channel to accommodate mirrors of thickness indicated and in lengths required to cover bottom and top edges of each mirror in a single piece.
 - a. Bottom Trim: J-channels formed with front leg and back leg not less than **3/8 and 7/8 inch (9.5 and 22 mm)** in height, respectively, and a thickness of not less than **0.04 inch (1.0 mm) OR 0.05 inch (1.3 mm), as directed**.
 - b. Top Trim: J-channels formed with front leg and back leg not less than **5/8 and 1 inch (16 and 25 mm)** in height, respectively, and a thickness of not less than **0.04 inch (1.0 mm) OR 0.062 inch (1.57 mm), as directed**.
 - c. Finish: Clear **OR** Gold, **as directed**, bright anodized.
2. Top Channel/Cleat and Bottom Aluminum J-Channels: Aluminum extrusions with a return deep enough to produce a glazing channel to accommodate mirrors of thickness indicated and in lengths required to cover bottom and top edges of each mirror in a single piece.
 - a. Bottom Trim: J-channels formed with front leg and back leg not less than **5/16 and 3/4 inch (7.9 and 19 mm)** in height, respectively.
 - b. Top Trim: Formed with front leg with a height of **5/16 inch (7.9 mm)** and back leg designed to fit into the pocket created by wall-mounted aluminum cleat.
 - c. Finish: Clear **OR** Gold, **as directed**, bright anodized.
3. Mirror Bottom Clips: As indicated.
4. Mirror Top Clips: As indicated.
5. Plated Steel Hardware: Formed-steel shapes with plated finish indicated.
 - a. Profile: As indicated.
 - b. Finish: Selected from manufacturer's standards.
6. Fasteners: Fabricated of same basic metal and alloy as fastened metal and matching it in finished color and texture where fasteners are exposed.
7. Anchors and Inserts: Provide devices as required for mirror hardware installation. Provide toothed or lead-shield expansion-bolt devices for drilled-in-place anchors. Provide galvanized anchors and inserts for applications on inside face of exterior walls and where indicated.

D. Fabrication

1. Mirror Sizes: To suit Project conditions, and before tempering, **as directed**, cut mirrors to final sizes and shapes.
2. Cutouts: Fabricate cutouts before tempering, **as directed**, for notches and holes in mirrors without marring visible surfaces. Locate and size cutouts so they fit closely around penetrations in mirrors.

3. Mirror Edge Treatment: Flat polished **OR** Rounded polished **OR** Flat high-polished **OR** Rounded high-polished **OR** Beveled polished edge of width shown, **as directed**.
 - a. Seal edges of mirrors with edge sealer after edge treatment to prevent chemical or atmospheric penetration of glass coating.
 - b. Require mirror manufacturer to perform edge treatment and sealing in factory immediately after cutting to final sizes.
4. Film-Backed Safety Mirrors: Apply film backing with adhesive coating over mirror backing paint as recommended in writing by film-backing manufacturer to produce a surface free of bubbles, blisters, and other imperfections.

1.3 EXECUTION

A. Examination

1. Examine substrates, over which mirrors are to be mounted, with Installer present, for compliance with installation tolerances, substrate preparation, and other conditions affecting performance of the Work.
2. Verify compatibility with and suitability of substrates, including compatibility of mirror mastic with existing finishes or primers.
3. Proceed with installation only after unsatisfactory conditions have been corrected and surfaces are dry.

B. Preparation

1. Comply with mastic manufacturer's written installation instructions for preparation of substrates, including coating substrates with mastic manufacturer's special bond coating where applicable.

C. Installation

1. General: Install mirrors to comply with mirror manufacturer's written instructions and with referenced GANA publications. Mount mirrors accurately in place in a manner that avoids distorting reflected images.
2. Provide a minimum air space of **1/8 inch (3 mm)** between back of mirrors and mounting surface for air circulation between back of mirrors and face of mounting surface.
3. Wall-Mounted Mirrors: Install mirrors with mirror hardware **OR** mastic and mirror hardware, **as directed**. Attach mirror hardware securely to mounting surfaces with mechanical fasteners installed with anchors or inserts as applicable. Install fasteners so heads do not impose point loads on backs of mirrors.
 - a. Top and Bottom Aluminum J-Channels: Provide setting blocks **1/8 inch (3 mm)** thick by **4 inches (100 mm)** long at quarter points. To prevent trapping water, provide, between setting blocks, two slotted weeps not less than **1/4 inch (6.4 mm)** wide by **3/8 inch (9.5 mm)** long at bottom channel.
 - b. Top Channel/Cleat and Bottom Aluminum J-Channels: Fasten J-channel directly to wall and attach top trim to continuous cleat fastened directly to wall.
 - c. Mirror Clips: Place a felt or plastic pad between mirror and each clip to prevent spalling of mirror edges. Locate clips where indicated **OR** so they are symmetrically placed and evenly spaced, **as directed**.
 - d. Install mastic as follows:
 - 1) Apply barrier coat to mirror backing where approved in writing by manufacturers of mirrors and backing material.
 - 2) Apply mastic to comply with mastic manufacturer's written instructions for coverage and to allow air circulation between back of mirrors and face of mounting surface.
 - 3) After mastic is applied, align mirrors and press into place while maintaining a minimum air space of **1/8 inch (3 mm)** between back of mirrors and mounting surface.

D. Cleaning And Protection

1. Protect mirrors from breakage and contaminating substances resulting from construction operations.
2. Do not permit edges of mirrors to be exposed to standing water.
3. Maintain environmental conditions that will prevent mirrors from being exposed to moisture from condensation or other sources for continuous periods of time.
4. Wash exposed surface of mirrors not more than four days before date scheduled for inspections that establish date of Final Completion. Wash mirrors as recommended in writing by mirror manufacturer.

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Task	Specification	Specification Description
08 83 13 00	07 42 13 19	Glazing

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SECTION 08 84 00 00 - PLASTIC GLAZING

1.1 GENERAL

A. Description Of Work

1. This specification covers the furnishing and installation of material for plastic glazing. Products shall be as follows or as directed by the Owner. Installation procedures shall be in accordance with the products manufacturer's recommendations. Demolition and removal of materials shall be as required to support the work.

B. Summary

1. Section Includes:
 - a. Monolithic acrylic glazing.
 - b. Monolithic polycarbonate glazing.
 - c. Multiwalled structured polycarbonate glazing.

C. Performance Requirements

1. Provide plastic glazing sheets and glazing materials capable of withstanding normal temperature changes, wind, and impact loads without failure, including loss or breakage of plastic sheets attributable to the following: failure of sealants or gaskets to remain watertight and airtight, deterioration of plastic sheet and glazing materials, or other defects in materials and installation.
2. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes acting on plastic glazing and glazing framing members.
 - a. Temperature Change: 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.

D. Preconstruction Testing

1. Preconstruction Adhesion and Compatibility Testing: Test each plastic glazing type, tape sealant, gasket, glazing accessory, and glazing-framing member for adhesion to and compatibility with elastomeric glazing sealants.
 - a. Testing will not be required if data are submitted based on previous testing of current sealant products and plastic glazing matching those submitted.
 - b. Use ASTM C 1087 to determine whether priming and other specific joint-preparation techniques are required to obtain rapid, optimum adhesion of glazing sealants to glazing, tape sealants, gaskets, and glazing channel substrates.
 - c. Test no fewer than eight Samples of each type of material, including joint substrates, shims, sealant backings, secondary seals, and miscellaneous materials.
 - d. Schedule sufficient time for testing and analyzing results to prevent delaying the Work.
 - e. For materials failing tests, submit sealant manufacturer's written instructions for corrective measures including the use of specially formulated primers.

E. Submittals

1. Product Data: For each type of product indicated.
2. LEED Submittal:
 - a. Product Data for Credit EQ 4.1: For glazing sealants used inside the weatherproofing system, including printed statement of VOC content.
3. Plastic Glazing Samples: For each color and finish of plastic glazing indicated, 12 inches (300 mm) square and of same thickness indicated for final Work.
4. Glazing Accessory Samples: For gaskets and sealants, in 12-inch (300-mm) lengths. Install sealant Samples between two strips of material representative in color of the adjoining framing system, **as directed**.
5. Plastic Glazing Schedule: List plastic glazing types and thicknesses for each size opening and location. Use same designations indicated on Drawings. Indicate coordinated dimensions of

plastic glazing and construction that receives plastic glazing, including clearances and glazing channel dimensions.

6. Qualification Data: For installers, plastic glazing testing agency and sealant testing agency.
7. Product Certificates: For plastic glazing and glazing products, from manufacturer.
8. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for plastic glazing, glazing sealants and glazing gaskets.
 - a. For glazing sealants, provide test reports based on testing current sealant formulations within previous 36-month period.
9. Preconstruction adhesion and compatibility test report.
10. Research/Evaluation Reports: For plastic glazing.
11. Maintenance Data: For plastic glazing to include in maintenance manuals.
12. Warranty: Sample of special warranty.

F. Quality Assurance

1. Sealant Testing Agency Qualifications: An independent testing agency qualified according to ASTM C 1021 to conduct the testing indicated.
2. Source Limitations: Obtain plastic glazing from single source from single manufacturer. Obtain sealants and gaskets from single source from single manufacturer for each product and installation method.
3. Glazing Publication: Comply with published recommendations of plastic glazing manufacturers and with GANA's "Glazing Manual" unless more stringent requirements are indicated. Refer to this publication for definitions of glazing terms not otherwise defined in this Section or in other referenced standards.
4. Plastic Glazing Labeling: Identify plastic sheets with appropriate markings of applicable testing and inspecting agency, indicating compliance with required fire-test-response characteristics.
5. Safety Glazing Labeling: Where safety glazing labeling is indicated, permanently mark glazing with certification label of a certification agency acceptable to authorities having jurisdiction or manufacturer. Label shall indicate manufacturer's name, type of plastic glazing, thickness, and safety glazing standard with which glass complies.

G. Delivery, Storage, And Handling

1. Protect plastic glazing materials according to manufacturer's written instructions. Prevent damage to plastic glazing and glazing materials from condensation, temperature changes, direct exposure to sun, or other causes.
2. Maintain protective coverings on plastic glazing to avoid exposures to abrasive substances, excessive heat, and other sources of possible deterioration.

H. Project Conditions

1. Environmental Limitations: Do not proceed with glazing when ambient and substrate temperature conditions are outside limits permitted by glazing material manufacturers and when glazing channel substrates are wet from rain, frost, condensation, or other causes.
 - a. Do not install glazing sealants when ambient and substrate temperature conditions are outside limits permitted by sealant manufacturer or below 40 deg F (4.4 deg C).

I. Coordination

1. Coordinate dimensions of plastic glazing with dimensions of construction that receives plastic glazing to ensure that glazing channels provide adequate face and edge clearance, bite, and allowance for expansion.

J. Warranty

1. Manufacturer's Special Warranty for Abrasion- and UV-Resistant, Monolithic **OR** Multiwalled Structured, **as directed**, Polycarbonate: Manufacturer's standard form, made out to the Owner and signed by polycarbonate manufacturer, in which manufacturer agrees to replace polycarbonate products that break or develop defects from normal use that are attributable to manufacturing process and not to practices for maintaining and cleaning plastic glazing contrary

to manufacturer's written instructions. Defects include coating delamination, haze, excessive yellowing, and loss of light transmission beyond the limits stated in plastic glazing manufacturer's standard form.

- a. Warranty Period: Five years from date of Final Completion.

1.2 PRODUCTS

A. Plastic Glazing, General

1. Sizes: Fabricate plastic glazing to sizes required for openings indicated. Allow for thermal expansion and contraction of plastic glazing without restraint and without withdrawal of edges from frames, with edge clearances and tolerances complying with plastic glazing manufacturer's written instructions.
2. Fire-Test-Response Characteristics of Plastic Glazing: As determined by testing plastic glazing by a qualified testing agency acceptable to authorities having jurisdiction.
 - a. Self-ignition temperature of **650 deg F (343 deg C)** or higher when tested according to ASTM D 1929 on plastic sheets in thicknesses indicated for the Work.
 - b. Smoke-developed index of 450 or less when tested according to ASTM E 84, or smoke density of 75 or less when tested according to ASTM D 2843 on plastic sheets in thicknesses indicated for the Work.
 - c. Burning extent of **1 inch (25 mm)** or less when tested according to ASTM D 635 at a nominal thickness of **0.060 inch (1.52 mm)** or thickness indicated for the Work, where Class CC1 is indicated.
 - d. Burning rate of **2.5 in./min. (1.06 mm/s)** or less when tested according to ASTM D 635 at a nominal thickness of **0.060 inch (1.52 mm)** or thickness indicated for the Work, where Class CC2 is indicated.
 - e. Flame-spread index not less than that indicated when tested according to ASTM E 84.
3. Windborne-Debris-Impact Resistance: Provide exterior plastic glazing that passes basic **OR** enhanced, **as directed**, protection testing requirements in ASTM E 1996 for Wind Zone 1 **OR** Wind Zone 2 **OR** Wind Zone 3 **OR** Wind Zone 4, **as directed**, when tested according to ASTM E 1886. Test specimens shall be no smaller in width and length than plastic glazing indicated for use on Project and shall be installed in same manner as indicated for use on Project.
 - a. Large-Missile Test: For plastic glazing located within **30 feet (9.1 m)** of grade.
 - b. Small-Missile Test: For plastic glazing located more than **30 feet (9.1 m)** above grade.
OR
Large-Missile Test: For all plastic glazing, regardless of height above grade.

B. Monolithic Acrylic Glazing

1. Plastic Glazing: Transparent acrylic sheet; ASTM D 4802, Category A-1 (cell cast) **OR** Category A-2 (continuously cast) **OR** Category B-1 (continuously manufactured), **as directed**, Finish 1 (smooth or polished), Type UVF (UV filtering).
 - a. Nominal Thickness: **0.093 inch (2.5 mm) OR 0.118 inch (3 mm) OR 0.177 inch (4.5 mm) OR 0.236 inch (6 mm), as directed.**
 - b. Color: Colorless **OR** As selected from manufacturer's full range, **as directed.**
 - c. Combustibility Class: CC2.
 - d. Provide safety glazing labeling.
2. Plastic Glazing: Coated, transparent acrylic sheet; ASTM D 4802, Category A-1 (cell cast) **OR** Category B-1 (continuously manufactured), **as directed**, Finish 3 (abrasion-resistant coating) with coating on one side **OR** both sides, **as directed**, Type UVF (UV filtering).
 - a. Nominal Thickness: **0.093 inch (2.5 mm) OR 0.118 inch (3 mm) OR 0.177 inch (4.5 mm) OR 0.236 inch (6 mm), as directed.**
 - b. Color: Colorless **OR** As selected from manufacturer's full range, **as directed.**
 - c. Combustibility Class: CC2.
 - d. Provide safety glazing labeling.

3. Plastic Glazing: Translucent acrylic sheet; ASTM D 4802, Category A-1 (cell cast) **OR** Category B-1 (continuously manufactured), **as directed**, Finish 1 (smooth or polished), Type UVF (UV filtering).
 - a. Nominal Thickness: **0.093 inch (2.5 mm) OR 0.118 inch (3 mm) OR 0.177 inch (4.5 mm) OR 0.236 inch (6 mm), as directed.**
 - b. Color: White, with visible light transmittance of not more than 50 percent for **0.117-inch-(2.9-mm-)** thick sheet, measured according to ASTM D 1003 **OR** As selected from manufacturer's full range, **as directed.**
 - c. Combustibility Class: CC2.
 - d. Provide safety glazing labeling.
 4. Plastic Glazing: Patterned acrylic sheet; ASTM D 4802, Category A-1 (cell cast), Finish 2 (patterned), Type UVF (UV filtering).
 - a. Nominal Thickness: **0.093 inch (2.5 mm) OR 0.118 inch (3 mm) OR 0.177 inch (4.5 mm) OR 0.236 inch (6 mm), as directed.**
 - b. Pattern: Matte finish **OR** As selected from manufacturer's full range, **as directed.**
 - c. Color: Transparent colorless **OR** Translucent white **OR** As selected from manufacturer's full range, **as directed.**
 - d. Combustibility Class: CC2.
 - e. Provide safety glazing labeling.
- C. Monolithic Polycarbonate Glazing
1. Plastic Glazing: Polycarbonate sheet; ASTM C 1349, Appendix X1, Type I (standard, UV stabilized), with a polished finish.
 - a. Nominal Thickness: **0.093 inch (2.5 mm) OR 0.118 inch (3 mm) OR 0.177 inch (4.5 mm) OR 0.236 inch (6 mm), as directed.**
 - b. Color: Transparent colorless **OR** As selected from manufacturer's full range, **as directed.**
 - c. Combustibility Class: CC1.
 - d. Flame-Spread Index: **25 OR 75 OR 200, as directed**, or less.
 - e. Provide safety glazing labeling.
 2. Plastic Glazing: Coated polycarbonate sheet; ASTM C 1349, Appendix X1, Type II (coated mar-resistant, UV stabilized), with coating on both sides.
 - a. Nominal Thickness: **0.093 inch (2.5 mm) OR 0.118 inch (3 mm) OR 0.177 inch (4.5 mm) OR 0.236 inch (6 mm), as directed.**
 - b. Color: Transparent colorless **OR** As selected from manufacturer's full range, **as directed.**
 - c. Combustibility Class: CC1.
 - d. Flame-Spread Index: **25 OR 75 OR 200, as directed**, or less.
 - e. Provide safety glazing labeling.
- D. Multiwalled Structured Polycarbonate Glazing
1. Multiwalled Structured Polycarbonate Sheet: Manufacturer's standard polycarbonate extruded shape with smooth, flat exterior surfaces and internal ribbing.
 - a. Nominal Thickness: **5/16 inch (8 mm) OR 3/8 inch (10 mm) OR 5/8 inch (16 mm) OR 3/4 inch (20 mm) OR 1 inch (25 mm), as directed.**
 - b. Color: Transparent colorless **OR** As selected from manufacturer's full range, **as directed.**
 - c. Combustibility Class: CC1 **OR** CC2, **as directed.**
 - d. Flame-Spread Index: **25 OR 75 OR 200, as directed**, or less.
- E. Glazing Gaskets
1. Dense Compression Gaskets: Molded or extruded gaskets, EPDM, ASTM C 864 or silicone, ASTM C 1115; and of profile and hardness required to maintain watertight seal.
 2. Soft Compression Gaskets: Extruded or molded, closed-cell, integral-skinned EPDM or silicone gaskets complying with ASTM C 509, Type II, black; and of profile and hardness required to maintain watertight seal.
- F. Glazing Sealants

1. General:
 - a. Compatibility: Provide glazing sealants that are compatible with one another and with other materials they will contact, including plastic glazing products and glazing channel substrates, under conditions of service and application, as demonstrated by sealant manufacturer based on testing and field experience.
 - b. Suitability: Comply with sealant and glass manufacturers' written instructions for selecting glazing sealants suitable for applications indicated and for conditions existing at time of installation.
 - c. VOC Content: For sealants used inside the weatherproofing system, not more than 250 g/L when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 - d. Colors of Exposed Glazing Sealants: As indicated by manufacturer's designations **OR** As selected from manufacturer's full range, **as directed**.
2. Glazing Sealant: Neutral-curing silicone glazing sealant complying with ASTM C 920, Type S, Grade NS, Class 100/50, Use NT.
OR
Glazing Sealant: Neutral-curing silicone glazing sealant complying with ASTM C 920, Type S, Grade NS, Class 50, Use NT.
OR
Glazing Sealant: Neutral-curing silicone glazing sealant complying with ASTM C 920, Type S, Grade NS, Class 25, Use NT.
OR
Glazing Sealant: Acid-curing silicone glazing sealant complying with ASTM C 920, Type S, Grade NS, Class 25, Use NT.

G. Glazing Tapes

1. Back-Bedding Mastic Glazing Tapes: Preformed, butyl-based, 100 percent solids elastomeric tape; nonstaining and nonmigrating in contact with nonporous surfaces; with or without spacer rod as recommended in writing by tape and glass manufacturers for application indicated; and complying with ASTM C 1281 and AAMA 800 for products indicated below:
 - a. AAMA 804.3 tape, where indicated.
 - b. AAMA 806.3 tape, for glazing applications in which tape is subject to continuous pressure.
 - c. AAMA 807.3 tape, for glazing applications in which tape is not subject to continuous pressure.
2. Expanded Cellular Glazing Tapes: Closed-cell, PVC foam tapes; factory coated with adhesive on both surfaces; and complying with AAMA 800 for the following types:
 - a. AAMA 810.1, Type 1, for glazing applications in which tape acts as the primary sealant.
 - b. AAMA 810.1, Type 2, for glazing applications in which tape is used in combination with a full bead of liquid sealant.

H. Miscellaneous Glazing Materials

1. Compatibility: Provide products of material, size, and shape complying with requirements of manufacturers of plastic glazing and other glazing materials for application indicated, and with a proven record of compatibility with surfaces contacted in installation.
2. Cleaners, Primers, and Sealers: Types recommended by sealant or gasket manufacturer.
3. Setting Blocks: EPDM or silicone as required for compatibility with glazing sealant and plastic glazing, and of hardness recommended by plastic glazing manufacturer for application indicated.
4. Compressible Filler Rods: Closed cell of waterproof-jacketed rod stock of synthetic rubber or plastic foam, flexible and resilient, with **5- to 10-psi (35- to 70-kPa)** compression strength for 25 percent deflection.

1.3 EXECUTION

A. Examination

1. Examine plastic glazing framing, with glazing Installer present, for compliance with the following:

- a. Manufacturing and installation tolerances, including those for size, squareness, and offsets at corners.
 - b. Minimum required face or edge clearances.
 - c. Effective sealing between joints of plastic glazing framing members.
 2. Proceed with glazing only after unsatisfactory conditions have been corrected.
- B. Preparation
1. Clean glazing channels and other framing members immediately before glazing. Remove coatings not firmly bonded to substrates. Remove lacquer from metal surfaces where elastomeric sealants are indicated for use.
- C. Glazing, General
1. Comply with combined written instructions of manufacturers of plastic glazing materials, sealants, gaskets, and other glazing materials unless more stringent requirements are indicated, including those in referenced glazing publication.
 2. Glazing channel dimensions indicated on Drawings are designed to provide the necessary bite on plastic glazing, minimum edge and face clearances, and adequate sealant thicknesses, with reasonable tolerances. Adjust plastic glazing lites during installation to ensure that bite is equal on all sides.
 3. Sand or scrape cut edges of plastic glazing to provide smooth edges, free of chips and hairline cracks.
 4. Remove burrs and other projections from glazing channel surfaces.
 5. Protect plastic glazing surfaces from abrasion and other damage during handling and installation, according to the following requirements:
 - a. Retain plastic glazing manufacturer's protective covering or protect by other methods according to plastic glazing manufacturer's written instructions.
 - b. Remove covering at border of each piece before glazing; remove remainder of covering immediately after installation where plastic glazing will be exposed to sunlight or where other conditions make later removal difficult.
 - c. Remove damaged plastic glazing sheets from Project site and legally dispose of off-site. Damaged plastic glazing sheets are those containing imperfections that, when installed, result in weakened glazing and impaired performance and appearance.
 6. Apply primers to joint surfaces where required for adhesion of sealants, as determined by preconstruction sealant-substrate testing.
 7. Install elastomeric setting blocks in sill channels, sized and located to comply with referenced glazing publication, unless otherwise instructed by plastic glazing manufacturer. Set blocks in thin course of compatible sealant suitable for heel bead.
 8. Provide edge blocking to comply with referenced glazing publication unless otherwise instructed by plastic glazing manufacturer.
 9. Where wedge-shaped gaskets are driven into one side of channel to pressurize sealant or gasket on opposite side, provide adequate anchorage so gasket cannot walk out when installation is subjected to movement.
 10. Square cut wedge-shaped gaskets at corners and install gaskets as recommended in writing by gasket manufacturer to prevent corners from pulling away; seal corner and butt joints with sealant recommended by gasket manufacturer.
- D. Tape Glazing
1. Install tapes continuously, but not in one continuous length. Do not stretch tapes to make them fit opening.
 2. Cover vertical framing joints by applying tapes to heads and sills first and then to jambs. Cover horizontal framing joints by applying tapes to jambs and then to heads and sills.
 3. Place joints in tapes at corners of opening with adjoining lengths butted together, not lapped. Seal joints in tapes with compatible sealant recommended by tape manufacturer.
 4. Do not remove release paper from tape until immediately before each lite is installed.
 5. Apply heel bead of glazing sealant.

6. Center plastic glazing lites in openings on setting blocks and press firmly against tape by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and work toward centers of openings.
 7. Apply cap bead of glazing sealant over exposed edge of tape.
- E. Gasket Glazing (Dry)
1. Fabricate compression gaskets in lengths recommended in writing by gasket manufacturer to fit openings exactly, with allowance for stretch during installation.
 2. Insert soft compression gasket between plastic glazing and frame or fixed stop so it is securely in place with joints miter cut and bonded together at corners.
 3. Center plastic glazing lites in openings on setting blocks and press firmly against soft compression gasket by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and work toward centers of openings. Compress gaskets to produce a weathertight seal without developing bending stresses in plastic glazing. Seal gasket joints with sealant recommended by gasket manufacturer.
 4. Install gaskets so they protrude past face of glazing stops.
- F. Sealant Glazing (Wet)
1. Install continuous spacers between plastic glazing lites and glazing stops to maintain plastic glazing face clearances and to prevent sealant from extruding into glazing channel weep systems until sealants cure. Secure spacers in place and in position to control depth of installed sealant relative to edge clearance for optimum sealant performance.
 2. Force sealants into glazing channels to eliminate voids and to ensure complete wetting or bond of sealant to plastic glazing and channel surfaces.
 3. Tool exposed surfaces of sealants to provide a substantial wash away from plastic glazing.
- G. Protecting And Cleaning
1. Protect plastic glazing from contact with contaminating substances from construction operations. If, despite such protection, contaminating substances do come into contact with plastic glazing, remove immediately and wash plastic glazing according to plastic glazing manufacturer's written instructions.
 2. Remove and replace plastic glazing that is broken, chipped, cracked, abraded, or damaged in other ways during construction period, including natural causes, accidents, and vandalism.
 3. Wash plastic glazing on both faces before date scheduled for inspections intended to establish date of Final Completion in each area of Project. Wash plastic glazing according to plastic glazing manufacturer's written instructions.

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Task	Specification	Specification Description
08 85 00 00	08 44 13 00	Glazed Aluminum Curtain Walls
08 85 00 00	08 44 13 00a	Structural-Sealant-Glazed Curtain Walls
08 85 00 00	08 44 13 00b	Sloped Glazing Assemblies
08 87 13 00	07 42 13 19	Glazing

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SECTION 08 87 23 16 - FRAGMENT RETENTION FILM FOR GLASS

1.1 GENERAL

A. Description Of Work

1. This specification covers the furnishing and installation of fragment retention film for glass. Products shall match existing materials and/or shall be as follows or as directed by the Owner. Installation procedures shall be in accordance with the product manufacturer's recommendations. Demolition and removal of materials shall be as required to support the work.

B. Submittals

1. Product Data: For each type of product indicated.
2. Samples: For each type of product indicated.
3. Test Reports: Certified test reports including analysis and interpretation of test results. Each report shall identify the manufacturer, the specific product name, the film thickness, the adhesive type and thickness, and the glass type and thickness. Test reports shall clearly identify the methods used and shall include the results recorded.
4. Certificates: On applications where the film will contact the glazing beads or gaskets, a certificate from the Contractor stating that the glazing compounds and gaskets are compatible with the fragment retention film and adhesive.

C. Delivery, Storage, And Handling

1. Deliver, store, and handle in accordance with the manufacturer's recommendations. Glass, including glass in windows or doors, that has the film factory applied shall be stored in a dry location free of dust, water, and other contaminants. Glass with factory applied film shall be delivered, stored, and handled so that the film is not damaged, scratched, or abraded and shall be stored in a manner which permits easy access for inspection and handling. Each roll of film shall have a tamperproof label containing full details of the roll and the batch number.

D. Warranty

1. Provide a 5 year warranty for fragment retention film material. The warranty shall provide for replacement of film if cracking, crazing, peeling, or inadequate adhesion occurs.

1.2 PRODUCTS

- #### A. Standard Products:
- Fragment retention film shall be the standard product of a manufacturer regularly engaged in the manufacture of such products and shall essentially duplicate items that have been in satisfactory use for at least 2 years prior to bid opening.

- #### B. Fragment Retention Film:
- Fragment retention film shall be polyester, polyethylene terephthalate, or a composite. Fragment retention film shall be optically clear and free of waves, distortions, impurities, and adhesive lines. The film may be a single layer or laminated. Lamination of the film shall only occur at the factory of the fragment retention film manufacturer. The film shall include an abrasion resistant coating on the surface that does not receive the film adhesive. Fragment retention film shall be a minimum thickness of **0.004 inch (0.10 mm)**, as required to meet Project requirements, and shall be clear **OR** tinted, **OR** reflective, **as directed**. The film shall be supplied with an optically clear weatherable pressure sensitive adhesive. The adhesive shall contain ultraviolet inhibitors to protect the film for its required life and shall limit ultraviolet transmission to not more than 8 percent of the radiation between 300 and 380 nanometers. The adhesive shall not be water activated.

1. Impact Performance: Test fragment retention film for impact in accordance with ANSI Z97.1 or 16 CFR 1201.

2. Tensile Strength: The fragment retention film samples tested shall exhibit a minimum tensile strength at break of **25,000 psi (172.4 MPa)** when tested in accordance with ASTM D882, Method A.
3. Peel Strength: The fragment retention film shall exhibit a minimum peel strength of **5.3 pounds/inch (930 N/m)** for **0.004 inch (0.10 mm)** thick film when tested in accordance with ASTM D3330, Method A.
4. Surface Abrasion: The fragment retention film shall exhibit a change in haze not to exceed 3.2 percent following 100 turns, using 500-gram weights on a CS 10F abrasive wheel when tested in accordance with ASTM D1044.
5. Flame Spread and Smoke Density: The fragment retention film shall exhibit a flame spread index not exceeding 25 and a smoke density index not exceeding 100 when tested in accordance with ASTM E84.

1.3 EXECUTION

- A. Surface Preparation: The glass surface to which the fragment retention film is to be applied shall be cleaned of paint, foreign compounds, smears, and spatters. After the initial cleaning, the surface to receive the film shall be further cleaned in accordance with the film manufacturer's instructions.
- B. Application: Provide fragment retention film on window and door glass where indicated. After surface preparation, apply the fragment retention film in accordance with the manufacturer's recommendations and instructions. Apply film to the interior (room) side of the glass for both single and double glazed sheets, unless otherwise indicated. Multiple applications of film to achieve specified thicknesses will not be allowed. The film shall not be applied if there are visible dust particles in the air, if there is frost on the glazing, or if any room condition such as temperature and humidity do not meet the manufacturer's instructions. After film application, maintain room conditions as required by the manufacturer's instructions to allow for proper curing of the adhesive.
 1. Application to New Glass Before Glazing: Apply fragment retention film so that it extends edge to edge of the glass sheet. Set the film reinforced glass into the frame with glazing compounds or gaskets as specified in Division 08 Section "Glazing". When contact between the glazing compounds and/or gaskets and the film occurs, the Contractor shall ensure compatibility. The Contractor shall be responsible for delivery of the fragment retention film to the appropriate location for application. Coordinate fragment retention film application and curing with the glass supplier and window or door manufacturer prior to glazing installation.
 2. Application to Existing Glass Involving Dismantlement: Remove the existing glazing compound, gaskets, and/or stops as required to expose the existing glass pane. If necessary, remove the glass so that the film can be applied. Apply the film so that it extends edge to edge of the glass sheet. Install existing gaskets and/or stops and replace any removed glazing compounds with new glazing compounds. Scrap removed glazing compounds. Glazing compounds shall be in accordance with GANA Sealant Manual. Glazing methods shall be in accordance with GANA Glazing Manual. When contact between the glazing compounds and/or gaskets and the film occurs, the Contractor shall ensure compatibility. Replace and reinstall any damaged or broken glazing and gaskets in kind.
 3. Application to Existing Glass Without Dismantlement: Apply fragment retention film so that it extends to within **1/16-inch (1.6 mm)**, with a maximum of **1/8 inch (3 mm)**, of the edge of the visible glass area.
 4. Application to Existing Glass and Frame Without Dismantlement: Apply fragment retention film past the edge of the visible glass and extend onto the frame. Amount of film overlap, edge connection to the frame, and adhesive for adhering film to frame shall be as recommended by the film manufacturer. When contact between the glazing compounds and/or gaskets and the film occurs, the Contractor shall ensure compatibility.
 5. Splicing: Splices or seams in fragment retention film shall be permitted only when a sheet of glass has a dimension exceeding **58 inches (1.475 m)** in both directions. All seams shall be

applied with a minimum overlap of **1/4 inch (6 mm)** unless submitted test reports indicate impact performance is not diminished when seam is applied with a different overlap or a gap.

- C. Cleaning: Clean the fragment retention film in accordance with the manufacturer's instructions.

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SECTION 08 88 53 00 - SECURITY GLAZING

1.1 GENERAL

A. Description Of Work

1. This specification covers the furnishing and installation of material for security glazing. Products shall be as follows or as directed by the Owner. Installation procedures shall be in accordance with the products manufacturer's recommendations. Demolition and removal of materials shall be as required to support the work.

B. Summary

1. Section includes glazing for the following products and applications and of the following types:
 - a. Products and applications specified in other Sections where glazing requirements are specified by reference to this Section:
 - 1) Steel detention and Steel doors.
 - 2) Glazed entrances.
 - 3) Storefront framing.
 - 4) Interior borrowed lites.
 - 5) Glazed curtain walls.
 - 6) Sloped glazing.
 - 7) Security, Detention, Aluminum and Steel windows.
 - b. Security Glazing Types:
 - 1) Monolithic polycarbonate.
 - 2) Laminated glass.
 - 3) Laminated polycarbonate.
 - 4) Glass-clad polycarbonate.
 - 5) Laminated glass and polycarbonate.
 - 6) Insulating security glazing.
 - 7) Air-gap security glazing.

C. Definitions

1. Glazing Manufacturers: Firms that produce primary glass, monolithic plastic glazing, or fabricated security glazing, as defined in referenced glazing publications.
2. Interspace: Space between lites of air-gap security glazing or insulating security glazing.

D. Performance Requirements

1. General:
 - a. Installed security glazing shall withstand normal thermal movement and wind and impact loads (where applicable) without failure, including loss or breakage attributable to the following: defective manufacture, fabrication, or installation; failure of sealants or gaskets to remain watertight and airtight; deterioration of glazing; or other defects in construction.
 - b. Installed security glazing shall withstand security-related loads and forces without damage to the glazing beyond that allowed by referenced standards.
2. Delegated Design: Design security glazing, including comprehensive engineering analysis by a qualified professional engineer.
 - a. Design Procedure for Glass: Design according to ASTM E 1300 **OR** ICC's 2003 International Building Code, **as directed**.
 - b. Design Wind Pressures: As indicated on Drawings.
OR
Design Wind Pressures: Determine design wind pressures applicable to Project according to ASCE/SEI 7, based on heights above grade indicated on Drawings.
 - 1) Basic Wind Speed: **85 mph (38 m/s) OR 90 mph (40 m/s) OR 100 mph (44 m/s) OR 110 mph (49 m/s), as directed.**
 - 2) Importance Factor.

- 3) Exposure Category: **B OR C OR D, as directed.**
- c. Design Snow Loads: As indicated on Drawings **OR as directed.**
- d. Vertical Glazing: For glass surfaces sloped 15 degrees or less from vertical, design glass to resist design wind pressure based on glass type factors for short-duration load.
- e. Sloped Glazing: For glass surfaces sloped more than 15 degrees from vertical, design glass to resist each of the following combinations of loads:
 - 1) Outward design wind pressure minus the weight of the glass. Base design on glass type factors for short-duration load.
 - 2) Inward design wind pressure plus the weight of the glass plus half of the design snow load. Base design on glass type factors for short-duration load.
 - 3) Half of the inward design wind pressure plus the weight of the glass plus the design snow load. Base design on glass type factors for long-duration load.
- f. Probability of Breakage for Sloped Glazing: For glass surfaces sloped more than 15 degrees from vertical, design glass for a probability of breakage not greater than 0.001.
- g. Maximum Lateral Deflection: For glass supported on all four edges, limit center-of-glass deflection at design wind pressure to not more than 1/50 times the short-side length or **1 inch (25 mm)**, whichever is less.
3. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes acting on glazing framing members and glazing components.
 - a. Temperature Change: **120 deg F (67 deg C)**, ambient; **180 deg F (100 deg C)**, material surfaces.
- E. Preconstruction Testing
 1. Preconstruction Adhesion and Compatibility Testing: Test each security glazing type, tape sealant, gasket, glazing accessory, and glazing-framing member for adhesion to and compatibility with elastomeric glazing sealants.
 - a. Testing will not be required if data are submitted based on previous testing of current sealant products and glazing materials matching those submitted.
 - b. Use ASTM C 1087 to determine whether priming and other specific joint-preparation techniques are required to obtain rapid, optimum adhesion of glazing sealants to security glazing, tape sealants, gaskets, and glazing channel substrates.
 - c. Test no fewer than eight Samples of each type of material, including joint substrates, shims, sealant backings, secondary seals, and miscellaneous materials.
 - d. Schedule sufficient time for testing and analyzing results to prevent delaying the Work.
 - e. For materials failing tests, submit sealant manufacturer's written instructions for corrective measures including the use of specially formulated primers.
- F. Submittals
 1. Product Data: For each type of product indicated.
 2. LEED Submittal:
 - a. Product Data for Credit EQ 4.1: For glazing sealants used inside of the weatherproofing system, including printed statement of VOC content.
 3. Security Glazing Samples: For each type of security glazing; **12 inches (300 mm)** square.
 4. Glazing Accessory Samples: For gaskets, sealants and colored spacers, in **12-inch (300-mm)** lengths. Install sealant Samples between two strips of material representative in color of the adjoining framing system, **as directed.**
 5. Security Glazing Schedule: List security glazing types and thicknesses for each size opening and location. Use same designations indicated on Drawings. Indicate coordinated dimensions of security glazing and construction that receives security glazing, including clearances and glazing channel dimensions.
 6. Delegated-Design Submittal: For security glazing indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
 7. Qualification Data: For installers, manufacturers of insulating security glazing with sputter-coated, low-e coatings, glazing testing agency and sealant testing agency.

8. Product Certificates: For each type of product indicated, from manufacturer.
9. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for each type of security glazing, glazing sealant and glazing gasket.
 - a. For glazing sealants, provide test reports based on testing current sealant formulations within previous 36-month period.
10. Preconstruction adhesion and compatibility test reports.
11. Warranties: Sample of special warranties.

G. Quality Assurance

1. Manufacturer Qualifications for Insulating Security Glazing Units with Sputter-Coated, Low-E Coatings: A qualified insulating glazing manufacturer who is approved and certified, **as directed**, by coated-glass manufacturer.
2. Installer Qualifications: A qualified installer who employs glazing installers for this Project who are certified under the National Glass Association Glazier Certification Program.
3. Sealant Testing Agency Qualifications: An independent testing agency qualified according to ASTM C 1021 to conduct the testing indicated.
4. Source Limitations for Security Glazing: Obtain security glazing from single source from single manufacturer using the same type of lites, plies, interlayers, and spacers for each security glazing type indicated.
 - a. Source Limitations for Tinted Glass: Obtain tinted glass from single source from single primary glass manufacturer for each tint color indicated.
5. Source Limitations for Glazing Sealants and Gaskets: Obtain from single source from single manufacturer for each product and installation method.
6. Glazing Publications: Comply with published recommendations of security glazing and glazing material manufacturers and organizations below, unless more stringent requirements are indicated. Refer to these publications for glazing terms not otherwise defined in this Section or in referenced standards.
 - a. GANA Publications: GANA's "Laminated Glazing Reference Manual" and GANA's "Glazing Manual."
 - b. AAMA Publications: AAMA GDSG-1, "Glass Design for Sloped Glazing," and AAMA TIR-A7, "Sloped Glazing Guidelines."
 - c. IGMA Publication for Sloped Glazing: IGMA TB-3001, "Guidelines for Sloped Glazing."
 - d. IGMA Publication for Insulating Glass: SIGMA TM-3000, "North American Glazing Guidelines for Sealed Insulating Glass Units for Commercial and Residential Use."
7. Plastic Glazing Labeling: Identify plastic sheets with appropriate markings of applicable testing and inspecting agency, indicating compliance with required fire-test-response characteristics.
8. Safety Glazing Labeling: Where safety glazing labeling is indicated, permanently mark glazing with certification label of the SGCC **OR** another certification agency acceptable to authorities having jurisdiction **OR** manufacturer, **as directed**. Label shall indicate manufacturer's name, type of glazing, thickness, and safety glazing standard with which glazing complies.
9. Insulating Glazing Certification Program: Permanently marked either on spacers or on at least one component lite of units with appropriate certification label of IGCC.
10. Preinstallation Conference: Conduct conference at Project site.

H. Delivery, Storage, And Handling

1. Protect security glazing and glazing materials according to manufacturer's written instructions. Prevent damage from condensation, temperature changes, direct exposure to sun, or other causes.
2. Comply with insulating security glazing and with air-gap security glazing manufacturers' written recommendations for venting and sealing units to avoid hermetic seal ruptures due to altitude change.

I. Project Conditions

1. Environmental Limitations: Do not proceed with glazing when ambient and substrate temperature conditions are outside limits permitted by glazing material manufacturers and when glazing channel substrates are wet from rain, frost, condensation, or other causes.

- a. Do not install glazing sealants when ambient and substrate temperature conditions are outside limits permitted by sealant manufacturer or below **40 deg F (4.4 deg C)**.

J. Coordination

1. Coordinate dimensions, including thickness, of security glazing with dimensions of construction that receives security glazing.

K. Warranty

1. Manufacturer's Special Warranty for Coated Glass: Manufacturer's standard form in which coated-glass manufacturer agrees to replace coated glass that deteriorates within specified warranty period. Deterioration is defined as defects developed from normal use that are not attributed to glass breakage or to maintaining and cleaning coated glass contrary to manufacturer's written instructions. Defects include peeling, cracking, and other indications of deterioration in coating.
 - a. Warranty Period: 10 years from date of Final Completion.
2. Manufacturer's Special Warranty on Laminated Glass: Manufacturer's standard form in which laminated-glass manufacturer agrees to replace laminated glass that deteriorates within specified warranty period. Deterioration is defined as defects developed from normal use that are not attributed to glass breakage or to maintaining and cleaning laminated glass contrary to manufacturer's written instructions. Defects include edge separation, delamination materially obstructing vision through glass, and blemishes exceeding those allowed by referenced laminated-glass standard.
 - a. Warranty Period: Five **OR 10, as directed**, years from date of Final Completion.
3. Manufacturer's Special Warranty for Polycarbonate Sheet: Manufacturer's standard form in which glazing manufacturer agrees to replace polycarbonate sheet that deteriorates within specified warranty period. Deterioration is defined as defects developed from normal use that are not attributed to maintaining and cleaning polycarbonate sheet contrary to manufacturer's written instructions. Defects include yellowing and loss of light transmission.
 - a. Warranty Period: 10 years from date of Final Completion.
4. Manufacturer's Special Warranty for Laminated Polycarbonate: Manufacturer's standard form in which laminated polycarbonate manufacturer agrees to replace laminated polycarbonate that deteriorates within specified warranty period. Deterioration is defined as defects developed from normal use that are not attributed to maintaining and cleaning laminated polycarbonate contrary to manufacturer's written instructions. Defects include edge separation, delamination materially obstructing vision through glazing, blemishes exceeding those allowed by referenced standard, yellowing, and loss of light transmission.
 - a. Warranty Period: Five **OR 10, as directed**, years from date of Final Completion.
5. Manufacturer's Special Warranty for Glass-Clad Polycarbonate: Manufacturer's standard form in which glass-clad polycarbonate manufacturer agrees to replace glass-clad polycarbonate that deteriorates within specified warranty period. Deterioration is defined as defects developed from normal use that are not attributed to glass breakage or to maintaining and cleaning glass-clad polycarbonate contrary to manufacturer's written instructions. Defects include edge separation, delamination materially obstructing vision through glazing, blemishes exceeding those allowed by referenced glass-clad polycarbonate standard, yellowing, and loss of light transmission.
 - a. Warranty Period: Five **OR 10, as directed**, years from date of Final Completion.
6. Manufacturer's Special Warranty for Laminated Glass and Polycarbonate: Manufacturer's standard form in which laminated-glass-and-polycarbonate manufacturer agrees to replace laminated glass and polycarbonate that deteriorates within specified warranty period. Deterioration is defined as defects developed from normal use that are not attributed to glass breakage or to maintaining and cleaning laminated glass and polycarbonate contrary to manufacturer's written instructions. Defects include edge separation, delamination materially obstructing vision through glazing, blemishes exceeding those allowed by referenced glass-clad polycarbonate standard, yellowing, and loss of light transmission.
 - a. Warranty Period: Five **OR 10, as directed**, years from date of Final Completion.

7. Manufacturer's Special Warranty on Insulating Security Glazing: Manufacturer's standard form in which insulating security glazing manufacturer agrees to replace insulating security glazing that deteriorates within specified warranty period. Deterioration is defined as defects in individual lites developed from normal use or failure of hermetic seal under normal use. Deterioration does not include defects in individual lites or failure of hermetic seal that is attributed to glass breakage or to maintaining and cleaning insulating security glazing contrary to manufacturer's written instructions.
 - a. Defects in coated glass lites include peeling, cracking, and other indications of deterioration in coating.
 - b. Defects in laminated-glass lites include edge separation, delamination materially obstructing vision through glass, and blemishes exceeding those allowed by referenced laminated-glass standard.
 - c. Defects in glass-clad polycarbonate lites include edge separation, delamination materially obstructing vision through glazing, blemishes exceeding those allowed by referenced glass-clad polycarbonate standard, yellowing, and loss of light transmission.
 - d. Evidence of hermetic seal failure is the obstruction of vision by dust, moisture, or film on interior surfaces of glazing.
 - e. Warranty Period: Five **OR** 10, **as directed**, years from date of Final Completion.

1.2 PRODUCTS

A. Security Glazing, General

1. Thickness: Where thickness is indicated, it is a minimum. Provide security glazing in thicknesses as needed to comply with requirements indicated.
2. Thickness of Tinted Glass: Provide same thickness for each tint color indicated throughout Project.
3. Fire-Test-Response Characteristics of Plastic Sheets: As determined by testing plastic sheets identical to those used in security glazing products by a qualified testing agency acceptable to authorities having jurisdiction.
 - a. Self-ignition temperature of **650 deg F (343 deg C)** or more when tested per ASTM D 1929 on plastic sheets in thicknesses indicated for the Work.
 - b. Smoke-developed index of 450 or less when tested according to ASTM E 84, or smoke density of 75 or less when tested per ASTM D 2843 on plastic sheets in thicknesses indicated for the Work.
 - c. Burning extent of **1 inch (25 mm)** **OR** rate of **2.5 in./min. (1.06 mm/s)**, **as directed**, or less when tested per ASTM D 635 at a nominal thickness of **0.060 inch (1.52 mm)** or thickness indicated for the Work.
4. Windborne-Debris-Impact Resistance: Provide exterior security glazing that passes basic **OR** enhanced, **as directed**, -protection testing requirements in ASTM E 1996 for Wind Zone 1 **OR** Wind Zone 2 **OR** Wind Zone 3 **OR** Wind Zone 4, **as directed**, when tested according to ASTM E 1886. Test specimens shall be no smaller in width and length than security glazing indicated for use on the Project and shall be installed in same manner as indicated for use on the Project.
 - a. Large-Missile Test: For security glazing located within **30 feet (9.1 m)** of grade.
 - b. Small-Missile Test: For security glazing located more than **30 feet (9.1 m)** above grade.

OR

Large-Missile Test: For all security glazing, regardless of height above grade.
5. Thermal and Optical Performance Properties: Provide security glazing with performance properties specified, as indicated in manufacturer's published test data, based on products of construction indicated and on procedures indicated below:
 - a. U-Factors: Center-of-glazing values, according to NFRC 100 and based on LBL's WINDOW 5.2 computer program, expressed as **Btu/sq. ft. x h x deg F (W/sq. m x K)**.
 - b. Solar-Heat-Gain Coefficient and Visible Transmittance: Center-of-glazing values, according to NFRC 200 and based on LBL's WINDOW 5.2 computer program.
 - c. Visible Reflectance: Center-of-glazing values, according to NFRC 300.

B. Glass Products

1. Float Glass: ASTM C 1036, Type I, Quality-Q3, Class I (clear) unless otherwise indicated.
2. Heat-Treated Float Glass: ASTM C 1048; Type I; Quality-Q3; Class I (clear) unless otherwise indicated; of kind and condition indicated.
 - a. Fabrication Process: By horizontal (roller-hearth) process with roll-wave distortion parallel to bottom edge of glass as installed unless otherwise indicated.
 - b. For heat-strengthened float glass, comply with requirements for Kind HS.
 - c. For fully tempered float glass, comply with requirements for Kind FT.
 - d. For uncoated glass, comply with requirements for Condition A.
 - e. For coated vision glass, comply with requirements for Condition C (other coated glass).
3. Chemically Strengthened Glass: Annealed float glass chemically strengthened to comply with ASTM C 1422, Surface Compression Level 1 **OR** Level 2 **OR** Level 3 **OR** Level 4 **OR** Level 5, **as directed**, and Case Depth Level A **OR** Level B **OR** Level C **OR** Level D **OR** Level E **OR** Level F, **as directed**.
4. Reflective-Coated Vision Glass: ASTM C 1376, Kind CV (coated vision glass), coated by pyrolytic process **OR** vacuum deposition (sputter-coating) process, **as directed**, and complying with other requirements specified.

C. Laminated Glass

1. Laminated Glass: ASTM C 1172, and complying with testing requirements in 16 CFR 1201 for Category II materials, and with other requirements specified. Use materials that have a proven record of no tendency to bubble, discolor, or lose physical and mechanical properties after fabrication and installation.
 - a. Construction: Laminate glass with polyvinyl butyral interlayer or cast-in-place and cured-transparent-resin interlayer to comply with interlayer manufacturer's written recommendations.
 - b. Interlayer Thickness: Provide thickness not less than that indicated and as needed to comply with requirements.
 - c. Interlayer Color: Clear unless otherwise indicated.
2. Windborne-Debris-Impact-Resistant Laminated Glass: ASTM C 1172, and complying with testing requirements in 16 CFR 1201 for Category II materials, with "Windborne-Debris-Impact Resistance" Paragraph, and with other requirements specified.
 - a. Construction: Laminate glass with one of the following to comply with interlayer manufacturer's written recommendations:
 - 1) Polyvinyl butyral interlayer.
 - 2) Polyvinyl butyral interlayers reinforced with polyethylene terephthalate film.
 - 3) Ionoplast interlayer.
 - 4) Cast-in-place and cured-transparent-resin interlayer.
 - 5) Cast-in-place and cured-transparent-resin interlayer reinforced with polyethylene terephthalate film.
 - b. Interlayer Thickness: Provide thickness not less than that indicated and as needed to comply with requirements.
 - c. Interlayer Color: Clear unless otherwise indicated.

D. Polycarbonate Security Glazing

1. Polycarbonate Sheet: ASTM C 1349, Appendix X1, Type II, coated, mar-resistant, UV-stabilized polycarbonate with coating on exposed surfaces and Type I, standard, UV-stabilized polycarbonate where no surfaces are exposed.
2. Laminated Polycarbonate: Polycarbonate sheets laminated with clear urethane interlayer that complies with ASTM C 1349, Appendix X2, and has a proven record of no tendency to bubble, discolor, or lose physical and mechanical properties after fabrication and installation. Provide laminated units that comply with requirements of ASTM C 1349 for maximum allowable laminating process blemishes and haze.
3. Glass-Clad Polycarbonate: ASTM C 1349, and other requirements specified.

- a. Provide glass-clad polycarbonate that complies with testing requirements in 16 CFR 1201 for Category II materials, and with other requirements specified.
 - 4. Laminated Glass and Polycarbonate: ASTM C 1349, and other requirements specified.
 - a. Provide laminated glass and polycarbonate that complies with testing requirements in 16 CFR 1201 for Category II materials, and with other requirements specified.
- E. Spall-Resistant Film
 - 1. Spall-Resistant Film: Composite of clear polyvinyl butyral film and clear abrasion-resistant polyester film.
 - 2. Laminating Process: Laminate spall-resistant film to glazing assemblies in factory to produce laminated lites free of foreign substances, air, and glass pockets.
- F. Insulating Security Glazing
 - 1. Insulating Security Glazing: Factory-assembled units consisting of sealed lites separated by a dehydrated interspace, qualified according to ASTM E 2190, and complying with other requirements specified.
 - a. Sealing System: Dual seal, with manufacturer's standard **OR** polyisobutylene and polysulfide **OR** polyisobutylene and silicone **OR** polyisobutylene and hot-melt butyl **OR** polyisobutylene and polyurethane, **as directed**, primary and secondary.
 - b. Spacer: Manufacturer's standard spacer material and construction **OR** Aluminum with mill or clear anodic finish **OR** Aluminum with black, color anodic finish **OR** Aluminum with bronze, color anodic finish **OR** Aluminum with powdered metal paint finish in color selected **OR** Galvanized steel **OR** Stainless steel **OR** Polypropylene-covered stainless steel in color selected **OR** Thermally broken aluminum **OR** Nonmetallic laminate **OR** Nonmetallic tube, **as directed**.
 - c. Desiccant: Molecular sieve or silica gel, or blend of both.
- G. Air-Gap Security Glazing
 - 1. Air-Gap Security Glazing: Factory-assembled units consisting of sealed lites separated by a dehydrated interspace and complying with other requirements specified.
 - a. Sealing System: Dual seal, with manufacturer's standard primary and secondary sealants.
 - b. Spacer Specifications: Manufacturer's standard rigid, **as directed**, spacer material and construction.
- H. Glazing Gaskets
 - 1. Dense Compression Gaskets: Molded or extruded gaskets of profile and hardness required to maintain watertight seal, made from one of the following:
 - a. Neoprene complying with ASTM C 864.
 - b. EPDM complying with ASTM C 864.
 - c. Silicone complying with ASTM C 1115.
 - d. Thermoplastic polyolefin rubber complying with ASTM C 1115.
 - 2. Soft Compression Gaskets: Extruded or molded, closed-cell, integral-skinned neoprene, EPDM, silicone or thermoplastic polyolefin rubber gaskets complying with ASTM C 509, Type II, black; of profile and hardness required to maintain watertight seal.
 - a. Application: Use where soft compression gaskets will be compressed by inserting dense compression gaskets on opposite side of glazing or pressure applied by means of pressure-glazing stops on opposite side of glazing.
- I. Glazing Sealants
 - 1. General:
 - a. Compatibility: Provide glazing sealants that are compatible with one another and with other materials they will contact, including security glazing, seals of insulating security glazing and air-gap security glazing, and glazing channel substrates, under conditions of service and application, as demonstrated by sealant manufacturer based on testing and field experience.

- b. Suitability: Comply with sealant and security glazing manufacturers' written instructions for selecting glazing sealants suitable for applications indicated and for conditions existing at time of installation.
 - c. VOC Content: For sealants used inside of the weatherproofing system, not more than 250 g/L when calculated according to 40 CFR 59, Subpart D.
 - d. Colors of Exposed Glazing Sealants: As indicated by manufacturer's designations **OR** As selected from manufacturer's full range, **as directed**.
 2. Glazing Sealant: Neutral-curing silicone glazing sealant complying with ASTM C 920, Type S, Grade NS, Class 100/50, Use NT.
 3. Glazing Sealant: Neutral-curing silicone glazing sealant complying with ASTM C 920, Type S, Grade NS, Class 50, Use NT.
 4. Glazing Sealant: Neutral-curing silicone glazing sealant complying with ASTM C 920, Type S, Grade NS, Class 25, Use NT.
 5. Glazing Sealant: Acid-curing silicone glazing sealant complying with ASTM C 920, Type S, Grade NS, Class 25, Use NT.
- J. Glazing Tapes
1. Back-Bedding Mastic Glazing Tapes: Preformed, butyl-based, 100 percent solids elastomeric tape; nonstaining and nonmigrating in contact with nonporous surfaces; with or without spacer rod as recommended in writing by tape and security glazing manufacturers for application indicated; and complying with ASTM C 1281 and AAMA 800 for products indicated below:
 - a. AAMA 806.3 tape, for glazing applications in which tape is subject to continuous pressure.
 - b. AAMA 807.3 tape, for glazing applications in which tape is not subject to continuous pressure.
 2. Expanded Cellular Glazing Tapes: Closed-cell, PVC foam tapes; factory coated with adhesive on both surfaces; and complying with AAMA 800 for the following types:
 - a. AAMA 810.1, Type 1, for glazing applications in which tape acts as the primary sealant.
 - b. AAMA 810.1, Type 2, for glazing applications in which tape is used in combination with a full bead of liquid sealant.
- K. Miscellaneous Glazing Materials
1. General: Provide products of material, size, and shape complying with referenced glazing standard, requirements of manufacturers of security glazing and other glazing materials for application indicated, and with a proven record of compatibility with surfaces contacted in installation.
 2. Cleaners, Primers, and Sealers: Types recommended by sealant or gasket manufacturer.
 3. Setting Blocks: Elastomeric material with a Shore, Type A durometer hardness of 85, plus or minus 5.
 4. Spacers: Elastomeric blocks or continuous extrusions of hardness required by security glazing manufacturer to maintain security glazing lites in place for installation indicated.
 5. Edge Blocks: Elastomeric material of hardness needed to limit security glazing lateral movement (side walking).
 6. Cylindrical Glazing Sealant Backing: ASTM C 1330, Type O (open-cell material), of size and density to control glazing sealant depth and otherwise produce optimum glazing sealant performance.
- L. Fabrication Of Security Glazing
1. Fabricate security glazing in sizes required to fit openings indicated for Project, with edge and face clearances, edge and surface conditions, and bite complying with written instructions of product manufacturer and referenced glazing publications, to comply with system performance requirements.
- M. Laminated-Glass Security Glazing Types
1. Security Glazing: Clear laminated glass **OR** Tinted laminated glass **OR** Clear reflective-coated laminated glass **OR** Tinted reflective-coated laminated glass, **as directed**.

- a. Forced-Entry Resistance: Class I **OR** Class II **OR** Class III **OR** Class IV **OR** Class V, **as directed**, per ASTM F 1233.
OR
Forced-Entry Resistance: Level I **OR** Level II **OR** Level III **OR** Level IV **OR** Level V, **as directed**, per HPW-TP-0500.03.
- b. Ballistic Resistance: Class/Level HG1 **OR** Class/Level HG2 **OR** Class/Level HG3 **OR** Class/Level HG4 **OR** Class/Level SMG **OR** Class/Level R1 **OR** Class/Level R2 **OR** Class/Level R3 **OR** Class/Level R4-AP **OR** Class/Level SH1 **OR** Class/Level SH2, **as directed**, per ASTM F 1233.
OR
Ballistic Resistance: Level 1 **OR** Level 2 **OR** Level 3 **OR** Level 4 **OR** Level 5 **OR** Level 6 **OR** Level 7 **OR** Level 8 **OR** Level 1-SG **OR** Level 2-SG **OR** Level 3-SG **OR** Level 4-SG **OR** Level 5-SG **OR** Level 6-SG **OR** Level 7-SG **OR** Level 8-SG, **as directed**, per UL 752.
- c. Blast Resistance:
 - 1) Hazard Rating: No hazard **OR** Minimal hazard **OR** Very low hazard **OR** Low hazard **OR** High hazard, **as directed**, per ASTM F 1642.
OR
Performance Condition: 1 **OR** 2 **OR** 3a **OR** 3b **OR** 4 **OR** 5, **as directed**, per GSA-TS01.
 - 2) Peak Pressure: as directed by the Owner.
 - 3) Positive Phase Impulse: as directed by the Owner.
- d. Number of Plies: Two **OR** Three, **as directed**.
- e. Overall Unit Thickness: as directed by the Owner.
- f. Outer Ply: 3-mm **OR** 5-mm **OR** 6-mm, **as directed**, float glass **OR** heat-strengthened float glass **OR** fully tempered float glass **OR** chemically strengthened float glass, **as directed**.
- g. Core Ply: 3-mm **OR** 5-mm **OR** 6-mm, **as directed**, float glass **OR** heat-strengthened float glass **OR** fully tempered float glass **OR** chemically strengthened float glass, **as directed**.
- h. Inner Ply: 3-mm **OR** 5-mm **OR** 6-mm, **as directed**, float glass **OR** heat-strengthened float glass **OR** fully tempered float glass **OR** chemically strengthened float glass, **as directed**.
- i. Interlayer Thickness: 0.030 inch (0.76 mm) **OR** 0.060 inch (1.52 mm) **OR** 0.090 inch (2.3 mm), **as directed**.
- j. Glass Tint Color: Blue **OR** Blue-green **OR** Bronze **OR** Green **OR** Gray **as directed**.
- k. Tinted Glass Location: Outer ply.
- l. Coating Color: Gold **OR** Pewter **OR** Silver, **as directed**.
- m. Coating Location: Second **OR** Third **OR** Fifth, **as directed**, surface.
- n. Overall Visible Light Transmittance: as directed by the Owner.
- o. Outdoor Visible Reflectance: as directed by the Owner. Winter Nighttime U-Factor: as directed by the Owner.
- p. Summer Daytime U-Factor: as directed by the Owner.
- q. Solar Heat-Gain Coefficient: as directed by the Owner.
- r. Provide safety glazing labeling.
2. Security Glazing: Tinted reflective-coated, **as directed**, laminated glass with clear glass and tinted interlayer.
 - a. Forced-Entry Resistance: Class I **OR** Class II **OR** Class III **OR** Class IV **OR** Class V, **as directed**, per ASTM F 1233.
OR
Forced-Entry Resistance: Level I **OR** Level II **OR** Level III **OR** Level IV **OR** Level V, **as directed**, per HPW-TP-0500.03.
 - b. Ballistic Resistance: Class/Level HG1 **OR** Class/Level HG2 **OR** Class/Level HG3 **OR** Class/Level HG4 **OR** Class/Level SMG **OR** Class/Level R1 **OR** Class/Level R2 **OR** Class/Level R3 **OR** Class/Level R4-AP **OR** Class/Level SH1 **OR** Class/Level SH2, **as directed**, per ASTM F 1233.
OR
Ballistic Resistance: Level 1 **OR** Level 2 **OR** Level 3 **OR** Level 4 **OR** Level 5 **OR** Level 6 **OR** Level 7 **OR** Level 8 **OR** Level 1-SG **OR** Level 2-SG **OR** Level 3-SG **OR** Level 4-SG **OR** Level 5-SG **OR** Level 6-SG **OR** Level 7-SG **OR** Level 8-SG, **as directed**, per UL 752.

- c. Blast Resistance:
 - 1) Hazard Rating: No hazard **OR** Minimal hazard **OR** Very low hazard **OR** Low hazard **OR** High hazard, **as directed**, per ASTM F 1642.
OR
Performance Condition: 1 **OR** 2 **OR** 3a **OR** 3b **OR** 4 **OR** 5, **as directed**, per GSA-TS01.
 - 2) Peak Pressure: as directed by the Owner.
 - 3) Positive Phase Impulse: as directed by the Owner.
 - d. Number of Plies: Two **OR** Three, **as directed**.
 - e. Overall Unit Thickness: as directed by the Owner.
 - f. Outer Ply: 3-mm **OR** 5-mm **OR** 6-mm, **as directed**, float glass **OR** heat-strengthened float glass **OR** fully tempered float glass **OR** chemically strengthened float glass, **as directed**.
 - g. Core Ply: 3-mm **OR** 5-mm **OR** 6-mm, **as directed**, float glass **OR** heat-strengthened float glass **OR** fully tempered float glass **OR** chemically strengthened float glass, **as directed**.
 - h. Inner Ply: 3-mm **OR** 5-mm **OR** 6-mm, **as directed**, float glass **OR** heat-strengthened float glass **OR** fully tempered float glass **OR** chemically strengthened float glass, **as directed**.
 - i. Interlayer Thickness: 0.030 inch (0.76 mm) **OR** 0.060 inch (1.52 mm) **OR** 0.090 inch (2.3 mm), **as directed**.
 - j. Interlayer Color: Clear **OR** Blue-green **OR** Bronze light **OR** Gray, **as directed**.
 - k. Coating Color: Gold **OR** Pewter **OR** Silver, **as directed**.
 - l. Coating Location: Second **OR** Third **OR** Fifth, **as directed**, surface.
 - m. Overall Visible Light Transmittance: as directed by the Owner.
 - n. Outdoor Visible Reflectance: as directed by the Owner. Winter Nighttime U-Factor: as directed by the Owner.
 - o. Summer Daytime U-Factor: as directed by the Owner.
 - p. Solar Heat-Gain Coefficient: as directed by the Owner. Provide safety glazing labeling.
- N. Monolithic Polycarbonate Security Glazing Types
- 1. Security Glazing: Monolithic polycarbonate with mar-resistant coating on both surfaces.
 - a. Detention Security Grade: Grade 4 per ASTM F 1915 cold-temperature impact test **OR** warm-temperature impact test **OR** torch and small blunt impactor test, **as directed**.
OR
Thickness: 3/8 inch (9.25 mm) **OR** 1/2 inch (12.7 mm), **as directed**.
- O. Laminated-Polycarbonate Security Glazing Types
- 1. Security Glazing: Laminated polycarbonate.
 - a. Detention Security Grade: Grade 1 **OR** Grade 2 **OR** Grade 3 **OR** Grade 4, **as directed**, per ASTM F 1915 cold-temperature impact test **OR** warm-temperature impact test **OR** torch and small blunt impactor test, **as directed**.
 - b. Forced-Entry Resistance: Class I **OR** Class II **OR** Class III **OR** Class IV **OR** Class V, **as directed**, per ASTM F 1233.
OR
Forced-Entry Resistance: Level I **OR** Level II **OR** Level III **OR** Level IV **OR** Level V, **as directed**, per HPW-TP-0500.03.
 - c. Blast Resistance:
 - 1) Hazard Rating: No hazard **OR** Minimal hazard **OR** Very low hazard **OR** Low hazard **OR** High hazard, **as directed**, per ASTM F 1642.
OR
Performance Condition: 1 **OR** 2 **OR** 3a **OR** 3b **OR** 4 **OR** 5, **as directed**, per GSA-TS01.
 - 2) Peak Pressure: as directed by the Owner.
 - 3) Positive Phase Impulse: as directed by the Owner.
 - d. Number of Plies: Two **OR** Three **OR** Four, **as directed**.
 - e. Overall Unit Thickness: as directed by the Owner.

- f. Outer and Inner Plies: **0.118-inch (4.57-mm) OR 0.177-inch (2.97-mm) OR 0.236-inch (5.99-mm), as directed**, polycarbonate.
- g. Core Ply **OR** Core Plies, **as directed**: **0.118-inch (4.57-mm) OR 0.177-inch (2.97-mm) OR 0.236-inch (5.99-mm), as directed**, polycarbonate.
- h. Interlayer Thicknesses: **0.025 inch (0.635 mm)**.

P. Glass-Clad Polycarbonate Security Glazing Types

1. Security Glazing: Clear symmetrical glass-clad polycarbonate **OR** Tinted symmetrical glass-clad polycarbonate **OR** Clear reflective-coated symmetrical glass-clad polycarbonate **OR** Tinted reflective-coated symmetrical glass-clad polycarbonate, **as directed**.
 - a. Detention Security Grade: Grade 1 **OR** Grade 2 **OR** Grade 3 **OR** Grade 4, **as directed**, per ASTM F 1915 cold-temperature impact test **OR** warm-temperature impact test **OR** torch and small blunt impactor test, **as directed**.
 - b. Forced-Entry Resistance: Class I **OR** Class II **OR** Class III **OR** Class IV **OR** Class V, **as directed**, per ASTM F 1233.
OR
Forced-Entry Resistance: Level I **OR** Level II **OR** Level III **OR** Level IV **OR** Level V, **as directed**, per HPW-TP-0500.03.
 - c. Ballistic Resistance: Class/Level HG1 **OR** Class/Level HG2 **OR** Class/Level HG3 **OR** Class/Level HG4 **OR** Class/Level SMG **OR** Class/Level R1 **OR** Class/Level R2 **OR** Class/Level R3 **OR** Class/Level R4-AP **OR** Class/Level SH1 **OR** Class/Level SH2, **as directed**, per ASTM F 1233.
OR
Ballistic Resistance: Level 1 **OR** Level 2 **OR** Level 3 **OR** Level 4 **OR** Level 5 **OR** Level 6 **OR** Level 7 **OR** Level 8 **OR** Level 1-SG **OR** Level 2-SG **OR** Level 3-SG **OR** Level 4-SG **OR** Level 5-SG **OR** Level 6-SG **OR** Level 7-SG **OR** Level 8-SG, **as directed**, per UL 752.
 - d. Blast Resistance:
 - 1) Hazard Rating: No hazard **OR** Minimal hazard **OR** Very low hazard **OR** Low hazard **OR** High hazard, **as directed**, per ASTM F 1642.
OR
Performance Condition: 1 **OR** 2 **OR** 3a **OR** 3b **OR** 4 **OR** 5, **as directed**, per GSA-TS01.
 - 2) Peak Pressure: as directed by the Owner.
 - 3) Positive Phase Impulse: as directed by the Owner.
 - e. Overall Unit Thickness: as directed by the Owner. Outer Ply: 3-mm **OR** 5-mm **OR** 6-mm, **as directed**, heat-strengthened **OR** chemically strengthened, **as directed**, float glass.
 - f. Single Core: **0.118-inch (4.57-mm) OR 0.177-inch (2.97-mm) OR 0.236-inch (5.99-mm), as directed**, polycarbonate.
OR
Multiple Core:
 - 1) Outer Core Ply: **0.118-inch (4.57-mm) OR 0.177-inch (2.97-mm) OR 0.236-inch (5.99-mm), as directed**, polycarbonate.
 - 2) Single Inner Core Ply **OR** Double Inner Core Plies, **as directed**: **0.118-inch (4.57-mm) OR 0.177-inch (2.97-mm) OR 0.236-inch (5.99-mm), as directed**, polycarbonate.
 - g. Inner Ply: 3-mm **OR** 5-mm **OR** 6-mm, **as directed**, heat-strengthened **OR** chemically strengthened, **as directed**, float glass.
 - h. Interlayer Thickness: **0.025 inch (0.635 mm) OR 0.050 inch (0.127 mm), as directed**.
 - i. Glass Tint Color: Blue **OR** Blue-green **OR** Bronze **OR** Green **OR** Gray, **as directed**.
 - j. Tinted Glass Location: Outer ply.
 - k. Coating Color: Gold **OR** Pewter **OR** Silver, **as directed**.
 - l. Coating Location: Second **OR** Third **OR** Fifth, **as directed**, surface.
 - m. Overall Visible Light Transmittance: as directed by the Owner.
 - n. Outdoor Visible Reflectance: as directed by the Owner.
 - o. Winter Nighttime U-Factor: as directed by the Owner.
 - p. Summer Daytime U-Factor: as directed by the Owner.

- q. Solar Heat-Gain Coefficient: as directed by the Owner.
- r. Provide safety glazing labeling.

Q. Laminated-Glass-And-Polycarbonate Security Glazing Types

1. Security Glazing: Nonsymmetrical clear **OR** tinted **OR** reflective-coated, **as directed**, laminated glass and polycarbonate with glass plies on the attack or threat side and polycarbonate plies on the witness side.
 - a. Detention Security Grade: Grade 1 **OR** Grade 2 **OR** Grade 3 **OR** Grade 4, **as directed**, per ASTM F 1915 cold-temperature impact test **OR** warm-temperature impact test **OR** torch and small blunt impactor test, **as directed**.
 - b. Forced-Entry Resistance: Class I **OR** Class II **OR** Class III **OR** Class IV **OR** Class V, **as directed**, per ASTM F 1233.
OR
Forced-Entry Resistance: Level I **OR** Level II **OR** Level III **OR** Level IV **OR** Level V, **as directed**, per HPW-TP-0500.03.
 - c. Ballistic Resistance: Class/Level HG1 **OR** Class/Level HG2 **OR** Class/Level HG3 **OR** Class/Level HG4 **OR** Class/Level SMG **OR** Class/Level R1 **OR** Class/Level R2 **OR** Class/Level R3 **OR** Class/Level R4-AP **OR** Class/Level SH1 **OR** Class/Level SH2, **as directed**, per ASTM F 1233.
OR
Ballistic Resistance: Level 1 **OR** Level 2 **OR** Level 3 **OR** Level 4 **OR** Level 5 **OR** Level 6 **OR** Level 7 **OR** Level 8 **OR** Level 1-SG **OR** Level 2-SG **OR** Level 3-SG **OR** Level 4-SG **OR** Level 5-SG **OR** Level 6-SG **OR** Level 7-SG **OR** Level 8-SG, **as directed**, per UL 752.
 - d. Blast Resistance:
 - 1) Hazard Rating: No hazard **OR** Minimal hazard **OR** Very low hazard **OR** Low hazard **OR** High hazard, **as directed**, per ASTM F 1642.
OR
Performance Condition: 1 **OR** 2 **OR** 3a **OR** 3b **OR** 4 **OR** 5, **as directed**, per GSA-TS01.
 - 2) Peak Pressure: as directed by the Owner.
 - 3) Positive Phase Impulse: as directed by the Owner.
 - e. Overall Unit Thickness: as directed by the Owner.
 - f. Makeup:
 - 1) Outer Glass Ply: 3-mm heat-strengthened float glass.
 - 2) Interlayer Thickness: 0.025 inch (0.635 mm) **OR** 0.050 inch (0.127 mm), **as directed**.
 - 3) First Inner Glass Ply: 12-mm, **as directed**, float glass.
 - 4) Interlayer Thickness: 0.025 inch (0.635 mm) **OR** 0.050 inch (0.127 mm), **as directed**.
 - 5) Second Inner Glass Ply: 10-mm, **as directed**, float glass.
 - 6) Interlayer Thickness: 0.025 inch (0.635 mm) **OR** 0.050 inch (0.127 mm), **as directed**.
 - 7) Inner Polycarbonate Ply: 0.118-inch (4.57-mm) **OR** 0.177-inch (2.97-mm) **OR** 0.236-inch (5.99-mm), **as directed**, Type I (standard, UV-stabilized) polycarbonate.
 - 8) Interlayer Thickness: 0.025 inch (0.635 mm) **OR** 0.050 inch (0.127 mm), **as directed**.
 - 9) Outer Polycarbonate Ply: 0.118-inch (4.57-mm) **OR** 0.177-inch (2.97-mm) **OR** 0.236-inch (5.99-mm), **as directed**, Type II (coated, mar-resistant, UV-stabilized) polycarbonate.
 - g. Glass Tint Color: Blue **OR** Blue-green **OR** Bronze **OR** Green **OR** Gray, **as directed**.
 - h. Tinted Glass Location: Outer glass ply.
 - i. Coating Color: Gold **OR** Pewter **OR** Silver, **as directed**.
 - j. Coating Location: Second **OR** Third **OR** Fifth, **as directed**, surface.
 - k. Overall Visible Light Transmittance: as directed by the Owner.
 - l. Outdoor Visible Reflectance: as directed by the Owner.

- m. Winter Nighttime U-Factor: as directed by the Owner.
- n. Summer Daytime U-Factor: as directed by the Owner.
- o. Solar Heat-Gain Coefficient: as directed by the Owner.
- p. Provide safety glazing labeling.

R. Insulating Security Glazing Types

1. Security Glazing: Clear insulating security glazing **OR** Tinted insulating security glazing **OR** Reflective-coated, clear insulating security glazing **OR** Reflective-coated, tinted insulating security glazing, **as directed**. Outdoor lite is monolithic glass and indoor lite is glass-clad polycarbonate.
 - a. Detention Security Grade: Grade 1 **OR** Grade 2 **OR** Grade 3 **OR** Grade 4, **as directed**, per ASTM F 1915 cold-temperature impact test **OR** warm-temperature impact test **OR** torch and small blunt impactor test, **as directed**.
 - b. Overall Unit Thickness: as directed by the Owner.
 - c. Outdoor Lite: Float glass **OR** Heat-strengthened float glass **OR** Fully tempered float glass, **as directed**.
 - d. Indoor Lite: Glass-clad polycarbonate.
 - 1) Outer Ply: 3-mm **OR** 5-mm **OR** 6-mm, **as directed**, heat-strengthened **OR** chemically strengthened **OR** fully tempered, **as directed**, float glass.
 - 2) Single Core: 0.118-inch (4.57-mm) **OR** 0.177-inch (2.97-mm) **OR** 0.236-inch (5.99-mm), **as directed**, polycarbonate.
OR
Multiple Core:
 - a) Outer Core Ply: 0.118-inch (4.57-mm) **OR** 0.177-inch (2.97-mm) **OR** 0.236-inch (5.99-mm), **as directed**, polycarbonate.
 - b) Single Inner Core Ply **OR** Double Inner Core Plies, **as directed**: 0.118-inch (4.57-mm) **OR** 0.177-inch (2.97-mm) **OR** 0.236-inch (5.99-mm), **as directed**, polycarbonate.
 - 3) Inner Ply: 3-mm **OR** 5-mm **OR** 6-mm, **as directed**, heat-strengthened **OR** chemically strengthened **OR** fully tempered, **as directed**, float glass.
 - e. Interspace Content: Air **OR** Argon, **as directed**.
 - f. Interspace Dimension: as directed by the Owner.
 - g. Glass Tint Color: Blue **OR** Blue-green **OR** Bronze **OR** Green **OR** Gray, **as directed**.
 - h. Tinted Glass Location: Outdoor lite.
 - i. Coating Color: Gold **OR** Pewter **OR** Silver, **as directed**.
 - j. Coating Location: Second **OR** Third **OR** Fifth, **as directed**, surface.
 - k. Overall Visible Light Transmittance: as directed by the Owner.
 - l. Outdoor Visible Reflectance: as directed by the Owner.
 - m. Winter Nighttime U-Factor: as directed by the Owner.
 - n. Summer Daytime U-Factor: as directed by the Owner.
 - o. Solar Heat-Gain Coefficient: as directed by the Owner.
 - p. Provide safety glazing labeling.
2. Security Glazing: Low-e-coated, clear insulating security glazing **OR** Low-e-coated, tinted insulating security glazing, **as directed**. Outdoor lite is monolithic glass and indoor lite is glass-clad polycarbonate.
 - a. Detention Security Grade: Grade 1 **OR** Grade 2 **OR** Grade 3 **OR** Grade 4, **as directed**, per ASTM F 1915 cold-temperature impact test **OR** warm-temperature impact test **OR** torch and small blunt impactor test, **as directed**.
 - b. Overall Unit Thickness: as directed by the Owner.
 - c. Outdoor Lite: Float glass **OR** Heat-strengthened float glass **OR** Fully tempered float glass, **as directed**.
 - d. Indoor Lite: Glass-clad polycarbonate.
 - 1) Outer Ply: 3-mm **OR** 5-mm **OR** 6-mm, **as directed**, heat-strengthened **OR** chemically strengthened **OR** fully tempered, **as directed**, float glass.
 - 2) Single Core: 0.118-inch (4.57-mm) **OR** 0.177-inch (2.97-mm) **OR** 0.236-inch (5.99-mm), **as directed**, polycarbonate.
OR

- Multiple Core:
- a) Outer Core Ply: **0.118-inch (4.57-mm) OR 0.177-inch (2.97-mm) OR 0.236-inch (5.99-mm), as directed**, polycarbonate.
 - b) Single Inner Core Ply OR Double Inner Core Plies, **as directed: 0.118-inch (4.57-mm) OR 0.177-inch (2.97-mm) OR 0.236-inch (5.99-mm), as directed**, polycarbonate.
- 3) Inner Ply: 3-mm **OR** 5-mm **OR** 6-mm, **as directed**, heat-strengthened **OR** chemically strengthened **OR** fully tempered, **as directed**, float glass.
- e. Interspace Content: Air **OR** Argon, **as directed**.
 - f. Interspace Dimension: as directed by the Owner.
 - g. Glass Tint Color: Blue **OR** Blue-green **OR** Bronze **OR** Green **OR** Gray, **as directed**.
 - h. Tinted Glass Location: Outer lite.
 - i. Low-E Coating: Pyrolytic on second surface **OR** Pyrolytic on third surface **OR** Sputtered on second surface **OR** Sputtered on third surface, **as directed**.
 - j. Overall Visible Light Transmittance: as directed by the Owner.
 - k. Winter Nighttime U-Factor: as directed by the Owner.
 - l. Summer Daytime U-Factor: as directed by the Owner.
 - m. Solar Heat-Gain Coefficient: as directed by the Owner..
 - n. Provide safety glazing labeling.
3. Security Glazing: Clear insulating security glazing **OR** Tinted insulating security glazing **OR** Reflective-coated, clear insulating security glazing **OR** Reflective-coated, tinted insulating security glazing, **as directed**. Outdoor lite is laminated glass and indoor lite is glass-clad polycarbonate with spall-resistant film on inside face.
- a. Detention Security Grade: Grade 1 **OR** Grade 2 **OR** Grade 3 **OR** Grade 4, **as directed**, per ASTM F 1915 cold-temperature impact test **OR** warm-temperature impact test **OR** torch and small blunt impactor test, **as directed**.
 - b. Forced-Entry Resistance: Class I **OR** Class II **OR** Class III **OR** Class IV **OR** Class V, **as directed**, per ASTM F 1233.
OR
Forced-Entry Resistance: Level I **OR** Level II **OR** Level III **OR** Level IV **OR** Level V, **as directed**, per HPW-TP-0500.03.
 - c. Ballistic Resistance: Class/Level HG1 **OR** Class/Level HG2 **OR** Class/Level HG3 **OR** Class/Level HG4 **OR** Class/Level SMG **OR** Class/Level R1 **OR** Class/Level R2 **OR** Class/Level R3 **OR** Class/Level R4-AP **OR** Class/Level SH1 **OR** Class/Level SH2, **as directed**, per ASTM F 1233.
OR
Ballistic Resistance: Level 1 **OR** Level 2 **OR** Level 3 **OR** Level 4 **OR** Level 5 **OR** Level 6 **OR** Level 7 **OR** Level 8 **OR** Level 1-SG **OR** Level 2-SG **OR** Level 3-SG **OR** Level 4-SG **OR** Level 5-SG **OR** Level 6-SG **OR** Level 7-SG **OR** Level 8-SG, **as directed**, per UL 752.
 - d. Blast Resistance:
 - 1) Hazard Rating: No hazard **OR** Minimal hazard **OR** Very low hazard **OR** Low hazard **OR** High hazard, **as directed**, per ASTM F 1642.
OR
Performance Condition: 1 **OR** 2 **OR** 3a **OR** 3b **OR** 4 **OR** 5, **as directed**, per GSA-TS01.
 - 2) Peak Pressure: as directed by the Owner.
 - 3) Positive Phase Impulse: as directed by the Owner.
 - e. Overall Unit Thickness: as directed by the Owner.
 - f. Outdoor Lite: Laminated glass with two plies of heat-strengthened float glass **OR** three plies of heat-strengthened float glass **OR** two outer plies of heat-strengthened float glass and two inner plies of annealed float glass, **as directed**.
 - 1) Outer Ply Thickness: 3 mm **OR** 5 mm **OR** 6 mm, **as directed**.
 - 2) Core Ply Thickness: 3 mm **OR** 5 mm **OR** 6 mm, **as directed**.
 - 3) Inner Ply Thickness: 3 mm **OR** 5 mm **OR** 6 mm, **as directed**.

- 4) Interlayer Thickness: 0.030 inch (0.76 mm) OR 0.060 inch (1.52 mm) OR 0.090 inch (2.3 mm), as directed.
- g. Indoor Lite: Glass-clad polycarbonate faced with a 0.037-inch- (0.94-mm-) thick, spall-resistant polyester film laminated to indoor face.
 - 1) Outer Ply: 3-mm OR 5-mm OR 6-mm, as directed, heat-strengthened OR chemically strengthened, as directed, float glass.
 - 2) Single Core: 0.118-inch (4.57-mm) OR 0.177-inch (2.97-mm) OR 0.236-inch (5.99-mm), as directed, polycarbonate.
OR
Multiple Core:
 - a) Outer Core Ply: 0.118-inch (4.57-mm) OR 0.177-inch (2.97-mm) OR 0.236-inch (5.99-mm), as directed, polycarbonate.
 - b) Single Inner Core Ply OR Double Inner Core Plies, as directed: 0.118-inch (4.57-mm) OR 0.177-inch (2.97-mm) OR 0.236-inch (5.99-mm), as directed, polycarbonate.
 - 3) Inner Ply: 3-mm OR 5-mm OR 6-mm, as directed, heat-strengthened OR chemically strengthened, as directed, float glass.
- h. Interspace Content: Air OR Argon, as directed.
- i. Interspace Dimension: as directed by the Owner.
- j. Glass Tint Color: Blue OR Blue-green OR Bronze OR Green OR Gray, as directed.
- k. Tinted Glass Location: Outer OR Inner, as directed, ply of outdoor lite.
- l. Coating Color: Gold OR Pewter OR Silver, as directed.
- m. Coating Location: Second OR Third OR Fifth, as directed, surface.
- n. Overall Visible Light Transmittance: as directed by the Owner.
- o. Outdoor Visible Reflectance: as directed by the Owner.
- p. Winter Nighttime U-Factor: as directed by the Owner.
- q. Summer Daytime U-Factor: as directed by the Owner.
- r. Solar Heat-Gain Coefficient: as directed by the Owner.
- s. Provide safety glazing labeling.
4. Security Glazing: Low-e-coated, clear insulating security glazing OR Low-e-coated, tinted insulating security glazing, as directed. Outdoor lite is laminated glass and indoor lite is glass-clad polycarbonate with spall-resistant film on inside face.
 - a. Detention Security Grade: Grade 1 OR Grade 2 OR Grade 3 OR Grade 4, as directed, per ASTM F 1915 cold-temperature impact test OR warm-temperature impact test OR torch and small blunt impactor test, as directed.
 - b. Forced-Entry Resistance: Class I OR Class II OR Class III OR Class IV OR Class V, as directed, per ASTM F 1233.
OR
Forced-Entry Resistance: Level I OR Level II OR Level III OR Level IV OR Level V, as directed, per HPW-TP-0500.03.
 - c. Ballistic Resistance: Class/Level HG1 OR Class/Level HG2 OR Class/Level HG3 OR Class/Level HG4 OR Class/Level SMG OR Class/Level R1 OR Class/Level R2 OR Class/Level R3 OR Class/Level R4-AP OR Class/Level SH1 OR Class/Level SH2, as directed, per ASTM F 1233.
OR
Ballistic Resistance: Level 1 OR Level 2 OR Level 3 OR Level 4 OR Level 5 OR Level 6 OR Level 7 OR Level 8 OR Level 1-SG OR Level 2-SG OR Level 3-SG OR Level 4-SG OR Level 5-SG OR Level 6-SG OR Level 7-SG OR Level 8-SG, as directed, per UL 752.
 - d. Blast Resistance:
 - 1) Hazard Rating: No hazard OR Minimal hazard OR Very low hazard OR Low hazard OR High hazard, as directed, per ASTM F 1642.
OR
Performance Condition: 1 OR 2 OR 3a OR 3b OR 4 OR 5, as directed, per GSA-TS01.
 - 2) Peak Pressure: as directed by the Owner.
 - 3) Positive Phase Impulse: as directed by the Owner.

- e. Overall Unit Thickness: as directed by the Owner.
- f. Outdoor Lite: Laminated glass with two plies of heat-strengthened float glass **OR** three plies of heat-strengthened float glass **OR** two outer plies of heat-strengthened float glass and two inner plies of annealed float glass, **as directed**.
 - 1) Outer Ply Thickness: 3 mm **OR** 5 mm **OR** 6 mm, **as directed**.
 - 2) Core Ply Thickness: 3 mm **OR** 5 mm **OR** 6 mm, **as directed**.
 - 3) Inner Ply Thickness: 3 mm **OR** 5 mm **OR** 6 mm, **as directed**.
 - 4) Interlayer Thickness: 0.030 inch (0.76 mm) **OR** 0.060 inch (1.52 mm) **OR** 0.090 inch (2.3 mm), **as directed**.
- g. Indoor Lite: Glass-clad polycarbonate faced with a 0.037-inch- (0.94-mm-) thick, spall-resistant polyester film laminated to indoor face.
 - 1) Outer Ply: 3-mm **OR** 5-mm **OR** 6-mm, **as directed**, heat-strengthened **OR** chemically strengthened, **as directed**, float glass.
 - 2) Inner Ply: 3-mm **OR** 5-mm **OR** 6-mm, **as directed**, heat-strengthened **OR** chemically strengthened, **as directed**, float glass.
 - 3) Single Core: 0.118-inch (4.57-mm) **OR** 0.177-inch (2.97-mm) **OR** 0.236-inch (5.99-mm), **as directed**, polycarbonate.
OR
Multiple Core:
 - a) Outer Core Ply: 0.118-inch (4.57-mm) **OR** 0.177-inch (2.97-mm) **OR** 0.236-inch (5.99-mm), **as directed**, polycarbonate.
 - b) Single Inner Core Ply **OR** Double Inner Core Plies, **as directed**: 0.118-inch (4.57-mm) **OR** 0.177-inch (2.97-mm) **OR** 0.236-inch (5.99-mm), **as directed**, polycarbonate.
 - 4) Inner Ply: 3-mm **OR** 5-mm **OR** 6-mm, **as directed**, heat-strengthened **OR** chemically strengthened, **as directed**, float glass.
- h. Interspace Content: Air **OR** Argon, **as directed**.
- i. Interspace Dimension: as directed by the Owner.
- j. Glass Tint Color: Blue **OR** Blue-green **OR** Bronze **OR** Green **OR** Gray, **as directed**.
- k. Tinted Glass Location: Outer lite.
- l. Low-E Coating: Pyrolytic on second surface **OR** Pyrolytic on third surface **OR** Sputtered on second surface **OR** Sputtered on third surface, **as directed**.
- m. Overall Visible Light Transmittance: as directed by the Owner.
- n. Winter Nighttime U-Factor: as directed by the Owner.
- o. Summer Daytime U-Factor: as directed by the Owner.
- p. Solar Heat-Gain Coefficient: as directed by the Owner. Provide safety glazing labeling.

S. Air-Gap Security Glazing Types

- 1. Security Glazing: Clear air-gap security glazing **OR** Tinted air-gap security glazing **OR** Clear reflective-coated air-gap security glazing **OR** Tinted reflective-coated air-gap security glazing, **as directed**. Outdoor lite is laminated glass and indoor lite is laminated polycarbonate.
 - a. Forced-Entry Resistance: Class I **OR** Class II **OR** Class III **OR** Class IV **OR** Class V, **as directed**, per ASTM F 1233.
OR
Forced-Entry Resistance: Level I **OR** Level II **OR** Level III **OR** Level IV **OR** Level V, **as directed**, per HPW-TP-0500.03.
 - b. Ballistic Resistance: Class/Level HG1 **OR** Class/Level HG2 **OR** Class/Level HG3 **OR** Class/Level HG4 **OR** Class/Level SMG **OR** Class/Level R1 **OR** Class/Level R2 **OR** Class/Level R3 **OR** Class/Level R4-AP **OR** Class/Level SH1 **OR** Class/Level SH2, **as directed**, per ASTM F 1233.
OR
Ballistic Resistance: Level 1 **OR** Level 2 **OR** Level 3 **OR** Level 4 **OR** Level 5 **OR** Level 6 **OR** Level 7 **OR** Level 8 **OR** Level 1-SG **OR** Level 2-SG **OR** Level 3-SG **OR** Level 4-SG **OR** Level 5-SG **OR** Level 6-SG **OR** Level 7-SG **OR** Level 8-SG, **as directed**, per UL 752.
 - c. Blast Resistance:

- 1) Hazard Rating: No hazard **OR** Minimal hazard **OR** Very low hazard **OR** Low hazard **OR** High hazard, **as directed**, per ASTM F 1642.
OR
Performance Condition: 1 **OR** 2 **OR** 3a **OR** 3b **OR** 4 **OR** 5, **as directed**, per GSA-TS01.
- 2) Peak Pressure: as directed by the Owner.
- 3) Positive Phase Impulse: as directed by the Owner.
- d. Overall Unit Thickness: as directed by the Owner.
- e. Outdoor Lite: Laminated glass with two **OR** three, **as directed**, plies of float glass **OR** heat-strengthened float glass **OR** fully tempered float glass **OR** chemically strengthened float glass, **as directed**.
 - 1) Outer Ply Thickness: 3 mm **OR** 5 mm **OR** 6 mm, **as directed**.
 - 2) Core Ply Thickness: 3 mm **OR** 5 mm **OR** 6 mm, **as directed**.
 - 3) Inner Ply Thickness: 3 mm **OR** 5 mm **OR** 6 mm, **as directed**.
 - 4) Interlayer Thickness: 0.030 inch (0.76 mm) **OR** 0.060 inch (1.52 mm) **OR** 0.090 inch (2.3 mm), **as directed**.
- f. Indoor Lite: Laminated polycarbonate with two **OR** three **OR** four, **as directed**, polycarbonate plies.
 - 1) Overall Unit Thickness: as directed by the Owner.
 - 2) Outer and Inner Plies: 0.118-inch (4.57-mm) **OR** 0.177-inch (2.97-mm) **OR** 0.236-inch (5.99-mm), **as directed**, polycarbonate.
 - 3) Core Ply **OR** Core Plies, **as directed**: 0.118-inch (4.57-mm) **OR** 0.177-inch (2.97-mm) **OR** 0.236-inch (5.99-mm), **as directed**, polycarbonate.
 - 4) Interlayer Thicknesses: 0.025 inch (0.635 mm).
- g. Air-Gap Dimension: as directed by the Owner.
- h. Glass Tint Color: Blue **OR** Blue-green **OR** Bronze **OR** Green **OR** Gray, **as directed**.
- i. Tinted Glass Location: Outer **OR** Inner, **as directed**, ply of outdoor lite.
- j. Coating Color: Gold **OR** Pewter **OR** Silver, **as directed**.
- k. Coating Location: Second **OR** Third **OR** Fifth, **as directed**, surface.
- l. Overall Visible Light Transmittance: as directed by the Owner..
- m. Outdoor Visible Reflectance: as directed by the Owner.
- n. Winter Nighttime U-Factor: as directed by the Owner.
- o. Summer Daytime U-Factor: as directed by the Owner.
- p. Solar Heat-Gain Coefficient: as directed by the Owner.
- q. Provide safety glazing labeling.
2. Security Glazing: Low-e-coated, clear air-gap security glazing **OR** Low-e-coated, tinted air-gap security glazing, **as directed**. Outdoor lite is laminated glass and indoor lite is laminated polycarbonate.
 - a. Forced-Entry Resistance: Class I **OR** Class II **OR** Class III **OR** Class IV **OR** Class V, **as directed**, per ASTM F 1233.
OR
Forced-Entry Resistance: Level I **OR** Level II **OR** Level III **OR** Level IV **OR** Level V, **as directed**, per HPW-TP-0500.03.
 - b. Ballistic Resistance: Class/Level HG1 **OR** Class/Level HG2 **OR** Class/Level HG3 **OR** Class/Level HG4 **OR** Class/Level SMG **OR** Class/Level R1 **OR** Class/Level R2 **OR** Class/Level R3 **OR** Class/Level R4-AP **OR** Class/Level SH1 **OR** Class/Level SH2, **as directed**, per ASTM F 1233.
OR
Ballistic Resistance: Level 1 **OR** Level 2 **OR** Level 3 **OR** Level 4 **OR** Level 5 **OR** Level 6 **OR** Level 7 **OR** Level 8 **OR** Level 1-SG **OR** Level 2-SG **OR** Level 3-SG **OR** Level 4-SG **OR** Level 5-SG **OR** Level 6-SG **OR** Level 7-SG **OR** Level 8-SG, **as directed**, per UL 752.
 - c. Blast Resistance:
 - 1) Hazard Rating: No hazard **OR** Minimal hazard **OR** Very low hazard **OR** Low hazard **OR** High hazard, **as directed**, per ASTM F 1642.
OR

- Performance Condition: 1 **OR** 2 **OR** 3a **OR** 3b **OR** 4 **OR** 5, **as directed**, per GSA-TS01.
- 2) Peak Pressure: as directed by the Owner.
 - 3) Positive Phase Impulse: as directed by the Owner.
 - d. Overall Unit Thickness: as directed by the Owner.
 - e. Outdoor Lite: Laminated glass with two **OR** three, **as directed**, plies of float glass **OR** heat-strengthened float glass **OR** fully tempered float glass **OR** chemically strengthened float glass, **as directed**.
 - 1) Outer Ply Thickness: 3 mm **OR** 5 mm **OR** 6 mm, **as directed**.
 - 2) Core Ply Thickness: 3 mm **OR** 5 mm **OR** 6 mm, **as directed**.
 - 3) Inner Ply Thickness: 3 mm **OR** 5 mm **OR** 6 mm, **as directed**.
 - 4) Interlayer Thickness: 0.030 inch (0.76 mm) **OR** 0.060 inch (1.52 mm) **OR** 0.090 inch (2.3 mm), **as directed**.
 - f. Indoor Lite: Laminated polycarbonate with two **OR** three **OR** four, **as directed**, polycarbonate plies.
 - 1) Overall Unit Thickness: as directed by the Owner.
 - 2) Outer and Inner Plies: 0.118-inch (4.57-mm) **OR** 0.177-inch (2.97-mm) **OR** 0.236-inch (5.99-mm), **as directed**, polycarbonate.
 - 3) Core Ply **OR** Core Plies, **as directed**: 0.118-inch (4.57-mm) **OR** 0.177-inch (2.97-mm) **OR** 0.236-inch (5.99-mm), **as directed**, polycarbonate.
 - 4) Interlayer Thicknesses: 0.025 inch (0.635 mm).
 - g. Air-Gap Dimension: as directed by the Owner.
 - h. Glass Tint Color: Blue **OR** Blue-green **OR** Bronze **OR** Green **OR** Gray, **as directed**.
 - i. Tinted Glass Location: Outer **OR** Inner, **as directed**, ply of outdoor lite.
 - j. Low-E Coating: Pyrolytic on second surface **OR** Pyrolytic on third surface **OR** Sputtered on second surface **OR** Sputtered on third surface, **as directed**.
 - k. Overall Visible Light Transmittance: as directed by the Owner.
 - l. Winter Nighttime U-Factor: as directed by the Owner.
 - m. Summer Daytime U-Factor: as directed by the Owner.
 - n. Solar Heat-Gain Coefficient: as directed by the Owner.
 - o. Provide safety glazing labeling.

1.3 EXECUTION

A. Examination

- 1. Examine framing for security glazing, with Installer present, for compliance with the following:
 - a. Manufacturing and installation tolerances, including those for size, squareness, and offsets at corners.
 - b. Presence and functioning of weep system.
 - c. Minimum required face or edge clearances.
 - d. Effective sealing between joints of framing members.
- 2. Proceed with installation only after unsatisfactory conditions have been corrected.

B. Preparation

- 1. Clean glazing channels and other framing members receiving security glazing immediately before glazing. Remove coatings not firmly bonded to substrates.

C. Glazing, General

- 1. Comply with combined written instructions of manufacturers of security glazing, sealants, gaskets, and other glazing materials, unless more stringent requirements are indicated, including those in referenced glazing publications.
- 2. Protect edges of security glazing from damage during handling and installation. Remove damaged security glazing from Project site and legally dispose of off Project site. Damaged

security glazing includes units with edge or face damage or other imperfections that, when installed, could weaken security glazing, impair performance, or impair appearance.

3. Apply primers to joint surfaces where required for adhesion of sealants, as determined by preconstruction testing.
4. Install setting blocks in sill rabbets, sized and located to comply with referenced glazing publications unless otherwise required by glazing unit manufacturer. Set blocks in thin course of compatible sealant suitable for heel bead.
5. Do not exceed edge pressures stipulated by security glazing manufacturers for installing lites.
6. Provide spacers for security glazing lites where the length plus width is larger than **50 inches (1270 mm)**.
 - a. Locate spacers directly opposite each other on both inside and outside faces of security glazing. Install correct size and spacing to preserve required face clearances unless gaskets and glazing tapes are used that have demonstrated ability to maintain required face clearances and to comply with performance requirements.
 - b. Provide **1/8-inch (3-mm)** minimum bite of spacers on glazing lites and use thickness equal to sealant width. With glazing tape, use thickness slightly less than final compressed thickness of tape.
7. Provide edge blocking where indicated or needed to prevent security glazing from moving sideways in glazing channel, as recommended in writing by security glazing manufacturer and according to requirements in referenced glazing publications.
8. Set security glazing in each series with uniform pattern, draw, bow, and similar characteristics.
9. Set coated security glazing with proper orientation so that coatings face exterior or interior as specified.
10. Where wedge-shaped gaskets are driven into one side of channel to pressurize sealant or gasket on opposite side, provide adequate anchorage so gasket cannot walk out when installation is subjected to movement.
11. Square cut wedge-shaped gaskets at corners and install gaskets in a manner recommended by gasket manufacturer to prevent corners from pulling away; seal corner joints and butt joints with sealant recommended by gasket manufacturer.

D. Tape Glazing

1. Position tapes on fixed stops so that, when compressed by security glazing, their exposed edges are flush with or protrude slightly above sightline of stops.
2. Install tapes continuously, but not necessarily in one continuous length. Do not stretch tapes to make them fit opening.
3. Cover vertical framing joints by applying tapes to heads and sills first and then to jambs. Cover horizontal framing joints by applying tapes to jambs and then to heads and sills.
4. Place joints in tapes at corners of opening with adjoining lengths butted together, not lapped. Seal joints in tapes with compatible sealant approved by tape manufacturer.
5. Do not remove release paper from tape until just before each glazing unit is installed.
6. Apply heel bead of elastomeric sealant.
7. Center security glazing in openings on setting blocks and press firmly against tape by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and work toward centers of openings.
8. Apply cap bead of elastomeric sealant over exposed edge of tape.

E. Gasket Glazing (Dry)

1. Cut compression gaskets to lengths recommended by gasket manufacturer to fit openings exactly, with allowance for stretch during installation.
2. Insert soft compression gasket securely in place between glazing unit and frame or fixed stop, with joints miter cut and bonded together at corners.
3. Installation with Drive-in Wedge Gaskets: Center security glazing in openings on setting blocks and press firmly against soft compression gasket by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and work toward centers of openings. Compress gaskets to produce a weathertight seal

without developing bending stresses in security glazing. Seal gasket joints with sealant recommended by gasket manufacturer.

4. Installation with Pressure-Glazing Stops: Center security glazing in openings on setting blocks and press firmly against soft compression gasket. Install dense compression gaskets and pressure-glazing stops, applying pressure uniformly to compression gaskets. Compress gaskets to produce a weathertight seal without developing bending stresses in security glazing. Seal gasket joints with sealant recommended by gasket manufacturer.
5. Install gaskets so they protrude past face of glazing stops.

F. Sealant Glazing (Wet)

1. Install continuous spacers, or spacers combined with cylindrical sealant backing, between security glazing and glazing stops to maintain face clearances and to prevent sealant from extruding into glazing channel and blocking weep systems. Secure spacers or spacers and backings in place and in position to control depth of installed sealant relative to edge clearance for optimum sealant performance.
2. Force sealants into glazing channels to eliminate voids and to ensure complete wetting or bond of sealant to security glazing and channel surfaces.
3. Tool exposed surfaces of sealants to provide a substantial wash away from security glazing.

G. Protection And Cleaning

1. Protect exterior security glazing from damage immediately after installation by attaching crossed streamers to framing held away from glazing unit. Do not apply markers to security glazing surfaces. Remove nonpermanent labels, and clean surfaces.
2. Protect security glazing from contact with contaminating substances resulting from construction operations, including weld splatter. If, despite such protection, contaminating substances do come into contact with security glazing, remove substances immediately as recommended in writing by security glazing manufacturer.
3. Examine security glazing surfaces adjacent to or below exterior concrete and other masonry surfaces at frequent intervals during construction, but not less than once a month, for buildup of dirt, scum, alkaline deposits, or stains; remove as recommended in writing by security glazing manufacturer.
4. Remove and replace security glazing that is broken, chipped, cracked, or abraded or that is damaged from natural causes, accidents, or vandalism during construction period.
5. Wash security glazing on exposed surfaces in each area of Project not more than four days before date scheduled for inspections that establish date of Final Completion. Wash security glazing as recommended in writing by security glazing manufacturer.

END OF SECTION 08 88 53 00



Task	Specification	Specification Description
08 88 53 00	07 42 13 19	Glazing

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SECTION 08 90 00 00 - LOUVERS AND VENTS

1.1 GENERAL

A. Description Of Work

1. This specification covers the furnishing and installation of materials for louvers and vents. Product shall be as follows or as directed by the Owner. Installation procedures shall be in accordance with the product manufacturer's recommendations. Demolition and removal of materials shall be as required to support the work.

B. Summary

1. Section Includes:
 - a. Fixed, extruded-aluminum and formed-metal louvers.
 - b. Adjustable, extruded-aluminum and formed-metal louvers.
 - c. Adjustable, extruded-aluminum and formed-metal insulated louvers.
 - d. Fixed, formed-metal acoustical louvers.
 - e. Wall vents (brick vents).

C. Definitions

1. Louver Terminology: Definitions of terms for metal louvers contained in AMCA 501 apply to this Section unless otherwise defined in this Section or in referenced standards.
2. Horizontal Louver: Louver with horizontal blades; i.e., the axes of the blades are horizontal.
3. Vertical Louver: Louver with vertical blades; i.e., the axes of the blades are vertical.
4. Drainable-Blade Louver: Louver with blades having gutters that collect water and drain it to channels in jambs and mullions, which carry it to bottom of unit and away from opening.
5. Storm-Resistant Louver: Louver that provides specified wind-driven rain performance, as determined by testing according to AMCA 500-L.

D. Performance Requirements

1. Delegated Design: Design louvers, including comprehensive engineering analysis by a qualified professional engineer, using structural and seismic performance requirements and design criteria indicated.
2. Structural Performance: Louvers shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated without permanent deformation of louver components, noise or metal fatigue caused by louver blade rattle or flutter, or permanent damage to fasteners and anchors.
 - a. Wind Loads:
 - 1) Determine loads based on pressures as indicated on Drawings.
OR
Determine loads based on a uniform pressure of **20 lbf/sq. ft. (957 Pa)** **OR** **30 lbf/sq. ft. (1436 Pa)**, **as directed**, acting inward or outward.
3. Seismic Performance: Louvers, including attachments to other construction, shall withstand the effects of earthquake motions determined according to SEI/ASCE 7.
 - a. Design earthquake spectral response acceleration, short period (Sds) for Project is **as directed**.
 - b. Component Importance Factor is **1.5 OR 1.0, as directed**.
4. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes, without buckling, opening of joints, overstressing of components, failure of connections, or other detrimental effects.
 - a. Temperature Change (Range): **120 deg F (67 deg C)**, ambient; **180 deg F (100 deg C)**, material surfaces.
5. Louver Performance Ratings: Provide louvers complying with requirements specified, as demonstrated by testing manufacturer's stock units identical to those provided, except for length and width according to AMCA 500-L.

6. Acoustic Performance: Provide acoustical louvers complying with ratings specified, as demonstrated by testing manufacturer's stock units identical to those specified, except for length and width for airborne sound-transmission loss according to ASTM E 90 **OR** outdoor-indoor sound-transmission loss according to ASTM E 966, **as directed**.

E. Submittals

1. Product Data: For each type of product indicated.
 - a. For louvers specified to bear AMCA seal, include printed catalog pages showing specified models with appropriate AMCA Certified Ratings Seals.
2. Shop Drawings: For louvers and accessories. Include plans, elevations, sections, details, and attachments to other work. Show frame profiles and blade profiles, angles, and spacing.
3. Samples: For each type of metal finish required.
4. Delegated-Design Submittal: For louvers indicated to comply with structural and seismic performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
5. Product Test Reports: Based on tests performed according to AMCA 500-L.

F. Quality Assurance

1. Welding: Qualify procedures and personnel according to the following:
 - a. AWS D1.2/D1.2M, "Structural Welding Code - Aluminum."
 - b. AWS D1.3, "Structural Welding Code - Sheet Steel."
 - c. AWS D1.6, "Structural Welding Code - Stainless Steel."
2. SMACNA Standard: Comply with recommendations in SMACNA's "Architectural Sheet Metal Manual" for fabrication, construction details, and installation procedures.
3. UL and NEMA Compliance: Provide motors and related components for motor-operated louvers that are listed and labeled by UL and comply with applicable NEMA standards.

1.2 PRODUCTS

A. Materials

1. Aluminum Extrusions: **ASTM B 221 (ASTM B 221M)**, Alloy 6063-T5, T-52, or T6.
2. Aluminum Sheet: **ASTM B 209 (ASTM B 209M)**, Alloy 3003 or 5005 with temper as required for forming, or as otherwise recommended by metal producer for required finish.
3. Aluminum Castings: ASTM B 26/B 26M, Alloy 319.
4. Galvanized-Steel Sheet: ASTM A 653/A 653M, **G60 (Z180) OR G90 (Z275)**, **as directed**, zinc coating, mill phosphatized.
5. Stainless-Steel Sheet: ASTM A 240/A 240M, Type 304, No. 2B finish **OR** No. 2D finish **OR** No. 4 finish, with grain running parallel to length of blades and frame members **OR** No. 4 finish, with grain running perpendicular to length of blades and frame members **OR** No. 4 finish, with grain running perpendicular to length of blades and parallel to length of frame members **OR** No. 6 finish, **as directed**.
6. Fasteners: Use types and sizes to suit unit installation conditions.
 - a. Use Phillips flat-head **OR** hex-head or Phillips pan-head **OR** tamper-resistant, **as directed**, screws for exposed fasteners unless otherwise indicated.
 - b. For fastening aluminum, use aluminum or 300 series stainless-steel fasteners.
 - c. For fastening galvanized steel, use hot-dip-galvanized steel or 300 series stainless-steel fasteners.
 - d. For fastening stainless steel, use 300 series stainless-steel fasteners.
 - e. For color-finished louvers, use fasteners with heads that match color of louvers.
7. Postinstalled Fasteners for Concrete and Masonry: Torque-controlled expansion anchors, made from stainless-steel components, with capability to sustain, without failure, a load equal to 4 times the loads imposed, for concrete, or 6 times the load imposed, for masonry, as determined by testing per ASTM E 488, conducted by a qualified independent testing agency.
8. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187.

B. Fabrication, General

1. Assemble louvers in factory to minimize field splicing and assembly. Disassemble units as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation.
2. Vertical Assemblies: Where height of louver units exceeds fabrication and handling limitations, fabricate units to permit field-bolted assembly with close-fitting joints in jambs and mullions, reinforced with splice plates.
 - a. Continuous Vertical Assemblies: Fabricate units without interrupting blade-spacing pattern unless horizontal mullions are indicated **OR** where indicated, **as directed**.
 - b. Horizontal Mullions: Provide horizontal mullions at joints unless continuous vertical assemblies are indicated **OR** where indicated, **as directed**.
3. Maintain equal louver blade spacing, including separation between blades and frames at head and sill, **as directed**, to produce uniform appearance.
4. Fabricate frames, including integral sills, to fit in openings of sizes indicated, with allowances made for fabrication and installation tolerances, adjoining material tolerances, and perimeter sealant joints.
 - a. Frame Type: Channel **OR** Exterior flange **OR** Interior flange, **as directed**, unless otherwise indicated.
5. Include supports, anchorages, and accessories required for complete assembly.
6. Provide vertical mullions of type and at spacings indicated, but not more than recommended by manufacturer, or **72 inches (1830 mm)** o.c., whichever is less.
 - a. Fully Recessed Mullions: Where indicated, provide mullions fully recessed behind louver blades. Where length of louver exceeds fabrication and handling limitations, fabricate with close-fitting blade splices designed to permit expansion and contraction.
 - b. Semirecessed Mullions: Where indicated, provide mullions partly recessed behind louver blades so louver blades appear continuous. Where length of louver exceeds fabrication and handling limitations, fabricate with interlocking split mullions and close-fitting blade splices designed to permit expansion and contraction.
 - c. Exposed Mullions: Where indicated, provide units with exposed mullions of same width and depth as louver frame. Where length of louver exceeds fabrication and handling limitations, provide interlocking split mullions designed to permit expansion and contraction.
 - d. Exterior Corners: Prefabricated corner units with mitered and welded blades **OR** blades with concealed close-fitting splices, **as directed**, and with fully recessed **OR** semirecessed, **as directed**, mullions at corners.
7. Provide subsills made of same material as louvers **OR** extended sills, **as directed**, for recessed louvers.
8. Join frame members to each other and to fixed louver blades with fillet welds concealed from view **OR** welds, threaded fasteners, or both, as standard with louver manufacturer, **as directed**, unless otherwise indicated or size of louver assembly makes bolted connections between frame members necessary.

C. Fixed, Extruded-Aluminum Louvers

1. Horizontal Storm-Resistant Louver:
 - a. Louver Depth: **4 inches (100 mm) OR 5 inches (125 mm) OR 7 inches (175 mm) OR 8 inches (200 mm) OR 9 inches (225 mm)**, **as directed**.
 - b. Frame and Blade Nominal Thickness: Not less than **0.080 inch (2.03 mm) OR 0.060 inch (1.52 mm)** for blades and **0.080 inch (2.03 mm)** for frames, **as directed**.
 - c. Louver Performance Ratings:
 - 1) Free Area: Not less than **5.0 sq. ft. (0.46 sq. m) OR 6.0 sq. ft. (0.56 sq. m) OR 7.0 sq. ft. (0.65 sq. m)**, **as directed**, for **48-inch- (1220-mm-)** wide by **48-inch- (1220-mm-)** high louver.
 - 2) Air Performance: Not more than **0.10-inch wg (25-Pa)** static pressure drop at **600-fpm (3.0-m/s) OR 700-fpm (3.6-m/s) OR 800-fpm (4.1-m/s)**, **as directed**, free-area exhaust **OR** intake, **as directed**, velocity.

- 3) Wind-Driven Rain Performance: Not less than 99 **OR** 95 **OR** 80, **as directed**, percent effectiveness when subjected to a rainfall rate of **3 inches (75 mm)** per hour and a wind speed of **29 mph (13 m/s) OR 8 inches (200 mm)** per hour and a wind speed of **50 mph (22.4 m/s)**, **as directed**, at a core-area intake velocity of **300 fpm (1.5 m/s) OR 400 fpm (2.0 m/s) OR 500 fpm (2.5 m/s)**, **as directed**.
- d. AMCA Seal: Mark units with AMCA Certified Ratings Seal.
2. Vertical Storm-Resistant Louver:
 - a. Louver Depth: **4 inches (100 mm) OR 6 inches (150 mm) OR 8 inches (200 mm) OR 9 inches (225 mm) OR 12 inches (300 mm)**, **as directed**.
 - b. Frame and Blade Nominal Thickness: Not less than **0.080 inch (2.03 mm) OR 0.060 inch (1.52 mm)** for blades and **0.080 inch (2.03 mm)** for frames, **as directed**.
 - c. Louver Performance Ratings:
 - 1) Free Area: Not less than **5.0 sq. ft. (0.46 sq. m) OR 6.0 sq. ft. (0.56 sq. m) OR 7.0 sq. ft. (0.65 sq. m)** **as directed**, for **48-inch- (1220-mm-)** wide by **48-inch- (1220-mm-)** high louver.
 - 2) Air Performance: Not more than **0.10-inch wg (25-Pa)** static pressure drop at **600-fpm (3.0-m/s) OR 700-fpm (3.6-m/s) OR 800-fpm (4.1-m/s)**, **as directed**, free-area exhaust **OR** intake, **as directed**, velocity.
 - 3) Wind-Driven Rain Performance: Not less than 99 percent effectiveness when subjected to a rainfall rate of **3 inches (75 mm)** per hour and a wind speed of **29 mph (13 m/s) OR 8 inches (200 mm)** per hour and a wind speed of **50 mph (22.4 m/s)**, **as directed**, at a core-area intake velocity of **300 fpm (1.5 m/s) OR 400 fpm (2.0 m/s) OR 500 fpm (2.5 m/s)**, **as directed**.
 - d. AMCA Seal: Mark units with AMCA Certified Ratings Seal.
3. Horizontal, Drainable-Blade Louver:
 - a. Louver Depth: **4 inches (100 mm) OR 6 inches (150 mm)**, **as directed**.
 - b. Frame and Blade Nominal Thickness: Not less than **0.080 inch (2.03 mm) OR 0.060 inch (1.52 mm)** for blades and **0.080 inch (2.03 mm)** for frames, **as directed**.
 - c. Mullion Type: Exposed.
 - d. Louver Performance Ratings:
 - 1) Free Area: Not less than **7.0 sq. ft. (0.65 sq. m) OR 7.5 sq. ft. (0.70 sq. m) OR 8.0 sq. ft. (0.74 sq. m) OR 8.5 sq. ft. (0.79 sq. m)**, **as directed**, for **48-inch- (1220-mm-)** wide by **48-inch- (1220-mm-)** high louver.
 - 2) Point of Beginning Water Penetration: Not less than **900 fpm (4.6 m/s) OR 950 fpm (4.8 m/s) OR 1000 fpm (5.1 m/s) OR 1050 fpm (5.3 m/s) OR 1100 fpm (5.6 m/s)**, **as directed**.
 - 3) Air Performance: Not more than **0.10-inch wg (25-Pa)** static pressure drop at **700-fpm (3.6-m/s) OR 750-fpm (3.8-m/s) OR 800-fpm (4.1-m/s) OR 850-fpm (4.3-m/s)**, **as directed**, free-area exhaust **OR** intake, **as directed**, velocity.
 - 4) Air Performance: Not more than **0.15-inch wg (37-Pa)** static pressure drop at **900-fpm (4.6-m/s) OR 950-fpm (4.8-m/s) OR 1000-fpm (5.1-m/s)**, **as directed**, free-area exhaust **OR** intake, **as directed**, velocity.
 - e. AMCA Seal: Mark units with AMCA Certified Ratings Seal.
4. Horizontal, Continuous-Line, Drainable-Blade Louver: Drainable-blade louver with blade gutters (drains) in rear two-thirds of blades only and with semirecessed mullions capable of collecting and draining water from blades.
 - a. Louver Depth: **6 inches (150 mm)**.
 - b. Frame and Blade Nominal Thickness: Not less than **0.080 inch (2.03 mm)**.
 - c. Louver Performance Ratings:
 - 1) Free Area: Not less than **7.8 sq. ft. (0.72 sq. m)** for **48-inch- (1220-mm-)** wide by **48-inch- (1220-mm-)** high louver.
 - 2) Point of Beginning Water Penetration: Not less than **850 fpm (4.3 m/s)**.
 - 3) Air Performance: Not more than **0.10-inch wg (25-Pa)** static pressure drop at **800-fpm (4.1-m/s)** free-area exhaust **OR** intake, **as directed**, velocity.
5. Horizontal, Sightproof, Drainable-Blade Louver:

- a. Louver Depth: **5 inches (125 mm)**.
- b. Frame and Blade Nominal Thickness: Not less than **0.080 inch (2.03 mm)** OR **0.060 inch (1.52 mm)** for blades and **0.080 inch (2.03 mm)** for frames, **as directed**.
- c. Mullion Type: Exposed.
- d. Louver Performance Ratings:
 - 1) Free Area: Not less than **8.3 sq. ft. (0.77 sq. m)** for **48-inch- (1220-mm-)** wide by **48-inch- (1220-mm-)** high louver.
 - 2) Point of Beginning Water Penetration: Not less than **750 fpm (3.8 m/s)** OR **950 fpm (4.8 m/s)**, **as directed**.
 - 3) Air Performance: Not more than **0.10-inch wg (25-Pa)** static pressure drop at **550-fpm (2.8-m/s)** free-area exhaust OR intake, **as directed**, velocity.
6. Horizontal, Nondrainable-Blade Louver:
 - a. Louver Depth: **2 inches (50 mm)** OR **4 inches (100 mm)** OR **6 inches (150 mm)**, **as directed**.
 - b. Blade Profile: Plain blade without OR Blade with, **as directed**, center baffle.
 - c. Frame and Blade Nominal Thickness: Not less than **0.080 inch (2.03 mm)** OR **0.060 inch (1.52 mm)** for blades and **0.080 inch (2.03 mm)** for frames, **as directed**.
 - d. Mullion Type: Exposed OR Semirecessed OR Fully recessed, **as directed**.
 - e. Louver Performance Ratings:
 - 1) Free Area: Not less than **7.5 sq. ft. (0.70 sq. m)** OR **8.0 sq. ft. (0.74 sq. m)** OR **8.5 sq. ft. (0.79 sq. m)**, **as directed**, for **48-inch- (1220-mm-)** wide by **48-inch- (1220-mm-)** high louver.
 - 2) Point of Beginning Water Penetration: Not less than **700 fpm (3.6 m/s)** OR **750 fpm (3.8 m/s)** OR **800 fpm (4.1 m/s)** OR **850 fpm (4.3 m/s)** OR **900 fpm (4.6 m/s)** OR **950 fpm (4.8 m/s)**, **as directed**.
 - 3) Air Performance: Not more than **0.10-inch wg (25-Pa)** static pressure drop at **650-fpm (3.3-m/s)** OR **700-fpm (3.6-m/s)** OR **750-fpm (3.8-m/s)**, **as directed**, free-area exhaust OR intake, **as directed**, velocity.
7. Vertical, Sightproof, Louver:
 - a. Louver Depth: **4 inches (100 mm)**.
 - b. Blade Profile: Chevron OR Y OR Labyrinth, **as directed**, -shaped blade.
 - c. Frame and Blade Nominal Thickness: Not less than **0.080 inch (2.03 mm)** OR **0.060 inch (1.52 mm)** for blades and **0.080 inch (2.03 mm)** for frames, **as directed**.
 - d. Blade Spacing: **2 inches (50 mm)** OR **4 inches (100 mm)**, **as directed**, o.c.
 - e. Mullion Type: Exposed OR Semirecessed OR Fully recessed, **as directed**.
- D. Fixed, Formed-Metal Louvers
 1. Horizontal, Drainable-Blade Louver:
 - a. Louver Depth: **4 inches (100 mm)** OR **6 inches (150 mm)**, **as directed**.
 - b. Frame and Blade Material and Nominal Thickness: Galvanized-steel sheet, not less than **0.052 inch (1.32 mm)** for frames and **0.040 inch (1.02 mm)** for blades OR **0.052 inch (1.32 mm)** OR **0.064 inch (1.63 mm)**, **as directed**.
 - c. Frame and Blade Material and Nominal Thickness: Stainless-steel sheet, not less than **0.050 inch (1.27 mm)** OR **0.062 inch (1.59 mm)**, **as directed**.
 - d. Mullion Type: Exposed.
 - e. Louver Performance Ratings:
 - 1) Free Area: Not less than **7.0 sq. ft. (0.65 sq. m)** OR **7.5 sq. ft. (0.70 sq. m)** OR **8.0 sq. ft. (0.74 sq. m)** OR **8.5 sq. ft. (0.79 sq. m)**, **as directed**, for **48-inch- (1220-mm-)** wide by **48-inch- (1220-mm-)** high louver.
 - 2) Point of Beginning Water Penetration: Not less than **800 fpm (4.1 m/s)** OR **850 fpm (4.3 m/s)** OR **900 fpm (4.6 m/s)** OR **950 fpm (4.8 m/s)** OR **1000 fpm (5.1 m/s)**, **as directed**.
 - 3) Air Performance: Not more than **0.10-inch wg (25-Pa)** static pressure drop at **700-fpm (3.6-m/s)** OR **750-fpm (3.8-m/s)** OR **800-fpm (4.1-m/s)** OR **850-fpm (4.3-m/s)**, **as directed**, free-area exhaust OR intake, **as directed**, velocity.

- 4) Air Performance: Not more than **0.15-inch wg (37-Pa)** static pressure drop at **900-fpm (4.6-m/s) OR 950-fpm (4.8-m/s) OR 1000-fpm (5.1-m/s)**, **as directed**, free-area velocity.
- f. AMCA Seal: Mark units with AMCA Certified Ratings Seal.
2. Horizontal, Nondrainable-Blade Louver:
 - a. Louver Depth: **4 inches (100 mm) OR 6 inches (150 mm)**, **as directed**.
 - b. Blade Profile: Plain blade without **OR** Blade with, **as directed**, center baffle.
 - c. Frame and Blade Material and Nominal Thickness: Galvanized-steel sheet, not less than **0.052 inch (1.32 mm)** for frames and **0.040 inch (1.02 mm)** for blades **OR 0.052 inch (1.32 mm) OR 0.064 inch (1.63 mm)**, **as directed**.
 - d. Frame and Blade Material and Nominal Thickness: Stainless-steel sheet, not less than **0.050 inch (1.27 mm) OR 0.062 inch (1.59 mm)**, **as directed**.
 - e. Mullion Type: Exposed **OR** Semirecessed **OR** Fully recessed, **as directed**.
 - f. Louver Performance Ratings:
 - 1) Free Area: Not less than **6.5 sq. ft. (0.60 sq. m) OR 7.0 sq. ft. (0.65 sq. m) OR 7.5 sq. ft. (0.70 sq. m) OR 8.0 sq. ft. (0.74 sq. m)**, **as directed**, for **48-inch- (1220-mm-)** wide by **48-inch- (1220-mm-)** high louver.
 - 2) Point of Beginning Water Penetration: Not less than **550 fpm (2.8 m/s) OR 600 fpm (3.0 m/s) OR 650 fpm (3.3 m/s) OR 700 fpm (3.6 m/s)**, **as directed**.
 - 3) Air Performance: Not more than **0.10-inch wg (25-Pa)** static pressure drop at **550-fpm (2.8-m/s) OR 600-fpm (3.0-m/s) OR 650-fpm (3.3-m/s) OR 700-fpm (3.6-m/s)**, **as directed**, free-area exhaust **OR** intake, **as directed**, velocity.
- E. Adjustable, Extruded-Aluminum Louvers
 1. Louver Construction and Operation: Provide adjustable louvers with extruded-aluminum frames and blades not less than **0.080-inch (2.03-mm)** nominal thickness, and with operating mechanisms to suit louver sizes.
 - a. Hand operation with push bars.
 - b. Crank operation with removable-crank operator in sill or jamb.
 - c. Chain operation with tension spring, wall clip, pull chain, and **160 deg F (71 deg C)** fusible link.
 - d. Motor operation with 2-position, spring-return application (with power on, motor opens louver; with power off, spring closes louver); 110-V, 60-Hz motor and limit switch **OR** 2-direction, 110-V, 60-Hz motor and limit switches, **as directed**; equipped with frame-mounted switch **OR** remote-mounted switch with indicator light **OR** terminals for controlling devices, **as directed**.
 - e. Pneumatic piston operation for use with **80- to 100-psi (550- to 690-kPa)** compressed air for 2-position **OR** modulating, **as directed**, operation; power open, power close with spring-return fail-safe, **as directed**.
 2. Dual-Blade, Drainable-Blade, Adjustable Louver: Fixed drainable blades and adjustable plain blades combined in single frame.
 - a. Louver Depth: **4 inches (100 mm) OR 6 inches (150 mm)**, **as directed**, overall.
 - b. Louver Performance Ratings:
 - 1) Free Area: Not less than **6.0 sq. ft. (0.56 sq. m) OR 6.5 sq. ft. (0.60 sq. m) OR 7.0 sq. ft. (0.65 sq. m) OR 7.5 sq. ft. (0.70 sq. m) OR 8.0 sq. ft. (0.74 sq. m)**, **as directed**, for **48-inch- (1220-mm-)** wide by **48-inch- (1220-mm-)** high louver.
 - 2) Point of Beginning Water Penetration: Not less than **750 fpm (3.8 m/s) OR 800 fpm (4.1 m/s) OR 850 fpm (4.3 m/s) OR 900 fpm (4.6 m/s) OR 950 fpm (4.8 m/s) OR 1000 fpm (5.1 m/s)**, **as directed**.
 - 3) Air Performance: Not more than **0.10-inch wg (25-Pa)** static pressure drop at **750-fpm (3.8-m/s) OR 800-fpm (4.1-m/s) OR 850-fpm (4.3-m/s) OR 900-fpm (4.6-m/s)**, **as directed**, free-area exhaust **OR** intake, **as directed**, velocity.
 - 4) Air Leakage: Not more than **1.5 cfm/sq. ft. (7.6 L/s per sq. m)** of louver gross area at a differential static pressure of **0.15-inch wg (37 Pa)** with adjustable louver blades closed.

- c. AMCA Seal: Mark units with AMCA Certified Ratings Seal.
3. Single-Blade, Adjustable Louver:
 - a. Louver Depth: **4 inches (100 mm) OR 6 inches (150 mm), as directed.**
 - b. Blade Type: Drainable **OR** Plain, **as directed.**
 - c. Accessories: Equip louvers as follows:
 - 1) Vinyl blade-edge gaskets for each louver blade.
 - 2) Stainless-steel jamb seals **OR** vinyl blade-end gaskets, **as directed.**
 - d. Louver Performance Ratings:
 - 1) Free Area: Not less than **6.5 sq. ft. (0.60 sq. m) OR 7.0 sq. ft. (0.65 sq. m) OR 7.5 sq. ft. (0.70 sq. m) OR 8.0 sq. ft. (0.74 sq. m), as directed,** for **48-inch- (1220-mm-)** high louver.
 - 2) Point of Beginning Water Penetration: Not less than **500 fpm (2.5 m/s) OR 600 fpm (3.0 m/s) OR 700 fpm (3.6 m/s) OR 800 fpm (4.1 m/s) OR 900 fpm (4.6 m/s) OR 1000 fpm (5.1 m/s), as directed.**
 - 3) Air Performance: Not more than **0.10-inch wg (25-Pa)** static pressure drop at **500-fpm (2.5-m/s) OR 600-fpm (3.0-m/s) OR 700-fpm (3.6-m/s) OR 800-fpm (4.1-m/s) OR 900-fpm (4.6-m/s), as directed,** free-area exhaust **OR** intake, **as directed,** velocity.
 - 4) Air Leakage: Not more than **3.5 cfm/sq. ft. (17.8 L/s per sq. m)** of louver gross area at a differential static pressure of **0.15-inch wg (37 Pa)** with adjustable louver blades closed.
 - e. AMCA Seal: Mark units with AMCA Certified Ratings Seal.
- F. Adjustable, Formed-Metal Louvers
 1. Louver Operation: Provide adjustable louvers with operating mechanisms to suit louver sizes.
 - a. Hand operation with push bars.
 - b. Crank operation with removable-crank operator in sill or jamb.
 - c. Chain operation with tension spring, wall clip, pull chain, and **160 deg F (71 deg C)** fusible link.
 - d. Motor operation with 2-position, spring-return application (with power on, motor opens louver; with power off, spring closes louver); 110-V, 60-Hz motor and limit switch **OR** 2-direction, 110-V, 60-Hz motor and limit switches, **as directed;** equipped with frame-mounted switch **OR** remote-mounted switch with indicator light **OR** terminals for controlling devices, **as directed.**
 - e. Pneumatic piston operation for use with **80- to 100-psi (550- to 690-kPa)** compressed air for 2-position **OR** modulating, **as directed,** operation; power open, power close with spring-return fail-safe, **as directed.**
 2. Dual-Blade, Drainable-Blade, Adjustable Louver: Fixed drainable blades and adjustable plain blades combined in single frame.
 - a. Louver Depth: **4 inches (100 mm) OR 6 inches (150 mm), as directed,** overall.
 - b. Frame and Blade Material and Nominal Thickness: Galvanized-steel sheet, not less than **0.052 inch (1.32 mm)** for frames and **0.040 inch (1.02 mm)** for blades **OR 0.052 inch (1.32 mm) OR 0.064 inch (1.63 mm), as directed.**
 - c. Frame and Blade Material and Nominal Thickness: Stainless-steel sheet, not less than **0.050 inch (1.27 mm) OR 0.062 inch (1.59 mm), as directed.**
 - d. Louver Performance Ratings:
 - 1) Air Leakage: Not more than **1.5 cfm/sq. ft. (7.6 L/s per sq. m)** of louver gross area at a differential static pressure of **0.15-inch wg (37 Pa)** with adjustable louver blades closed.
 - e. AMCA Seal: Mark units with AMCA Certified Ratings Seal.
 3. Single-Blade, Adjustable Louver:
 - a. Louver Depth: **4 inches (100 mm) OR 6 inches (150 mm), as directed.**
 - b. Blade Type: Drainable **OR** Plain, **as directed.**
 - c. Frame and Blade Material and Nominal Thickness: Galvanized-steel sheet, not less than **0.052 inch (1.32 mm)** for frames and **0.040 inch (1.02 mm)** for blades **OR 0.052 inch (1.32 mm) OR 0.064 inch (1.63 mm), as directed.**

- d. Frame and Blade Material and Nominal Thickness: Stainless-steel sheet, not less than **0.050 inch (1.27 mm) OR 0.062 inch (1.59 mm), as directed.**
- e. Accessories: Equip louvers as follows:
 - 1) Vinyl blade-edge gaskets for each louver blade.
 - 2) Stainless-steel jamb seals **OR** vinyl blade-end gaskets, **as directed.**
- f. Louver Performance Ratings:
 - 1) Free Area: Not less than **6.5 sq. ft. (0.60 sq. m) OR 7.0 sq. ft. (0.65 sq. m) OR 7.5 sq. ft. (0.70 sq. m) OR 8.0 sq. ft. (0.74 sq. m), as directed,** for **48-inch- (1220-mm-)** wide by **48-inch- (1220-mm-)** high louver.
 - 2) Point of Beginning Water Penetration: Not less than **500 fpm (2.5 m/s) OR 600 fpm (3.0 m/s) OR 700 fpm (3.6 m/s) OR 800 fpm (4.1 m/s) OR 900 fpm (4.6 m/s) OR 1000 fpm (5.1 m/s), as directed.**
 - 3) Air Performance: Not more than **0.10-inch wg (25-Pa)** static pressure drop at **500-fpm (2.5-m/s) OR 600-fpm (3.0-m/s) OR 700-fpm (3.6-m/s) OR 800-fpm (4.1-m/s) OR 900-fpm (4.6-m/s), as directed,** free-area exhaust **OR** intake, **as directed,** velocity.
 - 4) Air Leakage: Not more than **3.5 cfm/sq. ft. (17.8 L/s per sq. m)** of louver gross area at a differential static pressure of **0.15-inch wg (37 Pa)** with adjustable louver blades closed.
- g. AMCA Seal: Mark units with AMCA Certified Ratings Seal.

G. Adjustable, Insulated Louvers

- 1. Louver Operation: Provide adjustable louvers with operating mechanisms to suit louver sizes.
 - a. Hand operation with push bars.
 - b. Crank operation with removable-crank operator in sill or jamb.
 - c. Chain operation with tension spring, wall clip, pull chain, and **160 deg F (71 deg C)** fusible link.
 - d. Motor operation with 2-position, spring-return application (with power on, motor opens louver; with power off, spring closes louver); 110-V, 60-Hz motor and limit switch **OR** 2-direction, 110-V, 60-Hz motor and limit switches, **as directed;** equipped with frame-mounted switch **OR** remote-mounted switch with indicator light **OR** terminals for controlling devices, **as directed.**
 - e. Pneumatic piston operation for use with **80- to 100-psi (550- to 690-kPa)** compressed air for 2-position **OR** modulating, **as directed,** operation; power open, power close with spring-return fail-safe, **as directed.**
- 2. Adjustable, Insulated, Extruded-Aluminum Louver: Single-blade, adjustable louver with gasketed, insulated blades. Frames and blade frames have urethane thermal break. Frames are extruded aluminum, not less than **0.080-inch (2.03-mm)** nominal thickness. Blade facings are aluminum sheet, not less than **0.032-inch (0.81-mm)** nominal thickness.
 - a. Louver Depth: **6 inches (150 mm) OR 9 inches (225 mm), as directed.**
 - b. Insulation: Extruded-polystyrene foam, **2 inches (50 mm)** thick **OR** Foamed-in-place polyurethane, **as directed.**
- 3. Adjustable, Insulated, Formed-Metal Louver: Single-blade, adjustable louver with gasketed, insulated blades.
 - a. Louver Depth: **6 inches (150 mm) OR 8 inches (200 mm), as directed.**
 - b. Frame Material and Nominal Thickness: Galvanized-steel sheet, not less than **0.052 inch (1.32 mm) OR 0.064 inch (1.63 mm), as directed.**
 - c. Frame Material and Nominal Thickness: Stainless-steel sheet, not less than **0.050 inch (1.27 mm) OR 0.062 inch (1.59 mm), as directed.**
 - d. Blade Material and Nominal Thickness: Galvanized-steel sheet, not less than **0.028 inch (0.71 mm) OR 0.040 inch (1.02 mm) OR 0.052 inch (1.32 mm) OR 0.064 inch (1.63 mm), as directed.**
 - e. Blade Material and Nominal Thickness: Stainless-steel sheet, not less than **0.025 inch (0.64 mm) OR 0.038 inch (0.95 mm) OR 0.050 inch (1.27 mm) OR 0.062 inch (1.59 mm), as directed.**

- f. Insulation: Extruded-polystyrene foam, **1 inch (25 mm)** thick **OR** Rigid, glass-fiber-board insulation, **1 inch (25 mm)** thick **OR** Foamed-in-place polyurethane, **1/2 inch (13 mm)** thick, **as directed**.
- H. Fixed, Acoustical Louvers
1. Fixed, Formed-Metal Acoustical Louver: Louver with formed-metal blades filled on interior with mineral-fiber, rigid-board, acoustical insulation retained by perforated metal sheet of same material and finish as blade.
 - a. Louver Depth: **6 inches (150 mm)** **OR** **8 inches (200 mm)** **OR** **12 inches (300 mm)**, **as directed**.
 - b. Frame Material: Extruded-aluminum or aluminum sheet, not less than **0.080-inch (2.03-mm)** nominal thickness.
 - c. Frame Material: Galvanized-steel sheet, not less than **0.052-inch (1.32-mm)** **OR** **0.064-inch (1.63-mm)**, **as directed**, nominal thickness.
 - d. Blade Material: Aluminum sheet, not less than **0.063-inch (1.60-mm)** **OR** **0.080-inch (2.03-mm)**, **as directed**, nominal thickness.
 - e. Blade Material: Galvanized-steel sheet, not less than **0.034-inch (0.86-mm)** **OR** **0.040-inch (1.02-mm)** **OR** **0.052-inch (1.32-mm)**, **as directed**, nominal thickness.
 - f. Blade Shape: Straight **OR** Airfoil **OR** Chevron, **as directed**.
 - g. Blade Angle: 45 degrees unless otherwise indicated.
 - h. Blade Spacing: **6 inches (150 mm)** o.c. for **6-inch- (150-mm-)** deep louvers.
 - i. Blade Spacing: **6 inches (150 mm)** **OR** **8 inches (200 mm)**, **as directed**, o.c. for **8-inch- (200-mm-)** deep louvers.
 - j. Blade Spacing: **9 inches (225 mm)** **OR** **12 inches (300 mm)**, **as directed**, o.c. for **12-inch- (300-mm-)** deep louvers.
 - k. Free Area: Not less than **4 sq. ft. (0.37 sq. m)** for **48-inch- (1220-mm-)** wide by **48-inch- (1220-mm-)** high louver.
 - l. Airborne Sound-Transmission Loss: STC 10 per ASTM E 413, determined by testing per ASTM E 90.
 - m. Outdoor-Indoor Sound-Transmission Loss: OITC 10 per ASTM E 1332, determined by testing per ASTM E 966.
- I. Louver Screens
1. General: Provide screen at each exterior louver **OR** louvers indicated, **as directed**.
 - a. Screen Location for Fixed Louvers: Interior face.
 - b. Screen Location for Adjustable Louvers: Interior **OR** Exterior, **as directed**, face unless otherwise indicated.
 - c. Screening Type: Bird screening **OR** Bird screening except where insect screening is indicated **OR** Insect screening, **as directed**.
 2. Secure screen frames to louver frames with stainless-steel machine screws **OR** machine screws with heads finished to match louver, **as directed**, spaced a maximum of **6 inches (150 mm)** from each corner and at **12 inches (300 mm)** o.c.
 3. Louver Screen Frames: Fabricate with mitered corners to louver sizes indicated.
 - a. Metal: Same kind and form of metal as indicated for louver to which screens are attached. Reinforce extruded-aluminum screen frames at corners with clips, **as directed**.
 - b. Finish: Same finish as louver frames to which louver screens are attached **OR** Mill finish unless otherwise indicated, **as directed**.
 - c. Type: Rewirable frames with a driven spline or insert **OR** Non-rewirable, U-shaped frames, **as directed**.
 4. Louver Screening for Aluminum Louvers:
 - a. Bird Screening: Aluminum, **1/2-inch- (13-mm-)** square mesh, **0.063-inch (1.60-mm)** wire.
 - b. Bird Screening: Stainless steel, **1/2-inch- (13-mm-)** square mesh, **0.047-inch (1.19-mm)** wire.
 - c. Bird Screening: Flattened, expanded aluminum, **3/4 by 0.050 inch (19 by 1.27 mm)** thick.
 - d. Insect Screening: Aluminum, **18-by-16 (1.4-by-1.6-mm)** mesh, **0.012-inch (0.30-mm)** wire.

- e. Insect Screening: Stainless steel, **18-by-18** (1.4-by-1.4-mm) mesh, **0.009-inch** (0.23-mm) wire.
- 5. Louver Screening for Galvanized-Steel Louvers:
 - a. Bird Screening: Galvanized steel, **1/2-inch-** (13-mm-) square mesh, **0.041-inch** (1.04-mm) wire.
 - b. Bird Screening: Stainless steel, **1/2-inch-** (13-mm-) square mesh, **0.047-inch** (1.19-mm) wire.
 - c. Insect Screening: Galvanized steel, **18-by-14** (1.4-by-1.8-mm) mesh, **0.011-inch** (0.28-mm) wire.
 - d. Insect Screening: Stainless steel, **18-by-18** (1.4-by-1.4-mm) mesh, **0.009-inch** (0.23-mm) wire.
- 6. Louver Screening for Stainless-Steel Louvers:
 - a. Bird Screening: Stainless steel, **1/2-inch-** (13-mm-) square mesh, **0.047-inch** (1.19-mm) wire.
 - b. Insect Screening: Stainless steel, **18-by-18** (1.4-by-1.4-mm) mesh, **0.009-inch** (0.23-mm) wire.
- J. Blank-Off Panels
 - 1. Uninsulated, Blank-Off Panels: Metal sheet attached to back of louver.
 - a. Aluminum sheet for aluminum louvers, not less than **0.050-inch** (1.27-mm) nominal thickness.
 - b. Galvanized-steel sheet for galvanized-steel louvers, not less than **0.040-inch** (1.02-mm) **OR 0.052-inch** (1.32-mm), **as directed**, nominal thickness.
 - c. Stainless-steel sheet for stainless-steel louvers, not less than **0.038-inch** (0.95-mm) **OR 0.050-inch** (1.27-mm), **as directed**, nominal thickness, with grain running in same direction as grain of louver blades.
 - d. Panel Finish: Same finish applied to louvers **OR** Same type of finish applied to louvers, but black color, **as directed**.
 - e. Attach blank-off panels with clips **OR** sheet metal screws, **as directed**.
 - 2. Insulated, Blank-Off Panels: Laminated panels consisting of insulating core surfaced on back and front with metal sheets and attached to back of louver.
 - a. Thickness: **1 inch** (25 mm) **OR 2 inches** (50 mm), **as directed**.
 - b. Metal Facing Sheets: Aluminum sheet, not less than **0.032-inch** (0.81-mm) nominal thickness.
 - c. Metal Facing Sheets: Galvanized-steel sheet, not less than **0.028-inch** (0.71-mm) nominal thickness.
 - d. Metal Facing Sheets: Stainless-steel sheet, not less than **0.031-inch** (0.79-mm) nominal thickness.
 - e. Insulating Core: Rigid, glass-fiber-board insulation **OR** extruded-polystyrene foam, **as directed**.
 - f. Edge Treatment: Trim perimeter edges of blank-off panels with louver manufacturer's standard extruded-aluminum-channel frames, not less than **0.080-inch** (2.03-mm) nominal thickness **OR** channel frames, **as directed**, with corners mitered and with same finish as panels.
 - g. Seal perimeter joints between panel faces and louver frames with gaskets or sealant.
 - h. Panel Finish: Same finish applied to louvers **OR** Same type of finish applied to louvers, but black color, **as directed**.
 - i. Attach blank-off panels with clips **OR** sheet metal screws, **as directed**.
- K. Wall Vents (Brick Vents)
 - 1. Extruded-Aluminum Wall Vents:
 - a. Extruded-aluminum louvers and frames, not less than **0.125-inch** (3.18-mm) nominal thickness, assembled by welding; with **18-by-14-** (1.4-by-1.8-mm-) mesh, aluminum insect screening on inside face; incorporating weep holes, continuous drip at sill, and integral waterstop on inside edge of sill; of load-bearing design and construction.

- b. Dampers: Aluminum blades and frames mounted on inside of wall vents; operated from exterior with Allen wrench in socket-head cap screw. Fabricate operating mechanism from Type 304 stainless-steel components.
 - c. Finish: Mill finish.
 - 2. Cast-Aluminum Wall Vents:
 - a. One-piece, cast-aluminum louvers and frames; with ~~18-by-14-~~ (1.4-by-1.8-mm-) mesh, aluminum insect screening on inside face; incorporating integral waterstop on inside edge of sill; of load-bearing design and construction.
 - b. Dampers: Aluminum blades and frames mounted on inside of wall vents; operated from exterior with Allen wrench in socket-head cap screw. Fabricate operating mechanism from Type 304 stainless-steel components.
 - c. Finish: Mill finish.
- L. Finishes, General
 - 1. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- M. Aluminum Finishes
 - 1. Finish louvers after assembly.
 - 2. Clear Anodic Finish: AAMA 611, AA-M12C22A41, Class I, 0.018 mm **OR** AA-M12C22A31, Class II, 0.010 mm, **as directed**, or thicker.
 - 3. Color Anodic Finish: AAMA 611, AA-M12C22A42/A44, Class I, 0.018 mm **OR** AA-M12C22A32/A34, Class II, 0.010 mm, **as directed**, or thicker.
 - a. Color: As selected from full range of industry colors and color densities.
 - 4. Conversion-Coated Finish: AA-C12C42 (Chemical Finish: cleaned with inhibited chemicals; Chemical Finish: acid-chromate-fluoride-phosphate conversion coating).
 - 5. Conversion-Coated and Factory-Primed Finish: AA-C12C42R1x (Chemical Finish: cleaned with inhibited chemicals; Chemical Finish: acid-chromate-fluoride-phosphate conversion coating; Organic Coating: as specified below).
 - a. Organic Coating: Air-dried primer of not less than ~~2-mil~~ (0.05-mm) dry film thickness.
 - 6. Baked-Enamel or Powder-Coat Finish: AAMA 2603 except with a minimum dry film thickness of ~~1.5 mils~~ (0.04 mm). Comply with coating manufacturer's written instructions for cleaning, conversion coating, and applying and baking finish.
 - a. Color and Gloss: As indicated by manufacturer's designations **OR** As selected from manufacturer's full range, **as directed**.
 - 7. High-Performance Organic Finish: 2-coat fluoropolymer finish complying with AAMA 2604 **OR** AAMA 2605, **as directed**, and containing not less than 50 **OR** 70, **as directed**, percent PVDF resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
 - a. Color and Gloss: As indicated by manufacturer's designations **OR** As selected from manufacturer's full range, **as directed**.
 - 8. High-Performance Organic Finish: 3 **OR** 4, **as directed**, -coat fluoropolymer finish complying with AAMA 2605 and containing not less than 50 **OR** 70, **as directed**, percent PVDF resin by weight in both color coat and clear topcoat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
 - a. Color and Gloss: As indicated by manufacturer's designations **OR** As selected from manufacturer's full range, **as directed**.
- N. Galvanized-Steel Sheet Finishes
 - 1. Finish louvers after assembly.
 - 2. Surface Preparation: Clean surfaces with nonpetroleum solvent so surfaces are free of oil and other contaminants. After cleaning, apply a conversion coating suited to the organic coating to be applied over it. Clean welds, mechanical connections, and abraded areas and repair according to ASTM A 780.
 - 3. Baked-Enamel or Powder-Coat Finish: Immediately after cleaning and pretreating, apply manufacturer's standard 2-coat, baked-on finish consisting of prime coat and thermosetting

topcoat, with a minimum dry film thickness of **1 mil (0.025 mm)** for topcoat. Comply with coating manufacturer's written instructions for applying and baking to achieve a minimum dry film thickness of **2 mils (0.05 mm)**.

- a. Color and Gloss: As indicated by manufacturer's designations **OR** As selected from manufacturer's full range, **as directed**.

O. Stainless-Steel Sheet Finishes

1. Repair sheet finish by grinding and polishing irregularities, weld spatter, scratches, and forming marks to match surrounding finish.

1.3 EXECUTION

A. Installation

1. Locate and place louvers and vents level, plumb, and at indicated alignment with adjacent work.
2. Use concealed anchorages where possible. Provide brass or lead washers fitted to screws where required to protect metal surfaces and to make a weathertight connection.
3. Form closely fitted joints with exposed connections accurately located and secured.
4. Provide perimeter reveals and openings of uniform width for sealants and joint fillers, as indicated.
5. Repair finishes damaged by cutting, welding, soldering, and grinding. Restore finishes so no evidence remains of corrective work. Return items that cannot be refinished in the field to the factory, make required alterations, and refinish entire unit or provide new units.
6. Protect unpainted galvanized and nonferrous-metal surfaces that will be in contact with concrete, masonry, or dissimilar metals from corrosion and galvanic action by applying a heavy coating of bituminous paint or by separating surfaces with waterproof gaskets or nonmetallic flashing.
7. Install concealed gaskets, flashings, joint fillers, and insulation as louver installation progresses, where weathertight louver joints are required. Comply with Division 07 Section "Joint Sealants" for sealants applied during louver installation.

B. Adjusting And Cleaning

1. Test operation of adjustable louvers and adjust as needed to produce fully functioning units that comply with requirements.
2. Clean exposed surfaces of louvers and vents that are not protected by temporary covering, to remove fingerprints and soil during construction period. Do not let soil accumulate during construction period.
3. Before final inspection, clean exposed surfaces with water and a mild soap or detergent not harmful to finishes. Thoroughly rinse surfaces and dry.
4. Restore louvers and vents damaged during installation and construction so no evidence remains of corrective work. If results of restoration are unsuccessful, as determined by the Owner, remove damaged units and replace with new units.
 - a. Touch up minor abrasions in finishes with air-dried coating that matches color and gloss of, and is compatible with, factory-applied finish coating.

END OF SECTION 08 90 00 00



Task	Specification	Specification Description
08 91 16 00	08 90 00 00	Louvers And Vents
08 95 13 00	01 22 16 00	No Specification Required
08 95 16 00	01 22 16 00	No Specification Required
08 95 16 00	05 50 00 00	Metal Fabrications
08 95 16 00	05 73 23 00	Miscellaneous Ornamental Metals

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SECTION 09 01 30 91 - CERAMIC TILE

1.1 GENERAL

A. Description Of Work

1. This specification covers the furnishing and installation of materials for ceramic tile. Products shall be as follows or as directed by the Owner. Installation procedures shall be in accordance with the product manufacturer's recommendations. Demolition and removal of materials shall be as required to support the work.

B. Summary

1. Section Includes:
 - a. Ceramic tile.
 - b. Porcelain tile.
 - c. Stone thresholds.
 - d. Waterproof membrane.
 - e. Crack isolation membrane.
 - f. Tile backing panels.
 - g. Metal edge strips.

C. Definitions

1. General: Definitions in the ANSI A108 series of tile installation standards and in ANSI A137.1 apply to Work of this Section unless otherwise specified.
2. ANSI A108 Series: ANSI A108.01, ANSI A108.02, ANSI A108.1A, ANSI A108.1B, ANSI A108.1C, ANSI A108.4, ANSI A108.5, ANSI A108.6, ANSI A108.8, ANSI A108.9, ANSI A108.10, ANSI A108.11, ANSI A108.12, ANSI A108.13, ANSI A108.14, ANSI A108.15, ANSI A108.16, and ANSI A108.17, which are contained in "American National Standard Specifications for Installation of Ceramic Tile."
3. Module Size: Actual tile size plus joint width indicated.
4. Face Size: Actual tile size, excluding spacer lugs.

D. Performance Requirements

1. Static Coefficient of Friction: For tile installed on walkway surfaces, provide products with the following values as determined by testing identical products per ASTM C 1028:
 - a. Level Surfaces: Minimum 0.6.
 - b. Step Treads: Minimum 0.6.
 - c. Ramp Surfaces: Minimum 0.8.

E. Submittals

1. Product Data: For each type of product indicated.
2. LEED Submittal:
 - a. Product Data for Credit EQ 4.1: For adhesives and sealants, including printed statement of VOC content.
3. Shop Drawings: Show locations of each type of tile and tile pattern. Show widths, details, and locations of expansion, contraction, control, and isolation joints in tile substrates and finished tile surfaces.
4. Samples:
 - a. Full-size units of each type and composition of tile and for each color and finish required. For ceramic mosaic tile in color blend patterns, provide full sheets of each color blend.

OR

Assembled samples mounted on a rigid panel, with grouted joints, for each type and composition of tile and for each color and finish required. Make samples at least **12 inches**

(300 mm) square, but not fewer than 4 tiles. Use grout of type and in color or colors approved for completed Work.

- b. Full-size units of each type of trim and accessory for each color and finish required.
- c. Stone thresholds in 6-inch (150-mm) lengths.
- d. Metal edge strips in 6-inch (150-mm) lengths.
- 5. Qualification Data: For qualified Installer.
- 6. Master Grade Certificates: For each shipment, type, and composition of tile, signed by tile manufacturer and Installer.
- 7. Product Certificates: For each type of product, signed by product manufacturer. Certification: Porcelain tile certified by the Porcelain Tile Certification Agency.
- 8. Material Test Reports: For each tile-setting and -grouting product, special purpose tile and certified porcelain tile.

F. Quality Assurance

- 1. Source Limitations for Tile: Obtain tile of each type and color or finish **OR** tile of each type **OR** tile of each color or finish **OR** tile, **as directed**, from one source or producer.
 - a. Obtain tile of each type and color or finish from same production run and of consistent quality in appearance and physical properties for each contiguous area.
- 2. Source Limitations for Setting and Grouting Materials: Obtain ingredients of a uniform quality for each mortar, adhesive, and grout component from one manufacturer and each aggregate from one source or producer.
- 3. Source Limitations for Other Products: Obtain each of the following products specified in this Section from a single manufacturer for each product.
 - a. Stone thresholds.
 - b. Waterproof membrane.
 - c. Crack isolation membrane.
 - d. Joint sealants.
 - e. Cementitious backer units.
 - f. Metal edge strips.
- 4. Preinstallation Conference: Conduct conference at Project site.

G. Delivery, Storage, And Handling

- 1. Deliver and store packaged materials in original containers with seals unbroken and labels intact until time of use. Comply with requirements in ANSI A137.1 for labeling tile packages.
- 2. Store tile and cementitious materials on elevated platforms, under cover, and in a dry location.
- 3. Store aggregates where grading and other required characteristics can be maintained and contamination can be avoided.
- 4. Store liquid materials in unopened containers and protected from freezing.
- 5. Handle tile that has temporary protective coating on exposed surfaces to prevent coated surfaces from contacting backs or edges of other units. If coating does contact bonding surfaces of tile, remove coating from bonding surfaces before setting tile.

H. Project Conditions

- 1. Environmental Limitations: Do not install tile until construction in spaces is complete and ambient temperature and humidity conditions are maintained at the levels indicated in referenced standards and manufacturer's written instructions.

1.2 PRODUCTS

A. Products, General

- 1. ANSI Ceramic Tile Standard: Provide tile that complies with ANSI A137.1 for types, compositions, and other characteristics indicated.
 - a. Provide tile complying with Standard grade requirements unless otherwise indicated.

2. ANSI Standards for Tile Installation Materials: Provide materials complying with ANSI A108.02, ANSI standards referenced in other Part 1.2 articles, ANSI standards referenced by TCA installation methods specified in tile installation schedules, and other requirements specified.
3. Factory Blending: For tile exhibiting color variations within ranges, blend tile in factory and package so tile units taken from one package show same range in colors as those taken from other packages and match approved Samples.
4. Mounting: For factory-mounted tile, provide back- or edge-mounted tile assemblies as standard with manufacturer unless otherwise indicated.
 - a. Where tile is indicated for installation in swimming pools, on exteriors or in wet areas, do not use back- or edge-mounted tile assemblies unless tile manufacturer specifies in writing that this type of mounting is suitable for installation indicated and has a record of successful in-service performance.
5. Factory-Applied Temporary Protective Coating: Where indicated under tile type, protect exposed surfaces of tile against adherence of mortar and grout by precoating with continuous film of petroleum paraffin wax, applied hot. Do not coat unexposed tile surfaces.

B. Tile Products

1. Tile Type: Factory-mounted unglazed **OR** glazed, **as directed**, ceramic mosaic tile.
 - a. Composition: Porcelain **OR** Impervious natural clay or porcelain **OR** Vitreous or impervious natural clay or porcelain, **as directed**.
 - b. Module Size: **1 by 1 inch (25.4 by 25.4 mm) OR 1 by 2 inches (25.4 by 50.8 mm) OR 2 by 2 inches (50.8 by 50.8 mm), as directed.**
 - c. Thickness: **1/4 inch (6.35 mm).**
 - d. Face: Plain **OR** Pattern of design indicated, **as directed**, with cushion edges.
 - e. Surface (for unglazed tile): Smooth, without **OR** Slip-resistant, with, **as directed**, abrasive admixture.
 - f. Finish (for glazed tile): Bright, opaque **OR** Bright, clear **OR** Mat, opaque **OR** Mat, clear **OR** Semimat, opaque **OR** Semimat, clear **OR** Vellum, opaque **OR** Vellum, clear **OR** Crystalline, **as directed**, glaze.
 - g. Tile Color and Pattern: As indicated by manufacturer's designations **OR** As selected from manufacturer's full range, **as directed**.
 - h. Grout Color: As indicated by manufacturer's designations **OR** As selected from manufacturer's full range, **as directed**.
 - i. Trim Units: Coordinated with sizes and coursing of adjoining flat tile where applicable and matching characteristics of adjoining flat tile, **as directed**. Provide shapes as follows, selected from manufacturer's standard shapes:
 - 1) Base Cove: Cove, module size **1 by 1 inch (25.4 by 25.4 mm) OR 2 by 1 inch (50.8 by 25.4 mm), as directed.**
 - 2) Base Cap for Portland Cement Mortar Installations: Bead (bullnose), module size **1 by 1 inch (25.4 by 25.4 mm) OR 2 by 1 inch (50.8 by 25.4 mm), as directed.**
 - 3) Base Cap for Thin-Set Mortar Installations: Surface bullnose, module size **1 by 1 inch (25.4 by 25.4 mm) OR 2 by 1 inch (50.8 by 25.4 mm) OR 2 by 2 inches (50.8 by 50.8 mm), as directed.**
 - 4) Wainscot Cap for Portland Cement Mortar Installations: Bead (bullnose), module size **1 by 1 inch (25.4 by 25.4 mm) OR 2 by 1 inch (50.8 by 25.4 mm), as directed.**
 - 5) Wainscot Cap for Thin-Set Mortar Installations: Surface bullnose, module size **1 by 1 inch (25.4 by 25.4 mm) OR 2 by 1 inch (50.8 by 25.4 mm) OR 2 by 2 inches (50.8 by 50.8 mm), as directed.**
 - 6) Wainscot Cap for Flush Conditions: Regular flat tile for conditions where tile wainscot is shown flush with wall surface above it, same size as adjoining flat tile.
 - 7) External Corners for Portland Cement Mortar Installations: Bead (bullnose), module size **1 by 1 inch (25.4 by 25.4 mm) OR 2 by 1 inch (50.8 by 25.4 mm), as directed.**
 - 8) External Corners for Thin-Set Mortar Installations: Surface bullnose, module size **1 by 1 inch (25.4 by 25.4 mm) OR 2 by 1 inch (50.8 by 25.4 mm) OR 2 by 2 inches (50.8 by 50.8 mm), as directed.**

- 9) Internal Corners: Cove, module size **1 by 1 inch (25.4 by 25.4 mm) OR 2 by 1 inch (50.8 by 25.4 mm), as directed.**
OR
 Internal Corners: Field-butt square corners. For coved base and cap, use angle pieces designed to fit with stretcher shapes.
- 10) Tapered Transition Tile: Shape designed to effect transition between thickness of tile floor and adjoining floor finishes of different thickness, tapered to provide reduction in thickness from **1/2 to 1/4 inch (12.7 to 6.35 mm)** across nominal **4-inch (100-mm)** dimension.
2. Tile Type: Unglazed **OR** Glazed, **as directed**, square-edged quarry tile.
 - a. Face Size: **3 by 3 inches (76 by 76 mm) OR 4 by 4 inches (102 by 102 mm) OR 6 by 3 inches (152 by 76 mm) OR 6 by 6 inches (152 by 152 mm) OR 8 by 3-7/8 inches (203 by 98 mm) OR 8 by 8 inches (203 by 203 mm), as directed.**
 - b. Thickness: **3/8 inch (9.5 mm) OR 1/2 inch (12.7 mm) OR 3/4 inch (19 mm), as directed.**
 - c. Wearing Surface (for unglazed tile): Nonabrasive, smooth **OR** Abrasive aggregate embedded in surface, **as directed.**
 - d. Finish (for glazed tile): Bright, opaque **OR** Bright, clear **OR** Mat, opaque **OR** Mat, clear **OR** Semimat, opaque **OR** Semimat, clear **OR** Vellum, opaque **OR** Vellum, clear **OR** Crystalline, **as directed**, glaze.
 - e. Tile Color and Pattern: As indicated by manufacturer's designations **OR** As selected from manufacturer's full range, **as directed.**
 - f. Grout Color: As indicated by manufacturer's designations **OR** As selected from manufacturer's full range, **as directed.**
 - g. For furan-grouted quarry tile, precoat with temporary protective coating.
 - h. Trim Units: Coordinated with sizes and coursing of adjoining flat tile where applicable and matching characteristics of adjoining flat tile, **as directed.** Provide shapes as follows, selected from manufacturer's standard shapes:
 - 1) Base: Coved with surface bullnose top edge, **as directed**, face size **6 by 6 inches (152 by 152 mm) OR 8 by 3-7/8 inches (203 by 98 mm), as directed.**
 - 2) Wainscot Cap: Surface bullnose, face size **6 by 6 inches (152 by 152 mm) OR 8 by 3-7/8 inches (203 by 98 mm), as directed.**
 - 3) Wainscot Cap for Flush Conditions: Regular flat tile for conditions where tile wainscot is shown flush with wall surface above it, same size as adjoining flat tile.
3. Tile Type: Unglazed **OR** Glazed, **as directed**, paver tile.
 - a. Composition: Porcelain **OR** Impervious natural clay or porcelain **OR** Vitreous or impervious natural clay or porcelain **OR** Natural clay or porcelain, **as directed.**
 - b. Face Size: **3 by 3 inches (76 by 76 mm) OR 4 by 4 inches (102 by 102 mm) OR 6 by 6 inches (152 by 152 mm) OR 7-3/4 by 3-7/8 inches (197 by 98 mm) OR 7-7/8 by 7-7/8 inches (200 by 200 mm) OR 11-13/16 by 11-13/16 inches (300 by 300 mm) OR 165 by 333 mm OR 200 by 250 mm OR 250 by 250 mm OR 165 by 333 mm OR 333 by 333 mm OR 400 by 400 mm, as directed.**
 - c. Thickness: **1/4 inch (6.35 mm) OR 3/8 inch (9.5 mm) OR 1/2 inch (12.7 mm), as directed.**
 - d. Face: Plain with square or cushion edges **OR** Plain with square edges **OR** Plain with cushion edges **OR** Pattern of design indicated, with square or cushion edges **OR** As indicated, **as directed.**
 - e. Finish (for glazed tile): Bright, opaque **OR** Bright, clear **OR** Mat, opaque **OR** Mat, clear **OR** Semimat, opaque **OR** Semimat, clear **OR** Vellum, opaque **OR** Vellum, clear **OR** Crystalline, **as directed**, glaze.
 - f. Tile Color and Pattern: As indicated by manufacturer's designations **OR** As selected from manufacturer's full range, **as directed.**
 - g. Grout Color: As indicated by manufacturer's designations **OR** As selected from manufacturer's full range, **as directed.**
4. Tile Type: Glazed wall tile **OR** Decorative thin wall tile, **as directed.**

- a. Module Size: 4-1/4 by 4-1/4 inches (108 by 108 mm) OR 6 by 4-1/4 inches (152 by 108 mm) OR 6 by 6 inches (152 by 152 mm) OR 200 by 200 mm OR 250 by 250 mm OR 200 by 300 mm, **as directed**.
 - b. Thickness: 5/16 inch (8 mm).
 - c. Face: Plain with modified square edges or cushion edges OR Plain with modified square edges OR Plain with cushion edges OR Pattern of design indicated, with manufacturer's standard edges, **as directed**.
 - d. Finish: Bright, opaque OR Bright, clear OR Mat, opaque OR Mat, clear OR Semimat, opaque OR Semimat, clear OR Vellum, opaque OR Vellum, clear OR Crystalline, **as directed**, glaze.
 - e. Tile Color and Pattern: As indicated by manufacturer's designations OR As selected from manufacturer's full range, **as directed**.
 - f. Grout Color: As indicated by manufacturer's designations OR As selected from manufacturer's full range, **as directed**.
 - g. Mounting: Factory, back mounted.
 - h. Mounting: PregROUTED sheets of tiles factory assembled and grouted with manufacturer's standard white silicone rubber.
 - i. Trim Units: Coordinated with sizes and coursing of adjoining flat tile where applicable and matching characteristics of adjoining flat tile, **as directed**. Provide shapes as follows, selected from manufacturer's standard shapes:
 - 1) Base for Portland Cement Mortar Installations: Coved, module size 4-1/4 by 4-1/4 inches (108 by 108 mm) OR 6 by 6 inches (152 by 152 mm) OR 6 by 3-3/4 inches (152 by 95 mm), **as directed**.
 - 2) Base for Thin-Set Mortar Installations: Straight, module size 4-1/4 by 4-1/4 inches (108 by 108 mm) OR 6 by 6 inches (152 by 152 mm) OR 6 by 2 inches (152 by 51 mm), **as directed**.
 - 3) Wainscot Cap for Portland Cement Mortar Installations: Bullnose cap, module size 4-1/4 by 4-1/4 inches (108 by 108 mm) OR 6 by 6 inches (152 by 152 mm) OR 6 by 2 inches (152 by 51 mm), **as directed**.
 - 4) Wainscot Cap for Thin-Set Mortar Installations: Surface bullnose, module size 4-1/4 by 4-1/4 inches (108 by 108 mm) OR 6 by 6 inches (152 by 152 mm) OR 6 by 2 inches (152 by 51 mm), **as directed**.
 - 5) Wainscot Cap for Flush Conditions: Regular flat tile for conditions where tile wainscot is shown flush with wall surface above it, same size as adjoining flat tile.
 - 6) External Corners for Portland Cement Mortar Installations: Bullnose shape with radius of at least 3/4 inch (19 mm) unless otherwise indicated.
 - 7) External Corners for Thin-Set Mortar Installations: Surface bullnose, same size as adjoining flat tile.
 - 8) Internal Corners: Field-butt square corners. For coved base and cap use angle pieces designed to fit with stretcher shapes.
 5. Accessories: Provide vitreous china accessories of type and size indicated, suitable for installing by same method as adjoining wall tile.
 - a. One soap holder with grab handle, **as directed**, for each shower and tub indicated.
 - b. One paper holder at each water closet.
 - c. Color and Finish: Match adjoining glazed wall tile OR As indicated by manufacturer's designations OR As selected from manufacturer's full range OR White, bright glaze, **as directed**.
- C. Thresholds
1. General: Fabricate to sizes and profiles indicated or required to provide transition between adjacent floor finishes.
 - a. Bevel edges at 1:2 slope, with lower edge of bevel aligned with or up to 1/16 inch (1.5 mm) above adjacent floor surface. Finish bevel to match top surface of threshold. Limit height of threshold to 1/2 inch (12.7 mm) or less above adjacent floor surface.
 2. Granite Thresholds: ASTM C 615, with polished OR honed, **as directed**, finish.

- a. Description: Uniform, fine **OR** medium, **as directed**, -grained, white **OR** gray **OR** black, **as directed**, stone without veining.
OR
Description: Match sample.
 3. Marble Thresholds: ASTM C 503, with a minimum abrasion resistance of 10 **OR** 12, **as directed**, per ASTM C 1353 or ASTM C 241 and with honed finish.
 - a. Description: Uniform, fine- to medium-grained white stone with gray veining.
OR
Description: Match sample.
 4. Slate Thresholds: ASTM C 629, Classification I Exterior **OR** II Interior, **as directed**, with fine, even grain and honed finish.
 - a. Description: Uniform, black **OR** blue-black **OR** gray **OR** blue-gray **OR** green, **as directed**, stone and unfading.
OR
Description: Match sample.
- D. Tile Backing Panels
 1. Cementitious Backer Units: ANSI A118.9 or ASTM C 1325, in maximum lengths available to minimize end-to-end butt joints.
 - a. Thickness: **1/4 inch (6.4 mm) OR 1/2 inch (12.7 mm) OR 5/8 inch (15.9 mm) OR** As indicated, **as directed**.
 2. Fiber-Cement Underlayment: ASTM C 1288, in maximum lengths available to minimize end-to-end butt joints.
 - a. Thickness: **1/4 inch (6.4 mm) OR 1/2 inch (12.7 mm) OR** As indicated, **as directed**.
- E. Waterproof Membrane
 1. General: Manufacturer's standard product, selected from the following, that complies with ANSI A118.10 and is recommended by the manufacturer for the application indicated. Include reinforcement and accessories recommended by manufacturer.
 2. Chlorinated Polyethylene Sheet: Nonplasticized, chlorinated polyethylene faced on both sides with nonwoven polyester fabric; **0.030-inch (0.76-mm)** nominal thickness.
 3. PVC Sheet: Two layers of PVC sheet heat-fused together and to facings of nonwoven polyester; **0.040-inch (1.01-mm)** nominal thickness.
 4. Polyethylene Sheet: Polyethylene faced on both sides with fleece webbing; **0.008-inch (0.203-mm)** nominal thickness.
 5. Fabric-Reinforced, Modified-Bituminous Sheet: Self-adhering, SBS-modified-bituminous sheet with woven reinforcement facing; **0.040-inch (1.01-mm)** nominal thickness.
 6. Fabric-Reinforced, Fluid-Applied Membrane: System consisting of liquid-latex rubber or elastomeric polymer and continuous fabric reinforcement.
 7. Fluid-Applied Membrane: Liquid-latex rubber or elastomeric polymer.
 8. Latex-Portland Cement: Flexible mortar consisting of cement-based mix and latex additive.
 9. Urethane Waterproofing and Tile-Setting Adhesive: One-part, liquid-applied urethane, with a VOC content of 65 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24), in a consistency suitable for trowel application and intended for use as both waterproofing and tile-setting adhesive in a two-step process.
- F. Crack Isolation Membrane
 1. General: Manufacturer's standard product, selected from the following, that complies with ANSI A118.12 for standard **OR** high, **as directed**, performance and is recommended by the manufacturer for the application indicated. Include reinforcement and accessories recommended by manufacturer.
 2. Chlorinated Polyethylene Sheet: Nonplasticized, chlorinated polyethylene faced on both sides with nonwoven polyester fabric; **0.030-inch (0.76-mm)** nominal thickness.
 3. PVC Sheet: Two layers of PVC sheet heat-fused together and to facings of nonwoven polyester; **0.040-inch (1.01-mm)** nominal thickness.

4. Polyethylene Sheet: Polyethylene faced on both sides with fleece webbing; **0.008-inch (0.203-mm)** nominal thickness.
5. Corrugated Polyethylene: Corrugated polyethylene with dovetail-shaped corrugations and with anchoring webbing on the underside; **3/16-inch (4-mm)** nominal thickness.
6. Fabric-Reinforced, Modified-Bituminous Sheet: Self-adhering, modified-bituminous sheet with fabric reinforcement facing; **0.040-inch (1.01-mm)** nominal thickness.
7. Fabric-Reinforced, Fluid-Applied Membrane: System consisting of liquid-latex rubber or elastomeric polymer and fabric reinforcement.
8. Fluid-Applied Membrane: Liquid-latex rubber or elastomeric polymer.
9. Latex-Portland Cement: Flexible mortar consisting of cement-based mix and latex additive.
10. Urethane Crack Isolation Membrane and Tile-Setting Adhesive: One-part, liquid-applied urethane, with a VOC content of 65 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24), in a consistency suitable for trowel application and intended for use as both waterproofing and tile-setting adhesive in a two-step process.

G. Setting Materials

1. Portland Cement Mortar (Thickset) Installation Materials: ANSI A108.02.
 - a. Cleavage Membrane: Asphalt felt, ASTM D 226, Type I (No. 15); or polyethylene sheeting, ASTM D 4397, **4.0 mils (0.1 mm)** thick.
 - b. Reinforcing Wire Fabric: Galvanized, welded wire fabric, **2 by 2 inches (50.8 by 50.8 mm)** by **0.062-inch (1.57-mm)** diameter; comply with ASTM A 1064 and ASTM A 82 except for minimum wire size.
 - c. Expanded Metal Lath: Diamond-mesh lath complying with ASTM C 847.
 - 1) Base Metal and Finish for Interior Applications: Uncoated or zinc-coated (galvanized) steel sheet, with uncoated steel sheet painted after fabrication into lath.
 - 2) Base Metal and Finish for Exterior Applications: Zinc-coated (galvanized) steel sheet.
 - 3) Configuration over Studs and Furring: Flat.
 - 4) Configuration over Solid Surfaces: Self furring.
 - 5) Weight: **2.5 lb/sq. yd. (1.4 kg/sq. m)** **OR 3.4 lb/sq. yd. (1.8 kg/sq. m), as directed.**
 - d. Latex Additive: Manufacturer's standard, acrylic resin or styrene-butadiene-rubber water emulsion, serving as replacement for part or all of gaging water, of type specifically recommended by latex-additive manufacturer for use with field-mixed portland cement and aggregate mortar bed.
2. Dry-Set Portland Cement Mortar (Thin Set): ANSI A118.1.
 - a. For wall applications, provide mortar that complies with requirements for nonsagging mortar in addition to the other requirements in ANSI A118.1.
3. Latex-Portland Cement Mortar (Thin Set): ANSI A118.4.
 - a. Provide prepackaged, dry-mortar mix containing dry, redispersible, vinyl acetate or acrylic additive to which only water must be added at Project site.
OR
Provide prepackaged, dry-mortar mix combined with acrylic resin or styrene-butadiene-rubber liquid-latex additive at Project site.
 - b. For wall applications, provide mortar that complies with requirements for nonsagging mortar in addition to the other requirements in ANSI A118.4.
4. Medium-Bed, Latex-Portland Cement Mortar: Comply with requirements in ANSI A118.4. Provide product that is approved by manufacturer for application thickness of **5/8 inch (16 mm)**.
 - a. Provide prepackaged, dry-mortar mix containing dry, redispersible, vinyl acetate or acrylic additive to which only water must be added at Project site.
OR
Provide prepackaged, dry-mortar mix combined with acrylic resin or styrene-butadiene-rubber liquid-latex additive at Project site.
5. EGP (Exterior Glue Plywood) Latex-Portland Cement Mortar (Thin Set): ANSI A118.11.
 - a. Provide prepackaged, dry-mortar mix containing dry, redispersible, vinyl acetate or acrylic additive to which only water must be added at Project site.

- b. Provide prepackaged, dry-mortar mix combined with acrylic resin or styrene-butadiene-rubber liquid-latex additive at Project site.
 6. Water-Cleanable, Tile-Setting Epoxy: ANSI A118.3, with a VOC content of 65 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 - a. Provide product capable of withstanding continuous and intermittent exposure to temperatures of up to **140 deg F (60 deg C)** and **212 deg F (100 deg C)**, respectively, and certified by manufacturer for intended use.
 7. Chemical-Resistant Furan Mortar: ANSI A118.5, with carbon filler.
 8. Organic Adhesive: ANSI A136.1, Type I, with a VOC content of 65 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- H. Grout Materials
 1. Sand-Portland Cement Grout: ANSI A108.10, composed of white or gray cement and white or colored aggregate as required to produce color indicated.
 2. Standard Cement Grout: ANSI A118.6.
 3. Polymer-Modified Tile Grout: ANSI A118.7.
 - a. Polymer Type: Ethylene vinyl acetate or acrylic additive, in dry, redispersible form, prepackaged with other dry ingredients.
 - OR**
 - Polymer Type: Acrylic resin or styrene-butadiene rubber in liquid-latex form for addition to prepackaged dry-grout mix.
 4. Water-Cleanable Epoxy Grout: ANSI A118.3.
 - a. Provide product capable of withstanding continuous and intermittent exposure to temperatures of up to **140 deg F (60 deg C)** and **212 deg F (100 deg C)**, respectively, and certified by manufacturer for intended use.
 5. Chemical-Resistant Furan Grout: ANSI A118.5, with carbon filler.
 6. Grout for PregROUTed Tile Sheets: Same product used in factory to pregROUT tile sheets.
- I. Elastomeric Sealants
 1. General: Provide sealants, primers, backer rods, and other sealant accessories that comply with the following requirements and with the applicable requirements in Division 7 Section "Joint Sealants."
 - a. Use sealants that have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 - b. Use primers, backer rods, and sealant accessories recommended by sealant manufacturer.
 2. Colors: Provide colors of exposed sealants to match colors of grout in tile adjoining sealed joints unless otherwise indicated.
 3. One-Part, Mildew-Resistant Silicone Sealant: ASTM C 920; Type S; Grade NS; Class 25; Uses NT, G, A, and, as applicable to nonporous joint substrates indicated, O; formulated with fungicide, intended for sealing interior ceramic tile joints and other nonporous substrates that are subject to in-service exposures of high humidity and extreme temperatures.
 4. Multipart, Pourable Urethane Sealant for Use T: ASTM C 920; Type M; Grade P; Class 25; Uses T, M, A, and, as applicable to joint substrates indicated, O.
 5. Chemical-Resistant Sealants: For chemical-resistant floors, provide chemical-resistant elastomeric sealant of type recommended and produced by chemical-resistant mortar and grout manufacturer for type of application indicated, with proven service record and compatibility with tile and other setting materials, and with chemical resistance equivalent to mortar/grout.
- J. Miscellaneous Materials
 1. Trowelable Underlayments and Patching Compounds: Latex-modified, portland cement-based formulation provided or approved by manufacturer of tile-setting materials for installations indicated.
 2. Metal Edge Strips: Angle or L-shape, height to match tile and setting-bed thickness, metallic or combination of metal and PVC or neoprene base, designed specifically for flooring applications;

- half-hard brass **OR** white zinc alloy **OR** nickel silver **OR** stainless-steel, ASTM A 666, 300 Series, **as directed**, exposed-edge material.
3. Temporary Protective Coating: Either product indicated below that is formulated to protect exposed surfaces of tile against adherence of mortar and grout; compatible with tile, mortar, and grout products; and easily removable after grouting is completed without damaging grout or tile.
 - a. Petroleum paraffin wax, fully refined and odorless, containing at least 0.5 percent oil with a melting point of **120 to 140 deg F (49 to 60 deg C)** per ASTM D 87.
 - b. Grout release in form of manufacturer's standard proprietary liquid coating that is specially formulated and recommended for use as temporary protective coating for tile.
 4. Tile Cleaner: A neutral cleaner capable of removing soil and residue without harming tile and grout surfaces, specifically approved for materials and installations indicated by tile and grout manufacturers.
 5. Grout Sealer: Manufacturer's standard silicone product for sealing grout joints and that does not change color or appearance of grout.
- K. Mixing Mortars And Grout
1. Mix mortars and grouts to comply with referenced standards and mortar and grout manufacturers' written instructions.
 2. Add materials, water, and additives in accurate proportions.
 3. Obtain and use type of mixing equipment, mixer speeds, mixing containers, mixing time, and other procedures to produce mortars and grouts of uniform quality with optimum performance characteristics for installations indicated.

1.3 EXECUTION

- A. Examination
1. Examine substrates, areas, and conditions where tile will be installed, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of installed tile.
 - a. Verify that substrates for setting tile are firm, dry, clean, free of coatings that are incompatible with tile-setting materials including curing compounds and other substances that contain soap, wax, oil, or silicone; and comply with flatness tolerances required by ANSI A108.01 for installations indicated.
 - b. Verify that concrete substrates for tile floors installed with adhesives, bonded mortar bed or thin-set mortar comply with surface finish requirements in ANSI A108.01 for installations indicated.
 - 1) Verify that surfaces that received a steel trowel finish have been mechanically scarified.
 - 2) Verify that protrusions, bumps, and ridges have been removed by sanding or grinding.
 - c. Verify that installation of grounds, anchors, recessed frames, electrical and mechanical units of work, and similar items located in or behind tile has been completed.
 - d. Verify that joints and cracks in tile substrates are coordinated with tile joint locations; if not coordinated, adjust joint locations in consultation with Architect.
 2. Proceed with installation only after unsatisfactory conditions have been corrected.
- B. Preparation
1. Fill cracks, holes, and depressions in concrete substrates for tile floors installed with adhesives or thin-set mortar with trowelable leveling and patching compound specifically recommended by tile-setting material manufacturer.
 2. Where indicated, prepare substrates to receive waterproofing by applying a reinforced mortar bed that complies with ANSI A108.1A and is sloped **1/4 inch per foot (1:50)** toward drains.
 3. Blending: For tile exhibiting color variations, verify that tile has been factory blended and packaged so tile units taken from one package show same range of colors as those taken from

other packages and match approved Samples. If not factory blended, either return to manufacturer or blend tiles at Project site before installing.

4. Field-Applied Temporary Protective Coating: If indicated under tile type or needed to prevent grout from staining or adhering to exposed tile surfaces, precoat them with continuous film of temporary protective coating, taking care not to coat unexposed tile surfaces.

C. Tile Installation

1. Comply with TCA's "Handbook for Ceramic Tile Installation" for TCA installation methods specified in tile installation schedules. Comply with parts of the ANSI A108 Series "Specifications for Installation of Ceramic Tile" that are referenced in TCA installation methods, specified in tile installation schedules, and apply to types of setting and grouting materials used.
 - a. For the following installations, follow procedures in the ANSI A108 Series of tile installation standards for providing 95 percent mortar coverage:
 - 1) Exterior tile floors.
 - 2) Tile floors in wet areas.
 - 3) Tile swimming pool decks.
 - 4) Tile floors in laundries.
 - 5) Tile floors composed of tiles **8 by 8 inches (200 by 200 mm)** or larger.
 - 6) Tile floors composed of rib-backed tiles.
2. Extend tile work into recesses and under or behind equipment and fixtures to form complete covering without interruptions unless otherwise indicated. Terminate work neatly at obstructions, edges, and corners without disrupting pattern or joint alignments.
3. Accurately form intersections and returns. Perform cutting and drilling of tile without marring visible surfaces. Carefully grind cut edges of tile abutting trim, finish, or built-in items for straight aligned joints. Fit tile closely to electrical outlets, piping, fixtures, and other penetrations so plates, collars, or covers overlap tile.
4. Jointing Pattern: Lay tile in grid pattern unless otherwise indicated. Lay out tile work and center tile fields in both directions in each space or on each wall area. Lay out tile work to minimize the use of pieces that are less than half of a tile. Provide uniform joint widths unless otherwise indicated.
 - a. For tile mounted in sheets, make joints between tile sheets same width as joints within tile sheets so joints between sheets are not apparent in finished work.
 - b. Where adjoining tiles on floor, base, walls, or trim are specified or indicated to be same size, align joints.
 - c. Where tiles are specified or indicated to be whole integer multiples of adjoining tiles on floor, base, walls, or trim, align joints unless otherwise indicated.
5. Joint Widths: Unless otherwise indicated, install tile with the following joint widths:
 - a. Ceramic Mosaic Tile: **1/16 inch (1.6 mm)**.
 - b. Porcelain Tile: **1/4 inch (6.4 mm) OR 3/8 inch (9.5 mm), as directed.**
 - c. Quarry Tile: **1/4 inch (6.35 mm) OR 3/8 inch (9.5 mm), as directed.**
 - d. Paver Tile: **1/4 inch (6.35 mm) OR 3/8 inch (9.5 mm), as directed.**
 - e. Glazed Wall Tile: **1/16 inch (1.6 mm)**.
 - f. Decorative Thin Wall Tile: **1/16 inch (1.6 mm)**.
6. Lay out tile wainscots to dimensions indicated or to next full tile beyond dimensions indicated.
7. Expansion Joints: Provide expansion joints and other sealant-filled joints, including control, contraction, and isolation joints, where indicated. Form joints during installation of setting materials, mortar beds, and tile. Do not saw-cut joints after installing tiles.
 - a. Where joints occur in concrete substrates, locate joints in tile surfaces directly above them.
 - b. Prepare joints and apply sealants to comply with requirements in Division 07 Section "Joint Sealants".
8. Stone Thresholds: Install stone thresholds in same type of setting bed as adjacent floor unless otherwise indicated.
 - a. At locations where mortar bed (thickset) would otherwise be exposed above adjacent floor finishes, set thresholds in latex-portland cement mortar (thin set).

- b. Do not extend cleavage membrane, waterproofing or crack isolation membrane under thresholds set in dry-set portland cement or latex-portland cement mortar. Fill joints between such thresholds and adjoining tile set on cleavage membrane, waterproofing or crack isolation membrane with elastomeric sealant.
 - 9. Metal Edge Strips: Install at locations indicated **OR** where exposed edge of tile flooring meets carpet, wood, or other flooring that finishes flush with top of tile **OR** where exposed edge of tile flooring meets carpet, wood, or other flooring that finishes flush with or below top of tile and no threshold is indicated, **as directed**.
 - 10. Grout Sealer: Apply grout sealer to cementitious grout joints in tile floors according to grout-sealer manufacturer's written instructions. As soon as grout sealer has penetrated grout joints, remove excess sealer and sealer from tile faces by wiping with soft cloth.
- D. Tile Backing Panel Installation
- 1. Install cementitious backer units and fiber-cement underlayment and treat joints according to ANSI A108.11 and manufacturer's written instructions for type of application indicated. Use latex-portland cement mortar for bonding material unless otherwise directed in manufacturer's written instructions.
- E. Waterproofing Installation
- 1. Install waterproofing to comply with ANSI A108.13 and manufacturer's written instructions to produce waterproof membrane of uniform thickness and bonded securely to substrate.
 - 2. Do not install tile or setting materials over waterproofing until waterproofing has cured and been tested to determine that it is watertight.
- F. Crack Isolation Membrane Installation
- 1. Install crack isolation membrane to comply with ANSI A108.17 and manufacturer's written instructions to produce membrane of uniform thickness and bonded securely to substrate.
 - 2. Do not install tile or setting materials over crack isolation membrane until membrane has cured.
- G. Cleaning And Protecting
- 1. Cleaning: On completion of placement and grouting, clean all ceramic tile surfaces so they are free of foreign matter.
 - a. Remove epoxy and latex-portland cement grout residue from tile as soon as possible.
 - b. Clean grout smears and haze from tile according to tile and grout manufacturer's written instructions but no sooner than 10 days after installation. Use only cleaners recommended by tile and grout manufacturers and only after determining that cleaners are safe to use by testing on samples of tile and other surfaces to be cleaned. Protect metal surfaces and plumbing fixtures from effects of cleaning. Flush surfaces with clean water before and after cleaning.
 - c. Remove temporary protective coating by method recommended by coating manufacturer and that is acceptable to tile and grout manufacturer. Trap and remove coating to prevent drain clogging.
 - 2. Protect installed tile work with kraft paper or other heavy covering during construction period to prevent staining, damage, and wear. If recommended by tile manufacturer, apply coat of neutral protective cleaner to completed tile walls and floors.
 - 3. Prohibit foot and wheel traffic from tiled floors for at least seven days after grouting is completed.
 - 4. Before final inspection, remove protective coverings and rinse neutral protective cleaner from tile surfaces.
- H. Exterior Tile Installation Schedule
- 1. Exterior Floor Installations:
 - a. Tile Installation F101: Cement mortar bed (thickset) bonded to concrete **OR** over waterproof membrane on concrete **OR** over waterproof membrane on concrete where indicated and bonded to concrete where membrane is not indicated, **as directed**; TCA F101 and ANSI A108.1A **OR** ANSI A108.1B **OR** ANSI A108.1C, **as directed**.
 - 1) Tile Type: as directed by the Owner.

- 2) Thin-Set Mortar for Cured-Bed Method: Dry-set **OR** Latex- **OR** Medium-bed, latex-, **as directed**, portland cement mortar.
- 3) Grout: Sand-portland cement **OR** Standard sanded cement **OR** Standard unsanded cement **OR** Polymer-modified sanded **OR** Polymer-modified unsanded, **as directed**, grout.
- b. Tile Installation F102: Thin-set mortar on concrete **OR** over waterproof membrane on concrete **OR** over waterproof membrane on concrete where indicated and on concrete where membrane is not indicated, **as directed**; TCA F102.
 - 1) Tile Type: as directed by the Owner.
 - 2) Thin-Set Mortar: Dry-set **OR** Latex- **OR** Medium-bed, latex-, **as directed**, portland cement mortar.
 - 3) Grout: Sand-portland cement **OR** Standard sanded cement **OR** Standard unsanded cement **OR** Polymer-modified sanded **OR** Polymer-modified unsanded, **as directed**, grout.
2. Exterior Wall Installations, Masonry or Concrete:
 - a. Tile Installation W201: Cement mortar bed (thickset) on metal lath over waterproof membrane; TCA W201 and ANSI A108.1A **OR** ANSI A108.1B **OR** ANSI A108.1C, **as directed**.
 - 1) Tile Type: as directed by the Owner.
 - 2) Bond Coat Mortar for Wet-Set Method: Dry-set **OR** Latex-, **as directed**, portland cement mortar.
 - 3) Thin-Set Mortar for Cured-Bed Method: Dry-set **OR** Latex-, **as directed**, portland cement mortar.
 - 4) Grout: Sand-portland cement **OR** Standard sanded cement **OR** Standard unsanded cement **OR** Polymer-modified sanded **OR** Polymer-modified unsanded, **as directed**, grout.
 - b. Tile Installation W202: Thin-set mortar; TCA W202.
 - 1) Tile Type: as directed by the Owner.
 - 2) Thin-Set Mortar: Dry-set **OR** Latex- **OR** Medium-bed, latex-, **as directed**, portland cement mortar.
 - 3) Grout: Sand-portland cement **OR** Standard sanded cement **OR** Standard unsanded cement **OR** Polymer-modified sanded **OR** Polymer-modified unsanded, **as directed**, grout.
- I. Interior Tile Installation Schedule
 1. Interior Floor Installations, Concrete Subfloor:
 - a. Tile Installation F111: Cement mortar bed (thickset) with cleavage membrane; TCA F111 and ANSI A108.1A **OR** ANSI A108.1B **OR** ANSI A108.1C, **as directed**.
 - 1) Tile Type: as directed by the Owner.
 - 2) Thin-Set Mortar for Cured-Bed Method: Dry-set **OR** Latex- **OR** Medium-bed, latex-, **as directed**, portland cement mortar.
 - 3) Grout: Sand-portland cement **OR** Standard sanded cement **OR** Standard unsanded cement **OR** Polymer-modified sanded **OR** Polymer-modified unsanded, **as directed**, grout.
 - b. Tile Installation F112: Cement mortar bed (thickset) bonded to concrete; TCA F112 and ANSI A108.1A **OR** ANSI A108.1B **OR** ANSI A108.1C, **as directed**.
 - 1) Tile Type: as directed by the Owner.
 - 2) Thin-Set Mortar for Cured-Bed Method: Dry-set **OR** Latex- **OR** Medium-bed, latex-, **as directed**, portland cement mortar.
 - 3) Grout: Sand-portland cement **OR** Standard sanded cement **OR** Standard unsanded cement **OR** Polymer-modified sanded **OR** Polymer-modified unsanded, **as directed**, grout.
 - c. Tile Installation F113: Thin-set mortar; TCA F113.
 - 1) Tile Type: as directed by the Owner.

- 2) Thin-Set Mortar: Dry-set **OR** Latex- **OR** Medium-bed, latex-, **as directed**, portland cement mortar.
 - 3) Grout: Sand-portland cement **OR** Standard sanded cement **OR** Standard unsanded cement **OR** Polymer-modified sanded **OR** Polymer-modified unsanded **OR** Water-cleanable epoxy, **as directed**, grout.
 - d. Tile Installation F114: Cement mortar bed (thickset) with cleavage membrane; epoxy **OR** furan, **as directed**, grout; TCA F114 and ANSI A108.1B.
 - 1) Tile Type: as directed by the Owner.
 - 2) Thin-Set Mortar for Cured-Bed Method: Dry-set **OR** Latex- **OR** Medium-bed, latex-, **as directed**, portland cement mortar.
 - 3) Grout: Water-cleanable epoxy **OR** Chemical-resistant furan, **as directed**, grout.
 - e. Tile Installation F115: Thin-set mortar; epoxy **OR** furan, **as directed**, grout; TCA F115.
 - 1) Tile Type: as directed by the Owner.
 - 2) Thin-Set Mortar: Dry-set **OR** Latex- **OR** Medium-bed, latex-, **as directed**, portland cement mortar.
 - 3) Grout: Water-cleanable epoxy **OR** Chemical-resistant furan, **as directed**, grout.
 - f. Tile Installation F116: Organic adhesive **OR** Water-cleanable, tile-setting epoxy, **as directed**; TCA F116.
 - 1) Tile Type: as directed by the Owner.
 - 2) Grout: Sand-portland cement **OR** Standard sanded cement **OR** Standard unsanded cement **OR** Polymer-modified sanded **OR** Polymer-modified unsanded **OR** Water-cleanable epoxy, **as directed**, grout.
 - g. Tile Installation F121: Cement mortar bed (thickset) on waterproof membrane; TCA F121 and ANSI A108.1A **OR** ANSI A108.1B **OR** ANSI A108.1C, **as directed**.
 - 1) Tile Type: as directed by the Owner.
 - 2) Thin-Set Mortar for Cured-Bed Method: Dry-set **OR** Latex- **OR** Medium-bed, latex-, **as directed**, portland cement mortar.
 - 3) Grout: Sand-portland cement **OR** Standard sanded cement **OR** Standard unsanded cement **OR** Polymer-modified sanded **OR** Polymer-modified unsanded, **as directed**, grout.
 - h. Tile Installation F122: Thin-set mortar on waterproof membrane; TCA F122.
 - 1) Tile Type: as directed by the Owner.
 - 2) Thin-Set Mortar: Latex- **OR** Medium-bed, latex-, **as directed**, portland cement mortar.
 - 3) Grout: Polymer-modified sanded **OR** unsanded, **as directed**, grout.
 - i. Tile Installation F125A: Thin-set mortar on crack isolation membrane; TCA F125A.
 - 1) Tile Type: as directed by the Owner.
 - 2) Thin-Set Mortar: Latex- **OR** Medium-bed, latex-, **as directed**, portland cement mortar.
 - 3) Grout: Standard sanded cement **OR** Standard unsanded cement **OR** Polymer-modified sanded **OR** Polymer-modified unsanded **OR** Water-cleanable epoxy, **as directed**, grout.
 - j. Tile Installation F131: Water-cleanable, tile-setting epoxy; epoxy grout; TCA F131.
 - 1) Tile Type: as directed by the Owner.
 - 2) Grout: Water-cleanable epoxy grout.
 - k. Tile Installation F132: Water-cleanable, tile-setting epoxy on cured cement mortar bed bonded to concrete subfloor **OR** installed over cleavage membrane, **as directed**; epoxy grout; TCA F132.
 - 1) Tile Type: as directed by the Owner.
 - 2) Grout: Water-cleanable epoxy grout.
 - l. Tile Installation F133: Chemical-resistant furan mortar **OR** Water-cleanable, tile-setting epoxy, **as directed**; furan grout. TCA F133 except use water-cleanable, tile-setting epoxy instead of chemical-resistant furan mortar for setting tile.
 - 1) Tile Type: as directed by the Owner.
 - 2) Grout: Chemical-resistant furan grout.
2. Interior Floor Installations, Wood Subfloor:

- a. Tile Installation F121: Cement mortar bed (thickset) on waterproof membrane; TCA F121 and ANSI A108.1A **OR** ANSI A108.1B **OR** ANSI A108.1C, **as directed**.
 - 1) Tile Type: as directed by the Owner.
 - 2) Thin-Set Mortar for Cured-Bed Method: Dry-set **OR** Latex- **OR** Medium-bed, latex-, **as directed**, portland cement mortar.
 - 3) Grout: Sand-portland cement **OR** Standard sanded cement **OR** Standard unsanded cement **OR** Polymer-modified sanded **OR** Polymer-modified unsanded **OR** Water-cleanable epoxy, **as directed**, grout.
- b. Tile Installation F141: Cement mortar bed (thickset) with cleavage membrane; TCA F141 and ANSI A108.1A **OR** ANSI A108.1B **OR** ANSI A108.1C, **as directed**.
 - 1) Tile Type: as directed by the Owner.
 - 2) Thin-Set Mortar for Cured-Bed Method: Dry-set **OR** Latex- **OR** Medium-bed, latex-, **as directed**, portland cement mortar.
 - 3) Grout: Sand-portland cement **OR** Standard sanded cement **OR** Standard unsanded cement **OR** Polymer-modified sanded **OR** Polymer-modified unsanded **OR** Water-cleanable epoxy, **as directed**, grout.
- c. Tile Installation F142: Organic adhesive; TCA F142.
 - 1) Tile Type: as directed by the Owner.
 - 2) Grout: Sand-portland cement **OR** Standard sanded cement **OR** Standard unsanded cement **OR** Polymer-modified sanded **OR** Polymer-modified unsanded **OR** Water-cleanable epoxy, **as directed**, grout.
- d. Tile Installation F143: Water-cleanable, tile-setting epoxy; epoxy grout; TCA F143.
 - 1) Tile Type: as directed by the Owner.
 - 2) Grout: Water-cleanable epoxy grout.
- e. Tile Installation F144: Thin-set mortar on cementitious backer units or fiber cement underlayment; TCA F144.
 - 1) Tile Type: as directed by the Owner.
 - 2) Thin-Set Mortar: Dry-set **OR** Latex- **OR** Medium-bed, latex-, **as directed**, portland cement mortar.
 - 3) Grout: Sand-portland cement **OR** Standard sanded cement **OR** Standard unsanded cement **OR** Polymer-modified sanded **OR** Polymer-modified unsanded **OR** Water-cleanable epoxy, **as directed**, grout.
- f. Tile Installation F150/160: Thin-set mortar on exterior-glue plywood; TCA F150 or TCA F160.
 - 1) Tile Type: as directed by the Owner.
 - 2) Thin-Set Mortar: EGP latex-portland cement mortar.
 - 3) Grout: Sand-portland cement **OR** Standard sanded cement **OR** Standard unsanded cement **OR** Polymer-modified sanded **OR** Polymer-modified unsanded **OR** Water-cleanable epoxy, **as directed**, grout.
3. Interior Radiant Heat Floor Installations, Concrete Subfloor:
 - a. Tile Installation RH110: Thin-set mortar on crack isolation membrane; hydronic piping installed in concrete; TCA RH110.
 - 1) Tile Type: as directed by the Owner.
 - 2) Thin-Set Mortar: Latex- **OR** Medium-bed, latex-, **as directed**, portland cement mortar.
 - 3) Grout: Sand-portland cement **OR** Standard sanded cement **OR** Standard unsanded cement **OR** Polymer-modified sanded **OR** Polymer-modified unsanded **OR** Water-cleanable epoxy, **as directed**, grout.
 - b. Tile Installation RH115: Thin-set mortar; electric radiant system encapsulated in thin-set mortar; TCA RH115.
 - 1) Tile Type: as directed by the Owner.
 - 2) Thin-Set Mortar: Latex- **OR** Medium-bed, latex-, **as directed**, portland cement mortar.

- 3) Grout: Sand-portland cement **OR** Standard sanded cement **OR** Standard unsanded cement **OR** Polymer-modified sanded **OR** Polymer-modified unsanded **OR** Water-cleanable epoxy, **as directed**, grout.
- c. Tile Installation RH116: Thin-set mortar on crack isolation membrane; electric radiant system encapsulated in cementitious self-leveling underlayment; TCA RH116.
 - 1) Tile Type: as directed by the Owner.
 - 2) Cementitious Self-Leveling Underlayment: Specified in Division 03 Section "Hydraulic Cement Underlayment".
 - 3) Thin-Set Mortar: Latex- **OR** Medium-bed, latex-, **as directed**, portland cement mortar.
 - 4) Grout: Sand-portland cement **OR** Standard sanded cement **OR** Standard unsanded cement **OR** Polymer-modified sanded **OR** Polymer-modified unsanded **OR** Water-cleanable epoxy, **as directed**, grout.
4. Interior Radiant Heat Floor Installations, Wood Subfloor:
 - a. Tile Installation RH130: Thin-set mortar on exterior-glue plywood; electric radiant system encapsulated in thin-set mortar; TCA RH130.
 - 1) Tile Type: as directed by the Owner.
 - 2) Thin-Set Mortar: EGP latex-portland cement mortar.
 - 3) Grout: Sand-portland cement **OR** Standard sanded cement **OR** Standard unsanded cement **OR** Polymer-modified sanded **OR** Polymer-modified unsanded **OR** Water-cleanable epoxy, **as directed**, grout.
 - b. Tile Installation RH135: Thin-set mortar on cementitious backer units or fiber cement underlayment; electric radiant system encapsulated in thin-set mortar; TCA RH135.
 - 1) Tile Type: as directed by the Owner.
 - 2) Thin-Set Mortar: Latex- **OR** Medium-bed, latex-, **as directed**, portland cement mortar.
 - 3) Grout: Sand-portland cement **OR** Standard sanded cement **OR** Standard unsanded cement **OR** Polymer-modified sanded **OR** Polymer-modified unsanded **OR** Water-cleanable epoxy, **as directed**, grout.
 - c. Tile Installation RH140: Thin-set mortar on crack isolation membrane; electric radiant system encapsulated in cementitious self-leveling underlayment; TCA RH140.
 - 1) Tile Type: as directed by the Owner.
 - 2) Cementitious Self-Leveling Underlayment: Specified in Division 03 Section "Hydraulic Cement Underlayment".
 - 3) Thin-Set Mortar: Latex- **OR** Medium-bed, latex-, **as directed**, portland cement mortar.
 - 4) Grout: Sand-portland cement **OR** Standard sanded cement **OR** Standard unsanded cement **OR** Polymer-modified sanded **OR** Polymer-modified unsanded **OR** Water-cleanable epoxy, **as directed**, grout.
5. Interior Wall Installations, Masonry or Concrete:
 - a. Tile Installation W202: Thin-set mortar; TCA W202.
 - 1) Tile Type: as directed by the Owner.
 - 2) Thin-Set Mortar: Dry-set **OR** Latex- **OR** Medium-bed, latex-, **as directed**, portland cement mortar.
 - 3) Grout: Sand-portland cement **OR** Standard sanded cement **OR** Standard unsanded cement **OR** Polymer-modified sanded **OR** Polymer-modified unsanded **OR** Water-cleanable epoxy, **as directed**, grout.
 - b. Tile Installation W211: Cement mortar bed (thickset) bonded to substrate; TCA W211 and ANSI A108.1A **OR** ANSI A108.1B **OR** ANSI A108.1C, **as directed**.
 - 1) Tile Type: as directed by the Owner.
 - 2) Bond Coat Mortar for Wet-Set Method: Dry-set **OR** Latex-, **as directed**, portland cement mortar.
 - 3) Thin-Set Mortar for Cured-Bed Method: Dry-set **OR** Latex-, **as directed**, portland cement mortar.

- 4) Grout: Sand-portland cement **OR** Standard sanded cement **OR** Standard unsanded cement **OR** Polymer-modified sanded **OR** Polymer-modified unsanded **OR** Water-cleanable epoxy, **as directed**, grout.
- c. Tile Installation W221: Cement mortar bed (thickset) on metal lath over waterproof membrane, **as directed**; TCA W221 and ANSI A108.1A **OR** ANSI A108.1B **OR** ANSI A108.1C, **as directed**.
 - 1) Tile Type: as directed by the Owner.
 - 2) Bond Coat Mortar for Wet-Set Method: Dry-set **OR** Latex-, **as directed**, portland cement mortar.
 - 3) Thin-Set Mortar for Cured-Bed Method: Dry-set **OR** Latex-, **as directed**, portland cement mortar.
 - 4) Grout: Sand-portland cement **OR** Standard sanded cement **OR** Standard unsanded cement **OR** Polymer-modified sanded **OR** Polymer-modified unsanded **OR** Water-cleanable epoxy, **as directed**, grout.
- d. Tile Installation W222: One-coat cement mortar bed (thickset) on metal lath over waterproof membrane, **as directed**; TCA W222 and ANSI A108.1A **OR** ANSI A108.1B **OR** ANSI A108.1C, **as directed**.
 - 1) Tile Type: as directed by the Owner.
 - 2) Bond Coat Mortar for Wet-Set Method: Dry-set **OR** Latex-, **as directed**, portland cement mortar.
 - 3) Thin-Set Mortar for Cured-Bed Method: Dry-set **OR** Latex-, **as directed**, portland cement mortar.
 - 4) Grout: Sand-portland cement **OR** Standard sanded cement **OR** Standard unsanded cement **OR** Polymer-modified sanded **OR** Polymer-modified unsanded, **as directed**, grout.
- e. Tile Installation W223: Organic adhesive; TCA W223.
 - 1) Tile Type: as directed by the Owner.
 - 2) Grout: Sand-portland cement **OR** Standard sanded cement **OR** Standard unsanded cement **OR** Polymer-modified sanded **OR** Polymer-modified unsanded, **as directed**, grout.
6. Interior Wall Installations, Wood Studs or Furring:
 - a. Tile Installation W221: Cement mortar bed (thickset) over waterproof membrane, **as directed**, on solid backing; TCA W221 and ANSI A108.1A **OR** ANSI A108.1B **OR** ANSI A108.1C, **as directed**.
 - 1) Tile Type: as directed by the Owner.
 - 2) Bond Coat Mortar for Wet-Set Method: Dry-set **OR** Latex-, **as directed**, portland cement mortar.
 - 3) Thin-Set Mortar for Cured-Bed Method: Dry-set **OR** Latex-, **as directed**, portland cement mortar.
 - 4) Grout: Sand-portland cement **OR** Standard sanded cement **OR** Standard unsanded cement **OR** Polymer-modified sanded **OR** Polymer-modified unsanded **OR** Water-cleanable epoxy, **as directed**, grout.
 - b. Tile Installation W222: One-coat cement mortar bed (thickset) over waterproof membrane, **as directed**, on solid backing; TCA W222 and ANSI A108.1A **OR** ANSI A108.1B **OR** ANSI A108.1C, **as directed**.
 - 1) Tile Type: as directed by the Owner.
 - 2) Bond Coat Mortar for Wet-Set Method: Dry-set **OR** Latex-, **as directed**, portland cement mortar.
 - 3) Thin-Set Mortar for Cured-Bed Method: Dry-set **OR** Latex-, **as directed**, portland cement mortar.
 - 4) Grout: Sand-portland cement **OR** Standard sanded cement **OR** Standard unsanded cement **OR** Polymer-modified sanded **OR** Polymer-modified unsanded **OR** Water-cleanable epoxy, **as directed**, grout.
 - c. Tile Installation W223: Organic adhesive on solid backing; TCA W223.
 - 1) Tile Type: as directed by the Owner.

- 2) Grout: Sand-portland cement **OR** Standard sanded cement **OR** Standard unsanded cement **OR** Polymer-modified sanded **OR** Polymer-modified unsanded, **as directed**, grout.
- d. Tile Installation W231: Cement mortar bed (thickset); TCA W231 and ANSI A108.1A **OR** ANSI A108.1B **OR** ANSI A108.1C, **as directed**.
 - 1) Tile Type: as directed by the Owner.
 - 2) Bond Coat Mortar for Wet-Set Method: Dry-set **OR** Latex-, **as directed**, portland cement mortar.
 - 3) Thin-Set Mortar for Cured-Bed Method: Dry-set **OR** Latex-, **as directed**, portland cement mortar.
 - 4) Grout: Sand-portland cement **OR** Standard sanded cement **OR** Standard unsanded cement **OR** Polymer-modified sanded **OR** Polymer-modified unsanded, **as directed**, grout.
- e. Tile Installation W243: Thin-set mortar on gypsum board; TCA W243.
 - 1) Tile Type: as directed by the Owner.
 - 2) Thin-Set Mortar: Dry-set **OR** Latex-, **as directed**, portland cement mortar.
 - 3) Grout: Sand-portland cement **OR** Standard sanded cement **OR** Standard unsanded cement **OR** Polymer-modified sanded **OR** Polymer-modified unsanded, **as directed**, grout.
- f. Tile Installation W244: Thin-set mortar on cementitious backer units or fiber cement underlayment over cleavage membrane, **as directed**; TCA W244.
 - 1) Tile Type: as directed by the Owner.
 - 2) Thin-Set Mortar: Dry-set **OR** Latex-, **as directed**, portland cement mortar.
 - 3) Grout: Sand-portland cement **OR** Standard sanded cement **OR** Standard unsanded cement **OR** Polymer-modified sanded **OR** Polymer-modified unsanded **OR** Water-cleanable epoxy, **as directed**, grout.
- g. Tile Installation W245: Thin-set mortar **OR** Organic adhesive, **as directed**, on coated glass-mat, water-resistant gypsum backer board; TCA W245.
 - 1) Tile Type: as directed by the Owner.
 - 2) Thin-Set Mortar: Dry-set **OR** Latex-, **as directed**, portland cement mortar.
 - 3) Grout: Sand-portland cement **OR** Standard sanded cement **OR** Standard unsanded cement **OR** Polymer-modified sanded **OR** Polymer-modified unsanded **OR** Water-cleanable epoxy, **as directed**, grout.
7. Interior Wall Installations, Metal Studs or Furring:
 - a. Tile Installation W221: Cement mortar bed (thickset) over waterproof membrane, **as directed**, on solid backing; TCA W221 and ANSI A108.1A **OR** ANSI A108.1B **OR** ANSI A108.1C, **as directed**.
 - 1) Tile Type: as directed by the Owner.
 - 2) Bond Coat Mortar for Wet-Set Method: Dry-set **OR** Latex-, **as directed**, portland cement mortar.
 - 3) Thin-Set Mortar for Cured-Bed Method: Dry-set **OR** Latex-, **as directed**, portland cement mortar.
 - 4) Grout: Sand-portland cement **OR** Standard sanded cement **OR** Standard unsanded cement **OR** Polymer-modified sanded **OR** Polymer-modified unsanded **OR** Water-cleanable epoxy, **as directed**, grout.
 - b. Tile Installation W222: One-coat cement mortar bed (thickset) over waterproof membrane, **as directed**, on solid backing; TCA W222 and ANSI A108.1A **OR** ANSI A108.1B **OR** ANSI A108.1C, **as directed**.
 - 1) Tile Type: as directed by the Owner.
 - 2) Bond Coat Mortar for Wet-Set Method: Dry-set **OR** Latex-, **as directed**, portland cement mortar.
 - 3) Thin-Set Mortar for Cured-Bed Method: Dry-set **OR** Latex-, **as directed**, portland cement mortar.
 - 4) Grout: Sand-portland cement **OR** Standard sanded cement **OR** Standard unsanded cement **OR** Polymer-modified sanded **OR** Polymer-modified unsanded **OR** Water-cleanable epoxy, **as directed**, grout.

- c. Tile Installation W223: Organic adhesive on solid backing; TCA W223.
 - 1) Tile Type: as directed by the Owner.
 - 2) Grout: Sand-portland cement **OR** Standard sanded cement **OR** Standard unsanded cement **OR** Polymer-modified sanded **OR** Polymer-modified unsanded, **as directed**, grout.
- d. Tile Installation W241: Cement mortar bed (thickset); TCA W241 and ANSI A108.1B.
 - 1) Tile Type: as directed by the Owner.
 - 2) Thin-Set Mortar for Cured-Bed Method: Dry-set **OR** Latex-, **as directed**, portland cement mortar.
 - 3) Grout: Sand-portland cement **OR** Standard sanded cement **OR** Standard unsanded cement **OR** Polymer-modified sanded **OR** Polymer-modified unsanded, **as directed**, grout.
- e. Tile Installation W242: Organic adhesive on gypsum board; TCA W242.
 - 1) Tile Type: as directed by the Owner.
 - 2) Grout: Polymer-modified sanded **OR** Polymer-modified unsanded, **as directed**, grout.
- f. Tile Installation W243: Thin-set mortar on gypsum board; TCA W243.
 - 1) Tile Type: as directed by the Owner.
 - 2) Thin-Set Mortar: Dry-set **OR** Latex-, **as directed**, portland cement mortar.
 - 3) Grout: Sand-portland cement **OR** Standard sanded cement **OR** Standard unsanded cement **OR** Polymer-modified sanded **OR** Polymer-modified unsanded, **as directed**, grout.
- g. Tile Installation W244: Thin-set mortar on cementitious backer units or fiber cement underlayment over cleavage membrane, **as directed**; TCA W244.
 - 1) Tile Type: as directed by the Owner.
 - 2) Thin-Set Mortar: Dry-set **OR** Latex-, **as directed**, portland cement mortar.
 - 3) Grout: Sand-portland cement **OR** Standard sanded cement **OR** Standard unsanded cement **OR** Polymer-modified sanded **OR** Polymer-modified unsanded **OR** Water-cleanable epoxy, **as directed**, grout.
- h. Tile Installation W245: Thin-set mortar **OR** Organic adhesive, **as directed**, on coated glass-mat, water-resistant gypsum backer board; TCA W245.
 - 1) Tile Type: as directed by the Owner.
 - 2) Thin-Set Mortar: Dry-set **OR** Latex-, **as directed**, portland cement mortar.
 - 3) Grout: Sand-portland cement **OR** Standard sanded cement **OR** Standard unsanded cement **OR** Polymer-modified sanded **OR** Polymer-modified unsanded **OR** Water-cleanable epoxy, **as directed**, grout.
- 8. Bathtub Wall Installations, Wood **OR** Metal, **as directed**, Studs or Furring:
 - a. Tile Installation B413: Thin-set mortar **OR** Organic adhesive, **as directed**, on water-resistant gypsum board; TCA B413.
 - 1) Tile Type: as directed by the Owner.
 - 2) Thin-Set Mortar: Dry-set **OR** Latex-, **as directed**, portland cement mortar.
 - 3) Grout: Sand-portland cement **OR** Standard sanded cement **OR** Standard unsanded cement **OR** Polymer-modified sanded **OR** Polymer-modified unsanded, **as directed**, grout.
- 9. Bathtub/Shower Wall Installations, Wood **OR** Metal, **as directed**, Studs or Furring:
 - a. Tile Installation B411: Cement mortar bed (thickset); TCA B411 and ANSI A108.1A.
 - 1) Tile Type: as directed by the Owner.
 - 2) Bond Coat Mortar for Wet-Set Method: Dry-set **OR** Latex-, **as directed**, portland cement mortar.
 - 3) Grout: Sand-portland cement **OR** Standard sanded cement **OR** Standard unsanded cement **OR** Polymer-modified sanded **OR** Polymer-modified unsanded, **as directed**, grout.
 - b. Tile Installation B412: Thin-set mortar on cementitious backer units or fiber cement underlayment; TCA B412.
 - 1) Tile Type: as directed by the Owner.

- 2) Thin-Set Mortar: Dry-set **OR** Latex-, **as directed**, portland cement mortar.
- 3) Grout: Sand-portland cement **OR** Standard sanded cement **OR** Standard unsanded cement **OR** Polymer-modified sanded **OR** Polymer-modified unsanded **OR** Water-cleanable epoxy, **as directed**, grout.
- c. Tile Installation B419: Thin-set mortar **OR** Organic adhesive, **as directed**, on coated glass-mat, water-resistant backer board; TCA B419.
 - 1) Tile Type: as directed by the Owner.
 - 2) Thin-Set Mortar: Dry-set **OR** Latex-, **as directed**, portland cement mortar.
 - 3) Grout: Sand-portland cement **OR** Standard sanded cement **OR** Standard unsanded cement **OR** Polymer-modified sanded **OR** Polymer-modified unsanded **OR** Water-cleanable epoxy, **as directed**, grout.
10. Shower Receptor and Wall Installations, Concrete or Masonry:
 - a. Tile Installation B414: Cement mortar bed (thickset); TCA B414 and ANSI A108.1A **OR** ANSI A108.1B **OR** ANSI A108.1C, **as directed**.
 - 1) Tile Type: as directed by the Owner.
 - 2) Bond Coat Mortar for Wet-Set Method: Dry-set **OR** Latex-, **as directed**, portland cement mortar.
 - 3) Thin-Set Mortar for Cured-Bed Method: Dry-set **OR** Latex-, **as directed**, portland cement mortar.
 - 4) Grout: Sand-portland cement **OR** Standard sanded cement **OR** Standard unsanded cement **OR** Polymer-modified sanded **OR** Polymer-modified unsanded, **as directed**, grout.
 - b. Tile Installation B421: Thin-set mortar on waterproof membrane; TCA B421.
 - 1) Tile Type: as directed by the Owner.
 - 2) Thin-Set Mortar: Latex-portland cement mortar.
 - 3) Grout: Sand-portland cement **OR** Standard sanded cement **OR** Standard unsanded cement **OR** Polymer-modified sanded **OR** Polymer-modified unsanded, **as directed**, grout.
 - c. Tile Installation B422: Thin-set mortar on waterproof membrane with integrated bonding flange for bonded membranes; TCA B422.
 - 1) Tile Type: as directed by the Owner.
 - 2) Thin-Set Mortar: Dry-set **OR** Latex-, **as directed**, portland cement mortar.
 - 3) Grout: Sand-portland cement **OR** Standard sanded cement **OR** Standard unsanded cement **OR** Polymer-modified sanded **OR** Polymer-modified unsanded, **as directed**, grout.
11. Shower Receptor and Wall Installations, Wood **OR** Metal, **as directed**, Studs or Furring:
 - a. Tile Installation B414: Cement mortar bed (thickset); TCA B414 and ANSI A108.1A **OR** ANSI A108.1B **OR** ANSI A108.1C, **as directed**.
 - 1) Tile Type: as directed by the Owner.
 - 2) Bond Coat Mortar for Wet-Set Method: Dry-set **OR** Latex-, **as directed**, portland cement mortar.
 - 3) Thin-Set Mortar for Cured-Bed Method: Dry-set **OR** Latex-, **as directed**, portland cement mortar.
 - 4) Grout: Sand-portland cement **OR** Standard sanded cement **OR** Standard unsanded cement **OR** Polymer-modified sanded **OR** Polymer-modified unsanded, **as directed**, grout.
 - b. Tile Installation B415: Thin-set mortar on cementitious backer units or fiber cement underlayment; TCA B415.
 - 1) Tile Type: as directed by the Owner.
 - 2) Thin-Set Mortar: Dry-set **OR** Latex-, **as directed**, portland cement mortar.
 - 3) Grout: Sand-portland cement **OR** Standard sanded cement **OR** Standard unsanded cement **OR** Polymer-modified sanded **OR** Polymer-modified unsanded, **as directed**, grout.
 - c. Tile Installation B420: Thin-set mortar on coated glass-mat, water-resistant backer board; TCA B420.
 - 1) Tile Type: as directed by the Owner.

- 2) Thin-Set Mortar: Dry-set **OR** Latex-, **as directed**, portland cement mortar.
- 3) Grout: Sand-portland cement **OR** Standard sanded cement **OR** Standard unsanded cement **OR** Polymer-modified sanded **OR** Polymer-modified unsanded, **as directed**, grout.
- d. Tile Installation B421: Thin-set mortar on waterproof membrane over cementitious backer units or fiber cement underlayment; TCA B421.
 - 1) Tile Type: as directed by the Owner.
 - 2) Thin-Set Mortar: Latex-portland cement mortar.
 - 3) Grout: Sand-portland cement **OR** Standard sanded cement **OR** Standard unsanded cement **OR** Polymer-modified sanded **OR** Polymer-modified unsanded, **as directed**, grout.
- e. Tile Installation B422: Thin-set mortar on waterproof membrane over cementitious backer units or fiber cement underlayment with integrated bonding flange for bonded membranes; TCA B422.
 - 1) Tile Type: as directed by the Owner.
 - 2) Thin-Set Mortar: Latex-portland cement mortar.
 - 3) Grout: Sand-portland cement **OR** Standard sanded cement **OR** Standard unsanded cement **OR** Polymer-modified sanded **OR** Polymer-modified unsanded, **as directed**, grout.

END OF SECTION 09 01 30 91

SECTION 09 01 60 91 - PORTLAND CEMENT TERRAZZO FLOORING

1.1 GENERAL

A. Description Of Work

1. This specification covers the furnishing and installation of materials for portland cement terrazzo flooring. Products shall be as follows or as directed by the Owner. Installation procedures shall be in accordance with the product manufacturer's recommendations. Demolition and removal of materials shall be as required to support the work.

B. Summary

1. Section Includes:
 - a. Poured-in-place portland cement terrazzo flooring and base.
 - b. Poured-in-place rustic terrazzo flooring.
 - c. Precast terrazzo units.

C. Submittals

1. Product Data: For each type of product indicated.
2. LEED Submittals:
 - a. Product Data for Credit MR 4.1 and Credit MR 4.2, **as directed**: For marble chips, aggregates, documentation indicating percentages by weight of postconsumer and preconsumer recycled content.
 - 1) Include statement that indicates cost for each product having recycled content.
 - b. Product Data for Credit EQ 4.1: For adhesives, including printed statement of VOC content.
3. Shop Drawings: Include terrazzo installation requirements. Include plans, elevations, sections, component details, and attachments to other work.
4. Samples: For each type, material, color, and pattern of terrazzo and accessory required showing the full range of color, texture, and pattern variations expected
5. Qualification data.
6. Material certificates.
7. Maintenance data.

D. Quality Assurance

1. Installer Qualifications: An installer who is a contractor member of NTMA.
2. NTMA Standards: Comply with NTMA's "Terrazzo Specifications and Design Guide" and with written recommendations for terrazzo type indicated unless more stringent requirements are specified.
3. Preinstallation Conference: Conduct conference at Project site.

E. Delivery, Storage, And Handling

1. Deliver materials to Project site in supplier's original wrappings and containers, labeled with source's or manufacturer's name, material or product brand name, and lot number if any.
2. Store materials in their original, undamaged packages and containers, inside a well-ventilated area protected from weather, moisture, soiling, extreme temperatures, and humidity.

F. Project Conditions

1. Environmental Limitations: Maintain temperature above 50 deg F (10 deg C) for 48 hours before and during terrazzo installation.
2. Weather Limitations: Proceed with rustic terrazzo installation only when forecasted weather conditions permit work to be performed according to NTMA's written recommendations and temperatures remain above 45 deg F (7.2 deg C).
3. Field Measurements: Verify actual dimensions of construction contiguous with precast terrazzo by field measurements before fabrication.

4. Control and collect dust produced by grinding operations. Protect adjacent construction from detrimental effects of grinding operations.
 - a. Provide dustproof partitions and temporary enclosures to limit dust migration and to isolate areas from noise.

1.2 PRODUCTS

A. Portland Cement Terrazzo

1. Portland Cement Terrazzo Type: Sand cushion **OR** Structural **OR** Bonded **OR** Monolithic **OR** Installed over metal deck, **as directed**.
2. Materials:
 - a. Portland Cement: ASTM C 150, Type 1.
 - 1) Color for Exposed Matrix: As required by mix indicated **OR** White **OR** Gray, **as directed**.
 - b. Water: Potable.
 - c. Sand: ASTM C 33.
 - d. Marble Chips **OR** Aggregates, **as directed**: Complying with NTMA gradation standards for mix indicated and containing no deleterious or foreign matter.
 - 1) Abrasion and Impact Resistance: Less than 40 percent loss per ASTM C 131 and ASTM C 535, **as directed**.
 - 2) 24-Hour Absorption Rate: Less than 0.75 percent.
 - 3) Dust Content: Less than 1.0 percent by weight.
 - e. Matrix Pigments: Pure mineral or synthetic pigments, alkali resistant, durable under exposure to sunlight, and compatible with terrazzo matrix.
 - f. Bonding Agent: Neat portland cement or epoxy or acrylic bonding agents formulated for use with topping indicated.
 - g. Underbed Reinforcement: Galvanized welded-wire reinforcement, **2 by 2 inches (51 by 51 mm)** by **0.062-inch- (1.57-mm-)** diameter wire, complying with ASTM A 1064 and ASTM A 82, except for minimum wire size.
 - h. Isolation Membrane: Polyethylene sheeting, ASTM D 2103, Type 13300, **4 mils (0.1 mm)** thick; or unperforated asphalt felt, ASTM D 226, Type I (No. 15).
3. Mixes:
 - a. Underbed (for structural portland cement terrazzo or portland cement terrazzo installed over metal deck): Structural-concrete underbed as specified in Division 03 Section "Cast-in-place Concrete".
 - b. Underbed (for sand-cushion or bonded portland cement terrazzo): Comply with NTMA's "Terrazzo Specifications and Design Guide" for terrazzo type indicated for component proportions and mixing.
 - c. Portland Cement Terrazzo (below for NTMA-formulated design mixes): Comply with NTMA's "Terrazzo Specifications and Design Guide" for terrazzo type indicated for matrix and marble-chip proportions and mixing.
 - 1) Formulated Mix Color and Pattern: As selected from NTMA standard-terrazzo plates **OR** As selected from NTMA Venetian-terrazzo plates, **as directed**.
 - d. Portland Cement Terrazzo (for custom design mixes): Comply with NTMA's "Terrazzo Specifications and Design Guide" for terrazzo type indicated for matrix and marble-chip **OR** aggregate, **as directed**, proportions and mixing.
 - 1) Custom Mix Color and Pattern: Match sample **OR** Match existing, **as directed**.

B. Rustic Terrazzo

1. Rustic Terrazzo Type: Structural **OR** Bonded **OR** Monolithic **OR** Unbonded, **as directed**.
2. Materials:
 - a. Portland Cement: ASTM C 150, Type 1.
 - 1) Color for Exposed Matrix: As required by mix indicated.
 - b. Water: Potable.

- c. Sand: ASTM C 33.
 - d. Marble Chips **OR** Aggregates, **as directed**: As required for mix indicated, sizes complying with NTMA gradation standards, 0.25 percent maximum 24-hour absorption rate, and containing no deleterious or foreign matter.
 - e. Matrix Pigments: Pure mineral or synthetic pigments, alkali resistant, durable under exposure to sunlight and weather, and compatible with matrix binder.
 - f. Air-Entraining Agent (for underbed of structural, bonded, or unbonded rustic terrazzo): Complying with NTMA's written recommendations and recommended by supplier for intended use.
 - g. Underbed Bonding Agent (for bonded rustic terrazzo): Neat portland cement.
 - h. Topping Bonding Agent (for monolithic rustic terrazzo): Neat portland cement, or epoxy or acrylic bonding agents formulated for use with topping indicated.
 - i. Isolation Membrane (for unbonded rustic terrazzo): Polyethylene sheeting, ASTM D 2103, Type 13300, **4 mils (0.1 mm)** thick.
3. Mixes:
- a. Underbed (for structural or unbonded rustic terrazzo): Structural-concrete underbed as specified in Division 03 Section "Cast-in-place Concrete".
 - b. Underbed (for bonded rustic terrazzo): Comply with NTMA's "Terrazzo Specifications and Design Guide" for component proportions and mixing.
 - 1) Exterior Applications: Provide air-entraining agent.
 - c. Rustic Terrazzo (for NTMA-formulated design mixes): Comply with NTMA's "Terrazzo Specifications and Design Guide" for terrazzo type indicated for matrix and marble-chip proportions and mixing.
 - 1) Formulated Mix Color and Pattern: As selected from NTMA rustic-terrazzo plates.
 - d. Rustic Terrazzo (for custom design mixes): Comply with NTMA's "Terrazzo Specifications and Design Guide" for terrazzo type indicated for matrix and marble-chip **OR** aggregate, **as directed**, proportions and mixing.
 - 1) Custom Mix Color and Pattern: Match sample **OR** Match existing, **as directed**.
- C. Strip Materials
1. Standard Divider Strips: One-piece, flat-type strips for grouting into sawed joints prepared in concrete slab or underbed.
 - a. Material: As indicated **OR** White-zinc alloy **OR** Brass, **as directed**.
 - b. Depth: As indicated **OR 3/4 inch (19 mm) OR 1-1/4 inches (32 mm) OR 2 inches (51 mm), as directed**.
 - c. Width: As indicated **OR 0.05 inch (1.27 mm) OR 1/8 inch (3.2 mm) OR 1/4 inch (6.4 mm), as directed**.
 2. Heavy-Top Divider Strips: One-piece, flat-type strips for grouting into sawed joints prepared in concrete slab or underbed.
 - a. Base-Section Material: As indicated **OR** White-zinc alloy **OR** Galvanized steel, **as directed**.
 - b. Top-Section Material: As indicated **OR** White-zinc alloy **OR** Brass **OR** Plastic, in color selected from manufacturer's full range, **as directed**.
 - c. Depth: As indicated **OR 3/4 inch (19 mm) OR 1-1/4 inches (32 mm) OR 2 inches (51 mm), as directed**.
 - d. Top-Section Width: As indicated **OR 1/8 inch (3.2 mm) OR 1/4 inch (6.4 mm) OR 1/2 inch (12.7 mm), as directed**.
 3. Heavy-Top Angle Divider Strips: One-piece, L-type angle strips with anchoring device and in depth required for topping thickness indicated.
 - a. Material: As indicated **OR** White-zinc alloy **OR** Brass **OR** Plastic, in color selected from manufacturer's full range, **as directed**.
 - b. Top-Section Width: As indicated **OR 1/8 inch (3.2 mm) OR 1/4 inch (6.4 mm) OR 3/8 inch (9.5 mm) OR 1/2 inch (12.7 mm), as directed**.
 4. Control-Joint Strips: Separate, double L-type angles, positioned back to back, that match material, thickness, and color of divider strips and in depth required for topping thickness indicated.

5. Expansion-Joint Strips (for structural portland cement terrazzo or for any type of rustic terrazzo): Brass **OR** Plastic strips in color selected from manufacturer's full range, **as directed**, with removable zip-strip top for installing sealant; in width indicated **OR** minimum **1/2 inch (12.7 mm)** wide, **as directed**.
6. Accessory Strips: Match divider strip width, material, and color unless otherwise indicated. Use the following types of accessory strips as required to provide a complete installation:
 - a. Base-bead strips for exposed top edge of terrazzo base.
 - b. Edge-bead strips for exposed edges of terrazzo.
 - c. Nosings for terrazzo stair treads and landings.
7. Abrasive Strips (for terrazzo stair treads and landings): Silicon carbide or aluminum oxide, or combination of both, in epoxy-resin binder and set in channel.
 - a. Width: **1/2 inch (12.7 mm)**.
 - b. Depth: As required by terrazzo thickness.
 - c. Length: **4 inches (100 mm)** less than stair width **OR** As indicated, **as directed**.
 - d. Color: As selected from manufacturer's full range.

D. Miscellaneous Accessories

1. Strip Adhesive: Adhesive recommended by manufacturer for this use.
 - a. Use adhesives that have a VOC content of 70 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
2. Anchoring Devices:
 - a. Strips: Provide mechanical anchoring devices for strip materials as required for secure attachment to substrate.
 - b. Precast Terrazzo: Provide mechanical anchoring devices as recommended by fabricator for proper anchorage and support of units for conditions of installation and support.
3. Isolation and Expansion-Joint Material: Closed-cell polyethylene foam, nonabsorbent to liquid water and gas, and nonoutgassing in unruptured state; butyl rubber; rubber; or cork; in width indicated **OR** minimum **1/2 inch (12.7 mm)** wide, **as directed**.
4. Portland Cement Terrazzo Cleaner: Chemically neutral cleaner with pH factor between 7 and 10 that is biodegradable, phosphate free, and recommended by cleaner manufacturer for use on terrazzo type indicated.
5. Rustic Terrazzo Cleaner: Solution of muriatic acid and water for use on terrazzo type indicated.
6. Sealer: Slip- and stain-resistant, penetrating-type sealer that is chemically neutral with pH factor between 7 and 10; does not affect color or physical properties of terrazzo; is recommended by sealer manufacturer; and complies with NTMA's "Terrazzo Specifications and Design Guide" for terrazzo type indicated.
 - a. Rustic Terrazzo: Use solvent acrylic-type sealer.

E. Precast Terrazzo

1. Precast Terrazzo Base Units: Minimum **3/4-inch- (19-mm-)** thick, reinforced portland cement terrazzo units cast in maximum lengths possible, but not less than **36 inches (900 mm)**.
 - a. Type: As indicated **OR** Coved with minimum **3/4-inch (19-mm)** radius **OR** Straight **OR** Splayed, **as directed**.
 - b. Top Edge: Straight, unfinished if top edge is concealed **OR** Beveled with polished top surface **OR** Radius edge with polished top surface, **as directed**.
 - c. Metal Toe Strip (for coved-toe bases): Zinc **OR** Brass, **as directed**.
 - d. Outside Corner Units: With finished returned edges at outside corner.
 - e. Color, Pattern, and Finish: As selected from manufacturer's full range **OR** Match sample **OR** Match adjacent poured-in-place terrazzo flooring, **as directed**.
2. Precast Terrazzo Units for Stair Treads, Thresholds, Sills, Benches and Planters: Comply with NTMA's written recommendations for fabricating precast terrazzo units in sizes and profiles indicated. Reinforce units as required by unit sizes, profiles, and thicknesses and as recommended by manufacturer.
 - a. Stair Treads: Three-line **OR** Two-line **OR** One-line **OR** Abrasive nosing strip and two-line, **as directed**, abrasive inserts at nosings.

- b. Color, Pattern, and Finish: As selected from manufacturer's full range **OR** Match sample **OR** Match adjacent poured-in-place terrazzo flooring, **as directed**.
 - 3. Precast Terrazzo Finishing (for custom precast terrazzo components):
 - a. Finish exposed-to-view edges or reveals to match face finish.
 - b. Ease exposed edges to **1/8-inch (3-mm)** radius.

1.3 EXECUTION

A. Preparation

- 1. Clean substrates to produce clean, dry, and neutral substrate for terrazzo application.
 - a. Remove substances, including oil, grease, and curing compounds, that might impair bond of terrazzo system.
 - b. Roughen concrete substrates before installing terrazzo system according to NTMA's written recommendations.
- 2. Protect other work from dust generated by grinding operations. Control dust to prevent air pollution and comply with environmental protection regulations.
 - a. Erect and maintain temporary enclosures and other suitable methods to limit dust migration and to ensure adequate ambient temperatures and ventilation conditions during installation.

B. Installation, General

- 1. Comply with NTMA's written recommendations for terrazzo and accessory installation.
- 2. Installation Tolerance: Limit variation in terrazzo surface from level to **1/4 inch in 10 feet (6 mm in 3 m)**; noncumulative.
- 3. Structural Portland Cement **OR** Structural Rustic **OR** Bonded Rustic **OR** Monolithic Rustic **OR** Unbonded Rustic, **as directed**, Terrazzo: Install isolation and expansion material where terrazzo and underbed abut **OR** terrazzo abuts, **as directed**, adjacent construction and directly above substrate expansion joints.
- 4. Underbed (for structural portland cement terrazzo or portland cement terrazzo installed over metal deck, or for structural or unbonded rustic terrazzo): Install structural-concrete underbed according to requirements specified in Division 03 Section "Cast-in-place Concrete".
- 5. Underbed (for sand-cushion or bonded portland cement terrazzo or for bonded rustic terrazzo):
 - a. Comply with NTMA's "Terrazzo Specifications and Design Guide" for underbed installation.
 - b. For sand-cushion portland cement terrazzo only:
 - 1) Cover entire surface to receive terrazzo with dusting of sand.
 - 2) Install isolation membrane over sand, overlapping ends and edges a minimum of **3 inches (75 mm)**.
 - 3) Install welded wire reinforcement, overlapping at edges and ends at least two squares. Stop mesh a minimum of **1 inch (25 mm)** short of expansion joints.
 - c. Place underbed and screed to elevation indicated below finished floor elevation.
- 6. Strip Materials:
 - a. Divider and Control-Joint Strips:
 - 1) Locate divider strips over each edge of steel beams and girders **OR** centered over steel beams and joists **OR** directly over control joints, breaks, and saw cuts in concrete slabs **OR** in locations indicated, **as directed**.
 - 2) Install control-joint strips back to back and directly above concrete-slab control joints **OR** in locations indicated, **as directed**.
 - 3) Install control-joint strips with **1/4-inch (6.4-mm)** gap between strips, and install sealant in gap.
 - 4) Install strips in adhesive setting bed without voids below strips, or mechanically anchor strips as required to attach strips to substrate, as recommended by strip manufacturer.
 - b. Expansion-Joint Strips (for structural portland cement terrazzo or for any type of rustic terrazzo): Form expansion joints using divider strips and install directly above concrete-slab expansion joints.

- c. Accessory Strips: Install accessory strips as required to provide a complete installation.
 - d. Abrasive Strips: Install with surface of abrasive strip positioned **1/16 inch (1.6 mm)** OR **1/32 inch (0.8 mm)**, **as directed**, higher than terrazzo surface.
 - 7. Repair: Cut out and replace terrazzo areas that evidence lack of bond with substrate or underbed, including areas that emit a "hollow" sound if tapped. Cut out terrazzo areas in panels defined by strips and replace to match adjacent terrazzo, or repair panels according to NTMA's written recommendations, as approved by the Owner.
- C. Portland Cement Terrazzo Installation
- 1. Pour in place, cure, and finish portland cement terrazzo according to NTMA's "Terrazzo Specifications and Design Guide" for terrazzo type indicated.
 - 2. Terrazzo Topping Thickness: As indicated.
 - 3. Finishing:
 - a. Seed additional marble chips **OR** aggregates, **as directed**, in matrix to uniformly distribute granular material on surface.
 - b. Delay fine grinding until heavy trade work is complete and construction traffic through area is restricted.
 - c. Fine Grinding: Grind with stones 120 grit or finer until all grout is removed from surface. Repeat rough grinding, grout coat, and fine grinding if large voids exist after initial fine grinding. Produce surface with a minimum of 70 percent aggregate exposure.
- D. Rustic Terrazzo Installation
- 1. Pour in place, cure, and finish rustic terrazzo according to NTMA's "Terrazzo Specifications and Design Guide" for terrazzo type indicated.
 - 2. Terrazzo Topping Thickness: As indicated.
 - 3. Finishing:
 - a. Seed additional marble chips **OR** aggregates, **as directed**, in matrix to uniformly distribute granular material on surface.
- E. Precast Terrazzo Installation
- 1. Install precast terrazzo units using method recommended by NTMA and manufacturer unless otherwise indicated.
 - 2. Installation Tolerance: Set units with alignment level and true to dimensions, varying **1/8 inch (3.2 mm)** maximum in length, height, or width; noncumulative.
 - 3. Do not install units that are chipped, cracked, discolored, or improperly finished.
 - 4. Seal joints between units with cement grout matching precast terrazzo matrix **OR** joint sealant, **as directed**.
- F. Cleaning And Protection
- 1. Portland Cement Terrazzo and Precast Terrazzo Cleaning:
 - a. Remove grinding dust from installation and adjacent areas.
 - b. Wash surfaces with cleaner immediately after grouting precast terrazzo units and final cleaning of terrazzo flooring.
 - c. Wash surfaces with cleaner according to NTMA's written recommendations and manufacturer's written instructions; rinse surfaces with water and allow to dry thoroughly.
 - 2. Rustic Terrazzo Cleaning: Clean surfaces with 1:10 solution of muriatic acid in water. Legally contain and dispose of runoff from cleaning operations. Rinse surfaces with water and allow to dry thoroughly.
 - 3. Sealing:
 - a. Seal surfaces according to NTMA's written recommendations.
 - b. Apply sealer according to sealer manufacturer's written instructions.
 - 4. Protection: Provide final protection and maintain conditions, in a manner acceptable to Installer, that ensure that terrazzo is without damage or deterioration at time of Final Completion.



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SECTION 09 01 60 91a - CARPET

1.1 GENERAL

A. Description Of Work

1. This specification covers the furnishing and installation of materials for carpet. Products shall be as follows or as directed by the Owner. Installation procedures shall be in accordance with the product manufacturer's recommendations. Demolition and removal of materials shall be as required to support the work.

B. Summary

1. This Section includes the following:
 - a. Tufted carpet.
 - b. Woven carpet.
 - c. Carpet cushion.

C. Submittals

1. Product Data: For each product indicated.
2. Shop Drawings: Show the following:
 - a. Columns, doorways, enclosing walls or partitions, built-in cabinets, and locations where cutouts are required in carpet.
 - b. Existing flooring materials to be removed.
 - c. Existing flooring materials to remain.
 - d. Carpet type, color, and dye lot.
 - e. Locations where dye lot changes occur.
 - f. Seam locations, types, and methods.
 - g. Type of subfloor.
 - h. Type of installation.
 - i. Pattern type, repeat size, location, direction, and starting point.
 - j. Pile direction.
 - k. Type, color, and location of insets and borders.
 - l. Type, color, and location of edge, transition, and other accessory strips.
 - m. Transition details to other flooring materials.
 - n. Type of carpet cushion.
3. Samples: For each of the following products and for each color and texture required. Label each Sample with manufacturer's name, material description, color, pattern, and designation indicated on Drawings and in schedules.
 - a. Carpet: 12-inch- (300-mm-) square Sample.
 - b. Exposed Edge, Transition, and other Accessory Stripping: 12-inch- (300-mm-) long Samples.
 - c. Carpet Cushion: 6-inch- (150-mm-) square Sample.
 - d. Carpet Seam: 6-inch (150-mm) Sample.
 - e. Mitered Carpet Border Seam: 12-inch- (300-mm-) square Sample. Show carpet pattern alignment.
4. LEED Submittals:
 - a. Product Data for Credit EQ 4.3:
 - 1) For carpet, documentation indicating compliance with testing and product requirements of Carpet and Rug Institute's "Green Label Plus" program.
 - 2) For carpet cushion, documentation indicating compliance with testing and product requirements of Carpet and Rug Institute's "Green Label" program.
 - 3) For installation adhesive, including printed statement of VOC content.
5. Product Schedule: For carpet and carpet cushion. Use same designations indicated on Drawings.
6. Maintenance data.

- D. Quality Assurance
1. Installer Qualifications: An experienced installer who is certified by the Floor Covering Installation Board or who can demonstrate compliance with its certification program requirements.
 2. Fire-Test-Response Characteristics: Provide products with the critical radiant flux classification indicated in Part 1.2, as determined by testing identical products per ASTM E 648 by an independent testing and inspecting agency acceptable to authorities having jurisdiction.
 3. Preinstallation Conference: Conduct conference at Project site.
- E. Delivery, Storage, And Handling
1. Comply with CRI 104, Section 5, "Storage and Handling."
- F. Project Conditions
1. Comply with CRI 104, Section 7.2, "Site Conditions; Temperature and Humidity" and Section 7.12, "Ventilation."
 2. Environmental Limitations: Do not install carpet and carpet cushion until wet work in spaces is complete and dry, and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.
 3. Do not install carpet and carpet cushion over concrete slabs until slabs have cured, are sufficiently dry to bond with adhesive, and have pH range recommended by carpet manufacturer.
 4. Where demountable partitions or other items are indicated for installation on top of carpet, install carpet before installing these items.
- G. Warranty
1. Special Warranty for Carpet: Manufacturer's standard form in which manufacturer agrees to repair or replace components of carpet installation that fail in materials or workmanship within specified warranty period.
 - a. Warranty does not include deterioration or failure of carpet due to unusual traffic, failure of substrate, vandalism, or abuse.
 - b. Failures include, but are not limited to, more than 10 percent loss of face fiber, edge raveling, snags, runs, loss of tuft bind strength, excess static discharge, and delamination.
 - c. Warranty Period: 10 years from date of Final Completion.
 2. Special Warranty for Carpet Cushion: Manufacturer's standard form in which manufacturer agrees to repair or replace components of carpet cushion installation that fail in materials or workmanship within specified warranty period.
 - a. Warranty includes consequent removal and replacement of carpet and accessories.
 - b. Warranty does not include deterioration or failure of carpet cushion due to unusual traffic, failure of substrate, vandalism, or abuse.
 - c. Failure includes, but is not limited to, permanent indentation or compression.
 - d. Warranty Period: 10 years from date of Final Completion.

1.2 PRODUCTS

- A. Tufted Carpet
1. Fiber Content: 100 percent nylon 6, 6 **OR** 100 percent nylon 6 **OR** 100 percent polypropylene, **as directed**.
 2. Pile Characteristic: Level-loop **OR** Cut **OR** Cut-and-loop **OR** Multilevel-loop **OR** Level tip shear **OR** Random shear **OR** Frieze **OR** Sculptured, **as directed**, pile.
 3. Yarn Twist: as directed by the Owner.
 4. Yarn Count: as directed by the Owner.
 5. Density: as directed by the Owner.
 6. Pile Thickness: finished carpet per ASTM D 6859.
 7. Stitches: as directed by the Owner.
 8. Gage: as directed by the Owner.
 9. Face Weight: as directed by the Owner.

10. Total Weight: for finished carpet.
11. Primary Backing: Manufacturer's standard material **OR** Woven polypropylene **OR** Nonwoven, polypropylene or polyester, **as directed**.
12. Secondary Backing: Manufacturer's standard material **OR** Woven polypropylene **OR** Nonwoven, polypropylene or polyester **OR** Woven jute **OR** Fiberglass, **as directed**.
13. Backcoating: Manufacturer's standard material **OR** SBR latex **OR** PVC **OR** Thermoplastic copolymer, **as directed**.
14. Width: **12 feet (3.7 m) OR 6 feet (1.8 m) OR 13.5 feet (4.1 m) OR 15 feet (4.6 m)**, **as directed**.
15. Applied Soil-Resistance Treatment: Manufacturer's standard material.
16. Antimicrobial Treatment: Manufacturer's standard material.
17. Performance Characteristics: As follows:
 - a. Critical Radiant Flux Classification: Not less than 0.45 W/sq. cm **OR** 0.22 W/sq. cm, **as directed**.
 - b. Dry Breaking Strength: Not less than **100 lbf (445 N)** per ASTM D 2646.
 - c. Tuft Bind: Not less than **3 lbf (13 N) OR 5 lbf (22 N) OR 6.2 lbf (28 N) OR 8 lbf (36 N) OR 10 lbf (45 N)**, **as directed**, per ASTM D 1335.
 - d. Delamination: Not less than **2.5 lbf/in. (12 N/mm) OR 3.5 lbf/in. (15 N/mm) OR 4 lbf/in. (18 N/mm)**, **as directed**, per ASTM D 3936.
 - e. Resistance to Insects: Comply with AATCC 24.
 - f. Noise Reduction Coefficient (NRC): per ASTM C 423.
 - g. Colorfastness to Crocking: Not less than 4, wet and dry, per AATCC 165.
 - h. Colorfastness to Light: Not less than 4 after 40 **OR** 60, **as directed**, AFU (AATCC fading units) per AATCC 16, Option E.
 - i. Antimicrobial Activity: Not less than 2-mm halo of inhibition for gram-positive bacteria; not less than 1-mm halo of inhibition for gram-negative bacteria; no fungal growth; per AATCC 174.
 - j. Electrostatic Propensity: Less than 3.5 **OR** 2, **as directed**, kV per AATCC 134.
 - k. Environmental Requirements: Provide carpet that complies with testing and product requirements of Carpet and Rug Institute's "Green Label Plus" program.

B. Woven Carpet

1. Fiber Content: 100 percent wool **OR** 80 percent wool; 20 percent nylon 6, 6 **OR** 80 percent wool; 20 percent nylon 6, **as directed**.
2. Face Construction: Axminster **OR** Wilton **OR** Velvet, **as directed**.
3. Pile Characteristic: Level-loop **OR** Cut **OR** Cut-and-loop, **as directed**, pile.
4. Yarn Twist: as directed by the Owner.
5. Yarn Count: as directed by the Owner.
6. Density: as directed by the Owner.
7. Pile Thickness: for finished carpet per ASTM D 6859.
8. Rows: as directed by the Owner.
9. Pitch: as directed by the Owner.
10. Face Weight: as directed by the Owner.
11. Total Weight: as directed by the Owner., for finished carpet.
12. Backing: Manufacturers standard **OR** As follows, **as directed**:
 - a. Chain Warp: as directed by the Owner.
 - b. Stuffer Warp: as directed by the Owner.
 - c. Shot or Fill Weft: as directed by the Owner.
 - d. Backcoating: as directed by the Owner.
13. Applied Soil-Resistance Treatment: Manufacturer's standard material.
14. Performance Characteristics: As follows:
 - a. Critical Radiant Flux Classification: Not less than 0.45 W/sq. cm **OR** 0.22 W/sq. cm, **as directed**.
 - b. Dry Breaking Strength: Not less than **100 lbf (445 N)** per ASTM D 2646.
 - c. Resistance to Insects: Comply with AATCC 24.
 - d. Noise Reduction Coefficient (NRC): per ASTM C 423.
 - e. Colorfastness to Crocking: Not less than 4, wet and dry, per AATCC 165.



- f. Colorfastness to Light: Not less than 4 after 40 **OR** 60, **as directed**, AFU (AATCC fading units) per AATCC 16, Option E.
- g. Electrostatic Propensity: Less than 3.5 **OR** 2, **as directed**, kV per AATCC 134.
- h. Environmental Requirements: Provide carpet that complies with testing and product requirements of Carpet and Rug Institute's "Green Label Plus" program.

C. Carpet Cushion

- 1. Traffic Classification: CCC Class I, moderate **OR** II, heavy **OR** III, extra-heavy, **as directed**, traffic.
- 2. Fiber Cushion: Rubberized hair, mothproofed and sterilized **OR** Rubberized jute, mothproofed and sterilized **OR** Synthetic **OR** Resinated, recycled textile, **as directed**.
 - a. Weight: as directed by the Owner.
 - b. Thickness: as directed by the Owner.plus 5 percent maximum.
 - c. Density: as directed by the Owner.
- 3. Rubber Cushion: Flat **OR** Rippled waffle **OR** Textured flat **OR** Reinforced, **as directed**.
 - a. Weight: as directed by the Owner.
 - b. Thickness: as directed by the Owner.plus 5 percent maximum.
 - c. Compression Resistance: at 25 **OR** 65, **as directed**, percent per ASTM D 3676.
 - d. Density: as directed by the Owner.
- 4. Polyurethane-Foam Cushion: Grafted prime **OR** Densified **OR** Bonded **OR** Mechanically frothed, **as directed**.
 - a. Compression Force Deflection at 65 Percent: per ASTM D 3574.
 - b. Thickness: as directed by the Owner.
 - c. Density: as directed by the Owner.
- 5. Performance Characteristics: As follows:
 - a. Critical Radiant Flux Classification: Not less than 0.45 W/sq. cm **OR** 0.22 W/sq. cm, **as directed**.
 - b. Noise Reduction Coefficient (NRC): per ASTM C 423.
 - c. Environmental Requirements: Provide carpet cushion that complies with testing and product requirements of Carpet and Rug Institute's "Green Label" program.

D. Installation Accessories

- 1. Trowelable Leveling and Patching Compounds: Latex-modified, hydraulic-cement-based formulation provided or recommended by carpet **OR** carpet cushion, **as directed**, manufacturer.
- 2. Adhesives: Water-resistant, mildew-resistant, nonstaining type to suit products and subfloor conditions indicated, that complies with flammability requirements for installed carpet and is recommended or provided by carpet manufacturer **OR** carpet and carpet cushion manufacturers, **as directed**.
 - a. VOC Limits: Provide adhesives with VOC content not more than 50g/L when calculated according to 40 CFR 59, Subpart D (EPA method 24).
- 3. Tackless Carpet Stripping: Water-resistant plywood, in strips as required to match cushion thickness and that comply with CRI 104, Section 12.2.
- 4. Seam Adhesive: Hot-melt adhesive tape or similar product recommended by carpet manufacturer for sealing and taping seams and butting cut edges at backing to form secure seams and to prevent pile loss at seams.
- 5. Metal Edge Strips: Extruded aluminum with mill finish of width shown, of height required to protect exposed edge of carpet, and of maximum lengths to minimize running joints.

1.3 EXECUTION

A. Preparation

- 1. General: Comply with CRI 104, Section 7.3, "Site Conditions; Floor Preparation," and with carpet manufacturer's written installation instructions for preparing substrates.

2. Use trowelable leveling and patching compounds, according to manufacturer's written instructions, to fill cracks, holes, depressions, and protrusions in substrates. Fill or level cracks, holes and depressions **1/8 inch (3 mm)** wide or wider, and protrusions more than **1/32 inch (0.8 mm)**, unless more stringent requirements are required by manufacturer's written instructions.
3. Remove coatings, including curing compounds, and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, without using solvents. Use mechanical methods recommended in writing by carpet **OR** carpet cushion, **as directed**, manufacturer.
4. Broom and vacuum clean substrates to be covered immediately before installing carpet.

B. Installation

1. Comply with CRI 104 and carpet manufacturer's **OR** carpet and carpet cushion manufacturers', **as directed**, written installation instructions for the following:
 - a. Direct-Glue-Down Installation: Comply with CRI 104, Section 9, "Direct Glue-Down Installation."
 - b. Double-Glue-Down Installation: Comply with CRI 104, Section 10, "Double Glue-Down Installation."
 - c. Carpet with Attached-Cushion Installation: Comply with CRI 104, Section 11, "Attached-Cushion Installations."
 - d. Preapplied Adhesive Installation: Comply with CRI 104, Section 11.4, "Pre-Applied Adhesive Systems (Peel and Stick)."
 - e. Hook-and-Loop Installation: Comply with CRI 104, Section 11.5, "Hook and Loop Technology."
 - f. Stretch-in Installation: Comply with CRI 104, Section 12, "Stretch-in Installation."
 - g. Stair Installation: Comply with CRI 104, Section 13, "Carpet on Stairs" for stretch-in **OR** glue-down, **as directed**, installation.
2. Comply with carpet manufacturer's written recommendations and Shop Drawings for seam locations and direction of carpet; maintain uniformity of carpet direction and lay of pile. At doorways, center seams under the door in closed position.
 - a. Bevel adjoining border edges at seams with hand shears **OR** Level adjoining border edges, **as directed**.
3. Do not bridge building expansion joints with carpet.
4. Cut and fit carpet to butt tightly to vertical surfaces, permanent fixtures, and built-in furniture including cabinets, pipes, outlets, edgings, thresholds, and nosings. Bind or seal cut edges as recommended by carpet manufacturer.
5. Extend carpet into toe spaces, door reveals, closets, open-bottomed obstructions, removable flanges, alcoves, and similar openings.
6. Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating on finish flooring as marked on subfloor. Use nonpermanent, nonstaining marking device.
7. Install pattern parallel to walls and borders to comply with CRI 104, Section 15, "Patterned Carpet Installations" and with carpet manufacturer's written recommendations.
8. Comply with carpet cushion manufacturer's written recommendations. Install carpet cushion seams at 90-degree angle with carpet seams.

C. Cleaning And Protecting

1. Perform the following operations immediately after installing carpet:
 - a. Remove excess adhesive, seam sealer, and other surface blemishes using cleaner recommended by carpet manufacturer.
 - b. Remove yarns that protrude from carpet surface.
 - c. Vacuum carpet using commercial machine with face-beater element.
2. Protect installed carpet to comply with CRI 104, Section 16, "Protection of Indoor Installations."
3. Protect carpet against damage from construction operations and placement of equipment and fixtures during the remainder of construction period. Use protection methods indicated or recommended in writing by carpet manufacturer and carpet cushion manufacturer **OR** and carpet adhesive manufacturer **OR** and carpet cushion and adhesive manufacturers, **as directed**.

END OF SECTION 09 01 60 91a

NOT FOR BID



Task	Specification	Specification Description
09 01 60 91	01 22 16 00	No Specification Required
09 01 60 91	07 91 23 00	Joint Sealants
09 01 60 91	09 68 13 00	Carpet Tile
09 01 90 52	03 01 30 71	Concrete Rehabilitation
09 05 71 00	09 01 30 91	Ceramic Tile

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SECTION 09 22 13 13 - GYPSUM PLASTER

1.1 GENERAL

A. Description Of Work

1. This specification covers the furnishing and installation of materials for gypsum plaster. Products shall be as follows or as directed by the Owner. Installation procedures shall be in accordance with the product manufacturer's recommendations. Demolition and removal of materials shall be as required to support the work.

B. Summary

1. Section Includes:
 - a. Gypsum plasterwork on expanded-metal lath, unit masonry and monolithic concrete.
 - b. Solid-plaster partitions.

C. Submittals

1. Product Data: For each type of product indicated.
2. LEED Submittals:
 - a. Product Data for Credit MR 4.1 and Credit MR 4.2, **as directed**: For products having recycled content, documentation indicating percentages by weight of postconsumer and preconsumer recycled content.
 - 1) Include statement indicating costs for each product having recycled content.
 - b. Product Data for Credit EQ 4.1: For sealants, including printed statement of VOC content.
3. Shop Drawings: Show locations and installation of control and expansion joints including plans, elevations, sections, details of components, and attachments to other work.

D. Quality Assurance

1. Fire-Resistance Ratings: Where indicated, provide gypsum plaster assemblies identical to those of assemblies tested for fire resistance per ASTM E 119 by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
 - a. Indicate design designations from UL's "Fire Resistance Directory" or from the listings of another qualified testing agency.
2. Sound Transmission Characteristics: Where indicated, provide gypsum plaster assemblies identical to those of assemblies tested for STC ratings per ASTM E 90 and classified according to ASTM E 413 by a qualified testing agency.

E. Delivery, Storage, And Handling

1. Store materials inside under cover and keep them dry and protected against damage from weather, direct sunlight, surface contamination, corrosion, construction traffic, and other causes.

F. Project Conditions

1. Comply with ASTM C 842 requirements or gypsum plaster manufacturer's written recommendations, whichever are more stringent.
2. Room Temperatures: Maintain temperatures at not less than **55 deg F (13 deg C)** or greater than **80 deg F (27 deg C)** for at least seven days before application of gypsum plaster, continuously during application, and for seven days after plaster has set or until plaster has dried.
3. Avoid conditions that result in gypsum plaster drying out too quickly.
 - a. Distribute heat evenly; prevent concentrated or uneven heat on plaster.
 - b. Maintain relative humidity levels for prevailing ambient temperature that produce normal drying conditions.
 - c. Ventilate building spaces in a manner that prevents drafts of air from contacting surfaces during plaster application and until plaster is dry.

1.2 PRODUCTS

A. Steel Framing For Solid-Plaster Partitions

1. Components, General: Comply with ASTM C 841. For steel sheet components not included in ASTM C 841, comply with ASTM C 645 requirements for metal unless otherwise indicated.
2. Channel Studs: Cold-rolled channels, **3/4 inch (19.1 mm) OR 1-1/2 inches (38.1 mm), as directed**, deep.
3. Runners: L-runners with perforated or plain legs to suit lath attachment requirements, in **0.033-inch (0.84-mm)** base-metal thickness where attached to overhead support and in **0.043-inch (1.1-mm)** base-metal thickness where attached to floor.

B. Expanded-Metal Lath

1. Expanded-Metal Lath: ASTM C 847, cold-rolled carbon-steel sheet, ASTM A 653/A 653M, **G60 (Z180)**, hot-dip galvanized zinc coated.
 - a. Recycled Content: Provide steel products with average recycled content such that postconsumer recycled content plus one-half of preconsumer recycled content is not less than 25 percent.
 - b. Paper Backing: Kraft paper factory bonded to back of lath.
 - c. Diamond-Mesh Lath: Flat **OR** Self-furring, **as directed**, **2.5 lb/sq. yd. (1.4 kg/sq. m) OR 3.4 lb/sq. yd. (1.8 kg/sq. m), as directed**.
 - d. Flat Rib Lath: Rib depth of not more than **1/8 inch (3.1 mm)**, **2.75 lb/sq. yd. (1.5 kg/sq. m) OR 3.4 lb/sq. yd. (1.8 kg/sq. m), as directed**.
 - e. **3/8-Inch (9.5-mm) Rib Lath: 3.4 lb/sq. yd. (1.8 kg/sq. m) OR 4 lb/sq. yd. (2.2 kg/sq. m), as directed**.

C. Accessories

1. General: Comply with ASTM C 841 and coordinate depth of trim and accessories with thicknesses and number of plaster coats required.
2. Metal Accessories:
 - a. Cornerite: Fabricated from expanded-metal lath with ASTM A 653/A 653M, **G60 (Z180)**, hot-dip galvanized zinc coating.
 - b. Striplath: Fabricated from expanded-metal lath with ASTM A 653/A 653M, **G60 (Z180)**, hot-dip galvanized zinc coating.
 - c. Cornerbeads: Fabricated from zinc or zinc-coated (galvanized) steel.
 - 1) Small nose cornerbead with expanded flanges; use unless otherwise indicated.
 - 2) Small nose cornerbead with perforated flanges; use on curved corners.
 - 3) Small nose cornerbead with expanded flanges reinforced by perforated stiffening rib; use on columns and for finishing unit masonry corners.
 - 4) Bull nose cornerbead, radius **3/4 inch (19.1 mm)** minimum, with expanded flanges; use at locations indicated on Drawings.
 - d. Casing Beads: Fabricated from zinc or zinc-coated (galvanized) steel; square-edged style; with expanded flanges.
 - e. Control Joints: Fabricated from zinc or zinc-coated (galvanized) steel; one-piece-type, folded pair of unperforated screeds in M-shaped configuration; with perforated flanges and removable protective tape on plaster face of control joint.
 - f. Expansion Joints: Fabricated from zinc or zinc-coated (galvanized) steel; folded pair of unperforated screeds in M-shaped configuration; with expanded flanges.
 - g. Two-Piece Expansion Joints: Fabricated from zinc or zinc-coated (galvanized) steel; formed to produce slip-joint and square-edged reveal that is adjustable from **1/4 to 5/8 inch (6 to 16 mm)** wide; with perforated flanges.
3. Plastic Accessories: Fabricated from high-impact PVC.
 - a. Cornerbeads: With perforated flanges.
 - 1) Small nose cornerbead; use unless otherwise indicated.
 - 2) Bull nose cornerbead, radius **3/4 inch (19.1 mm)** minimum; use at locations indicated on Drawings.

- b. Casing Beads: With perforated flanges in depth required to suit plaster bases indicated and flange length required to suit applications indicated.
 - 1) Square-edge style; use unless otherwise indicated.
 - 2) Bull-nose style, radius **3/4 inch (19.1 mm)** minimum; use at locations indicated on Drawings.
 - c. Control Joints: One-piece-type, folded pair of unperforated screeds in M-shaped configuration; with perforated flanges and removable protective tape on plaster face of control joint.
 - d. Expansion Joints: Two-piece type, formed to produce slip-joint and square-edged **1/2-inch- (13-mm-) OR 1-inch- (25.4-mm-) OR 1-1/2-inch- (38.1-mm-)**, **as directed**, wide reveal; with perforated concealed flanges.
 4. Aluminum Trim: Extruded accessories of profiles and dimensions indicated on Drawings.
 - a. Aluminum: Alloy and temper with not less than the strength and durability properties of **ASTM B 221 (ASTM B 221M)**, Alloy 6063-T5.
 - b. Finish: Mill **OR** Chemical-conversion coating, ASTM D 1730, Type B, compatible with field-applied finish coatings specified, **as directed**.
- D. Miscellaneous Materials
 1. Water for Mixing and Finishing Plaster: Potable and free of substances capable of affecting plaster set or of damaging plaster, lath, or accessories.
 2. Bonding Compound: ASTM C 631.
 3. Steel Drill Screws: For metal-to-metal fastening, ASTM C 1002 or ASTM C 954, as required by thickness of metal being fastened; with pan head that is suitable for application; in lengths required to achieve penetration through joined materials of no fewer than three exposed threads.
 4. Fasteners for Attaching Metal Lath to Substrates: Complying with ASTM C 841.
 5. Wire: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, not less than **0.0475-inch (1.21-mm)** diameter, unless otherwise indicated.
 6. Sound Attenuation Blankets: ASTM C 665, Type I (blankets without membrane facing) produced by combining thermosetting resins with mineral fibers manufactured from glass, slag wool, or rock wool.
 - a. Fire-Resistance-Rated Assemblies: Comply with mineral-fiber requirements of rated assembly.
 - b. Recycled Content: Provide blankets with recycled content such that postconsumer recycled content plus one-half of preconsumer recycled content constitutes a minimum of 25 percent by weight.
 7. Acoustical Sealant: As specified in Division 7 Section "Joint Sealants."
 - a. Provide sealants that have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- E. Base-Coat Plaster Materials
 1. Base-Coat Plasters, General: ASTM C 28/C 28M.
 2. Lightweight Gypsum Ready-Mixed Plaster: With mill-mixed perlite aggregate.
 3. Gypsum Neat Plaster: For use with job-mixed aggregates.
 4. Gypsum Wood-Fibered Plaster:
 5. High-Strength Gypsum Neat Plaster: With a minimum, average, dry compressive strength of **2800 psi (19 MPa)** per ASTM C 472 for a mix of **100 lb (45 kg)** of plaster and **2 cu. ft. (0.06 cu. m)** of sand.
 6. Aggregates for Base-Coat Plasters: ASTM C 35, sand and perlite.
- F. Finish-Coat Plaster Materials
 1. Gypsum Gaging Plaster: ASTM C 28/C 28M.
 2. Gypsum Ready-Mixed Finish Plaster: Manufacturer's standard, mill-mixed, gaged, interior finish.
 3. High-Strength Gypsum Gaging Plaster: ASTM C 28/C 28M, with a minimum, average, dry compressive strength of **5000 psi (34 MPa)** per ASTM C 472 for a neat mix.
 4. Gypsum Keene's Cement: ASTM C 61/C 61M.
 5. Lime: ASTM C 206, Type S, special finishing hydrated lime.

6. Lime: ASTM C 206, Type N, normal finishing hydrated lime.
7. Aggregates for Float Finishes: ASTM C 35, sand **OR** perlite, **as directed**; graded per ASTM C 842.

G. Plaster Mixes

1. Mixing: Comply with ASTM C 842 and manufacturer's written instructions for applications indicated.

1.3 EXECUTION

A. Examination

1. Examine nonstructural and structural metal framing, substrates, and hollow-metal frames, for compliance with requirements and other conditions affecting performance of the Work.
2. Proceed with installation only after unsatisfactory conditions have been corrected.

B. Preparation

1. Protect adjacent work from soiling, spattering, moisture deterioration, and other harmful effects caused by plastering.

C. Installation, General

1. Fire-Resistance-Rated Assemblies: Install components according to requirements for design designations from listing organization and publication indicated on Drawings.
2. STC-Rated Assemblies: Install components according to requirements for design designations from listing organization and publication indicated on Drawings.
 - a. Seal construction at perimeters, behind control and expansion joints, and at openings and penetrations with a continuous bead of acoustical sealant. Install acoustical sealant at both faces of partitions at perimeters and through penetrations.
 - b. Comply with ASTM C 919 and manufacturer's written recommendations for locating edge trim and closing off sound-flanking paths around or through assemblies, including sealing partitions above acoustical ceilings.
3. Sound Attenuation Blankets: Where required, install blankets before installing lath unless blankets are readily installed after lath has been installed on one side.
4. Acoustical Sealant: Where required, seal joints between edges of plasterwork and abutting construction with acoustical sealant.

D. Installing Steel Framing For Solid-Plaster Partitions

1. Install according to ASTM C 841.
2. Framing for Solid-Plaster Partitions: Provide channel stud to support expanded-metal lath construction.
 - a. Space channel studs at **16 inches (406 mm) OR 24 inches (610 mm)**, **as directed**, o.c. unless otherwise indicated.
3. Framing for Studless Solid-Plaster Partition: Provide top and bottom L-track runners to support expanded-metal lath.

E. Installing Expanded-Metal Lath

1. Expanded-Metal Lath: Install according to ASTM C 841.
 - a. Partition Framing and Vertical Furring: Install flat diamond-mesh **OR** flat rib, **as directed**, lath.
 - b. Flat-Ceiling and Horizontal Framing: Install flat diamond-mesh **OR** flat rib, **as directed**, lath.
 - c. Curved-Ceiling Framing: Install flat diamond-mesh lath.
 - d. On Solid Surfaces, Not Otherwise Furred: Install self-furring, diamond-mesh lath.
 - e. Solid-Plaster Partitions: Where supported by channel studs, install flat rib **OR** flat diamond-mesh, **as directed**, lath.

- f. Studless Solid-Plaster Partitions: Install **3/8-inch (9.5-mm)** rib lath.

F. Installing Accessories

1. General: Install according to ASTM C 841.
2. Cornerbeads: Install at external corners.
3. Casing Beads: Install at terminations of plasterwork, except where plaster passes behind and is concealed by other work and where metal screeds, bases, or frames act as casing beads.
4. Control Joints: Install control joints at locations indicated on Drawings **OR** with spacing between joints in either direction not exceeding the following and in specific locations approved by Architect for visual effect, **as directed**:
 - a. Partitions: **30 feet (9 m)**.
 - b. Ceilings: **50 feet (15 m) OR 30 feet (9 m), as directed.**

G. Plaster Application

1. General: Comply with ASTM C 842.
 - a. Do not deviate more than plus or minus **1/8 inch in 10 feet (3.1 mm in 3 m)** from a true plane in finished plaster surfaces, as measured by a **10-foot (3-m)** straightedge placed on surface.
 - b. Grout hollow-metal frames, bases, and similar work occurring in plastered areas, with base-coat plaster material, before lathing where necessary. Except where full grouting is indicated or required for fire-resistance rating, grout at least **6 inches (152 mm)** at each jamb anchor.
 - c. Finish plaster flush with metal frames and other built-in metal items or accessories that act as a plaster ground unless otherwise indicated. Where casing bead does not terminate plaster at metal frame, cut base coat free from metal frame before plaster sets and groove finish coat at junctures with metal.
 - d. Provide plaster surfaces that are ready to receive field-applied finishes indicated.
2. Bonding Compound: Apply on unit masonry and concrete plaster bases.
3. Base Coats:
 - a. Base Coats over Expanded-Metal Lath: High-strength gypsum **OR** Gypsum neat, **as directed**, plaster with job-mixed sand for scratch and brown coats.
 - b. Base Coats over Expanded-Metal Lath:
 - 1) Scratch Coat: Gypsum wood-fibered plaster; neat or with job-mixed sand.
 - 2) Brown Coat: Gypsum wood-fibered plaster with job-mixed sand **OR** neat plaster with job-mixed sand **OR** lightweight ready-mixed plaster **OR** neat plaster with job-mixed perlite, **as directed**.
 - c. Base Coats over Unit Masonry: Gypsum wood-fibered plaster with job-mixed sand **OR** neat plaster with job-mixed sand **OR** lightweight ready-mixed plaster, **as directed**.
 - d. Base-Coat Mix over Monolithic Concrete: Gypsum neat plaster with job-mixed sand.
4. Finish Coats:
 - a. Finish-Coat Mix for Smooth-Troweled Finishes: Gypsum gaging plaster **OR** Gypsum ready-mixed finish plaster **OR** High-strength gypsum gaging plaster **OR** Gypsum Keene's cement, **as directed**.
 - b. Finish-Coat Mix for Float Finishes: Gypsum gaging plaster **OR** Gypsum Keene's cement, **as directed**.
 - c. Finish-Coat Mix for Sprayed Finishes: Gypsum ready-mixed finish plaster.
 - d. Finish-Coat Mix for Textured Finishes: Gypsum ready-mixed finish plaster.
5. Plaster Finishes:
 - a. Provide troweled finish unless otherwise indicated **OR** where indicated, **as directed**.
 - b. Provide float finish unless otherwise indicated **OR** where indicated, **as directed**.
 - c. Provide sprayed finish unless otherwise indicated **OR** where indicated, **as directed**.
 - 1) Sprayed Finish: Match sample.
 - d. Provide textured finish where indicated.
 - 1) Textured Finish: Match sample.
6. Concealed Plaster:



- a. Where plaster application will be concealed behind built-in cabinets, similar furnishings, and equipment, apply finish coat.
- b. Where plaster application will be concealed above suspended ceilings and in similar locations, finish coat may be omitted.
- c. Where plaster application will be used as a base for adhesive application of tile and similar finishes, finish coat may be omitted.

H. Plaster Repairs

- 1. Repair or replace work to eliminate cracks, dents, blisters, buckles, crazing and check cracking, dry outs, efflorescence, sweat outs, and similar defects and where bond to substrate has failed.

I. Cleaning And Protection

- 1. Remove temporary protection and enclosure of other work. Promptly remove plaster from door frames, windows, and other surfaces not indicated to be plastered. Repair floors, walls, and other surfaces stained, marred, or otherwise damaged during plastering.

END OF SECTION 09 22 13 13

NOT FOR BIDDING

SECTION 09 22 13 13a - GYPSUM VENEER PLASTER

1.1 GENERAL

A. Description Of Work

1. This specification covers the furnishing and installation of materials for gypsum veneer plastering. Products shall be as follows or as directed by the Owner. Installation procedures shall be in accordance with the product manufacturer's recommendations. Demolition and removal of materials shall be as required to support the work.

B. Summary

1. This Section includes the following:
 - a. Gypsum veneer plaster and gypsum base for veneer plaster.
 - b. Gypsum veneer plaster over cementitious backer units.
 - c. Gypsum veneer plaster over masonry surfaces.
 - d. Gypsum veneer plaster over monolithic concrete surfaces.

C. Submittals

1. Product Data: For each type of product indicated.
2. Shop Drawings: Show locations, fabrication, and installation of control joints, and reveals and trim; include plans, elevations, sections, details of components, and attachments to other work.
3. Samples: For the following products:
 - a. Trim Accessories: Full-size Sample in 12-inch (300-mm) length for each trim accessory.
 - b. Textured Finishes: Manufacturer's standard size for each textured finish and on rigid backing.
4. LEED Submittals:
 - a. Product Data for Credit EQ 4.1: For adhesives, including printed statement of VOC content.
 - b. Product Data for Credit MR 4.1 and MR 4.2, **as directed**: For products having recycled content, documentation indicating percentages by weight of postconsumer and preconsumer recycled content.
 - 1) Include statement indicating costs for each product having recycled content.

D. Quality Assurance

1. Source Limitations: Obtain gypsum veneer plaster products, including gypsum base for veneer plaster, **OR** cementitious base units, **as directed**, joint reinforcing tape, and embedding material, from a single manufacturer.
2. Fire-Resistance-Rated Assemblies: Provide materials and construction identical to those tested in assembly indicated according to ASTM E 119 by a testing and inspecting agency.
3. STC-Rated Assemblies: Provide materials and construction identical to those tested in assembly indicated according to ASTM E 90 and classified according to ASTM E 413 by a testing and inspecting agency.

E. Delivery, Storage, And Handling

1. Deliver materials in original packages, containers, and bundles bearing brand name and identification of manufacturer or supplier.
2. Store materials inside under cover and keep them dry and protected against damage from weather, direct sunlight, surface contamination, corrosion, construction traffic, and other causes.
3. Stack panels flat on leveled supports off floor or slab to prevent sagging.

F. Project Conditions

1. Environmental Limitations: Comply with ASTM C 843 requirements or gypsum veneer plaster manufacturer's written recommendations, whichever are more stringent.

2. Room Temperatures: Maintain not less than **55 deg F (13 deg C)** or more than **80 deg F (27 deg C)** for 7 days before application of gypsum base and gypsum veneer plaster, continuously during application, and after application until veneer plaster is dry.
3. Avoid conditions that result in gypsum veneer plaster drying too rapidly.
 - a. Distribute heat evenly; prevent concentrated or uneven heat on veneer plaster.
 - b. Maintain relative humidity levels, for prevailing ambient temperature, that produce normal drying conditions.
 - c. Ventilate building spaces in a manner that prevents drafts of air from contacting surfaces during veneer plaster application until it is dry.
4. Do not install panels that are wet, moisture damaged, or mold damaged.
 - a. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, and irregular shape.
 - b. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

1.2 PRODUCTS

A. Gypsum Veneer Plaster Materials

1. One-Component Gypsum Veneer Plaster: ASTM C 587, formulated for application directly over substrate without use of separate base-coat material.
2. High-Strength, One-Component Gypsum Veneer Plaster: ASTM C 587, ready-mixed, smooth, finish-coat veneer plaster containing mill-mixed, fine silica sand; with a compressive strength of **3000 psi (20 MPa)** when tested according to ASTM C 472; and formulated for application directly over substrate without use of separate base-coat material.
3. Two-Component Gypsum Veneer Plaster: ASTM C 587, with separate formulations; one for base-coat and one for finish-coat application over substrates.
4. High-Strength, Two-Component Gypsum Veneer Plaster: ASTM C 587, ready-mixed, base-coat plaster and smooth finish-coat veneer plaster containing mill-mixed, fine silica sand; with a compressive strength of **3000 psi (20 MPa)** when tested according to ASTM C 472.
5. Radiant-Heat, Two-Component Gypsum Veneer Plaster: ASTM C 587, and approved in writing by gypsum veneer plaster manufacturer for application with embedded electric heating cables.
 - a. Provide ready-mixed **OR** job-aggregated, **as directed**, components, as standard for manufacturer, to comply with manufacturer's written recommendations.
 - b. Aggregate: For job-aggregated base coat and texture finish coat, provide white silica sand passing a **No. 30 (0.6-mm)** sieve.

B. Panel Products

1. Recycled Content: Provide gypsum panel products with recycled content such that postconsumer recycled content plus one-half of preconsumer recycled content constitutes a minimum of 25 percent by weight.
2. Panel Size: Provide in maximum lengths and widths available that will minimize joints in each area and that correspond with support system indicated.
3. Gypsum Base for Veneer Plaster: ASTM C 588/C 588M.
 - a. Regular Type: In thickness indicated **OR 1/2 inch (13 mm)** thick, unless otherwise indicated, **as directed**.
 - b. Type X: In thickness indicated **OR 5/8 inch (16 mm)** thick, **as directed**.
 - c. Foil-Backed, Regular-Type Core: In thickness indicated **OR 1/2 inch (13 mm)** thick, unless otherwise indicated, **as directed**.
 - d. Type C: In thickness indicated **OR 5/8 inch (16 mm)** thick **OR 1/2 inch (13 mm)** thick, **as directed**.
 - e. Abuse-Resistant Base: With specially reinforced core for greater resistance to surface indentation, **5/8-inch (16-mm)** thick, Type X core **OR 1/2-inch (13-mm)** thick, regular-type core, **as directed**.

- f. High-Impact Base: With Type X core, plastic film laminated to back side for greater resistance to through-penetration (impact resistance), and in thickness indicated **OR 5/8 inch (16 mm) thick, as directed.**
 - 1) Plastic-Film Thickness: **0.010 inch (0.254 mm) OR 0.020 inch (0.508 mm) OR 0.030 inch (0.762 mm) OR 0.081 inch (2.057 mm), as directed.**
 - g. Moisture- and Mold-Resistant Base: With moisture- and mold-resistant core, glass-mat facing on both sides of panel, and in thickness indicated **OR 5/8-inch (16-mm) thick, Type X core OR 1/2-inch (13-mm) thick, regular-type core, as directed.**
 - 1) Mold Resistance: ASTM D 3273; no mold growth after four weeks' exposure.
 4. Backing Panels for Multilayer Applications: ASTM C 588/C 588M gypsum base or ASTM C 36/C 36M gypsum board, as recommended by gypsum veneer plaster manufacturer, for application method and thicknesses indicated.
 - a. Core: Matching face layer, unless otherwise indicated.
 - b. Thickness: Matching face layer, unless otherwise indicated.
 5. Cementitious Backer Units: ANSI A118.9, in thickness indicated **OR 1/2 inch (13 mm) thick, as directed.**
- C. Trim Accessories
1. Standard Trim: ASTM C 1047, provided or approved by manufacturer for use in gypsum veneer plaster applications indicated.
 - a. Material: Galvanized or aluminum-coated steel sheet, rolled zinc, plastic, or paper-faced galvanized steel sheet **OR** Galvanized or aluminum-coated steel sheet or rolled zinc **OR** Plastic **OR** Paper-faced galvanized steel sheet, **as directed.**
 - b. Shapes:
 - 1) Cornerbead.
 - 2) Bullnose bead.
 - 3) LC-Bead: J-shaped; exposed long flange receives joint compound.
 - 4) L-Bead: L-shaped; exposed long flange receives joint compound.
 - 5) U-Bead: J-shaped; exposed short flange does not receive joint compound.
 - 6) Curved-Edge Cornerbead: With notched or flexible flanges.
 - 7) Control joints.
 2. Aluminum Trim: Extruded accessories of profiles and dimensions indicated.
 - a. Aluminum: Alloy and temper with not less than the strength and durability properties of **ASTM B 221 (ASTM B 221M)**, Alloy 6063-T5.
 - b. Finish: Manufacturer's standard Architectural Class II, Clear Anodic Finish AA-M12C22A31, complying with AAMA 611 **OR** chemical conversion coat finish **OR** prime paint finish, **as directed.**
- D. Joint Reinforcing Materials
1. General: Comply with joint strength requirements in ASTM C 587 and with gypsum veneer plaster manufacturer's written recommendations for each application indicated.
 2. Joint Tape:
 - a. Gypsum Base for Veneer Plaster: As recommended by gypsum veneer plaster manufacturer for applications indicated **OR** Paper **OR** Open-mesh, glass fiber, **as directed.**
 - b. Cementitious Backer Units: As recommended by cementitious backer unit manufacturer.
 3. Embedding Material for Joint Tape:
 - a. Gypsum Base for Veneer Plaster: As recommended by gypsum veneer plaster manufacturer for use with joint-tape material and gypsum veneer plaster applications indicated.
 - b. Cementitious Backer Units: As recommended by cementitious backer unit manufacturer for applications indicated.
- E. Auxiliary Materials
1. General: Provide auxiliary materials that comply with referenced product standards and manufacturer's written recommendations.

2. Bonding Agent: ASTM C 631, polyvinyl acetate.
3. Laminating Adhesive: Adhesive or joint compound recommended by manufacturer for directly adhering gypsum base face-layer panels to backing-layer panels in multilayer construction.
 - a. Use adhesives that have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
4. Steel Drill Screws: ASTM C 1002, unless otherwise indicated.
 - a. Use screws complying with ASTM C 954 for fastening panels to steel members from **0.033 to 0.112 inch (0.84 to 2.84 mm)** thick.
5. For fastening cementitious backer units, use screws of type and size recommended by panel manufacturer.
6. Sound Attenuation Blankets: ASTM C 665, Type I (blankets without membrane facing), produced by combining thermosetting resins with mineral fibers manufactured from glass, slag wool, or rock wool.
 - a. Fire-Resistance-Rated Assemblies: Comply with mineral-fiber requirements of assembly.
 - b. Recycled Content: Provide blankets with recycled content such that postconsumer recycled content plus one-half of preconsumer recycled content constitutes a minimum of 25 percent by weight.
7. Acoustical Sealant: As specified in Division 07 Section "Thermal Insulation".
 - a. Provide sealants that have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
8. Patching Mortar: Dry-pack patching mortar, consisting of 1 part portland cement to 2-1/2 parts fine aggregate passing a **No. 16 (1.18-mm)** sieve, using only enough water for handling and placing.

F. Gypsum Veneer Plaster Mixes

1. Mechanically mix gypsum veneer plaster materials to comply with ASTM C 843 and with gypsum veneer plaster manufacturer's written recommendations.

1.3 EXECUTION

A. Preparation

1. Monolithic Concrete Substrates: Prepare according to gypsum veneer plaster manufacturer's written recommendations and as follows:
 - a. Clean surfaces to remove dust, loose particles, grease, oil, incompatible curing compounds, form-release agents, and other foreign matter and deposits that could impair bond with gypsum veneer plaster.
 - b. Remove ridges and protrusions greater than **1/8 inch (3 mm)** and fill depressions greater than **1/4 inch (6 mm)** with patching mortar. Allow to set and dry.
 - c. Apply bonding agent on dry and cured concrete substrates.
2. Masonry Substrates: Prepare according to gypsum veneer plaster manufacturer's written recommendations and as follows:
 - a. Clean surfaces to remove dirt, grease, oil, and other foreign matter and deposits that could impair bond with gypsum veneer plaster.
 - b. Apply bonding agent on dry masonry substrates.

B. Installing Panels, General

1. Gypsum Base for Veneer Plaster: Apply according to ASTM C 844 unless manufacturer's written recommendations are more stringent.
 - a. Do not allow gypsum base to degrade from exposure to sunlight as evidenced by fading of paper facing.
 - b. Erection Tolerance: No more than **1/16-inch (1.6-mm)** offsets between planes of gypsum base panels, and **1/8 inch in 8 feet (3 mm in 2.4 m)** noncumulative, for level, plumb, warp, and bow.

2. Install sound attenuation blankets before installing gypsum base for veneer plaster unless blankets are readily installed after panels have been installed on one side.
3. Install ceiling panels across framing to minimize the number of abutting end joints and to avoid abutting end joints in the central area of each ceiling. Stagger abutting end joints of adjacent panels not less than one framing member.
4. Install panels with face side out. Butt panels together for a light contact at edges and ends with not more than **1/16 inch (1.6 mm)** of open space between panels. Do not force into place.
5. Locate edge and end joints over supports except in ceiling applications where intermediate supports or back-blocking is provided behind end joints. Do not place tapered edges against cut edges or ends. Stagger vertical joints on opposite sides of partitions. Do not make joints, other than control joints, at corners of framed openings.
6. Attach panels to steel studs so leading edge or end of each panel is attached to open (unsupported) edges of stud flanges first.
7. Attach panels to framing provided at openings and cutouts.
8. Form control joints with space between edges of adjoining panels.
9. Cover both sides of steel stud partition framing with panels in concealed spaces, including above ceilings, except in internally braced chases.
 - a. Unless concealed application is indicated or required for sound, fire, air, or smoke ratings, coverage may be accomplished with scraps of not less than **8 sq. ft. (0.74 sq. m)** in area.
 - b. Fit panels around ducts, pipes, and conduits.
 - c. Where partitions intersect open concrete coffer, concrete joists, and other structural members projecting below underside of floor/roof slabs and decks, cut panels to fit profile formed by coffer, joists, and other structural members; allow **1/4- to 3/8-inch-** (6.4- to 9.5-mm-) wide joints; seal joints with acoustical sealant.
10. Wood Framing: Install panels over wood framing, with "floating" internal corner construction. Do not attach panels across the flat grain of wide-dimension lumber, including floor joists and headers. "Float" panels over these members or provide control joints to counteract wood shrinkage.
11. STC-Rated Assemblies: Seal construction at perimeters, behind control joints, and at openings and penetrations with a continuous bead of acoustical sealant. Install acoustical sealant at both faces of partitions at perimeters and through penetrations. Comply with ASTM C 919 and with manufacturer's written recommendations for locating edge trim and closing off sound-flanking paths around or through assemblies, including sealing partitions above acoustical ceilings.
12. Fastener Spacing: Comply with ASTM C 844, manufacturer's written recommendations, and fire-resistance-rating requirements.
 - a. Space screws a maximum of **12 inches (305 mm)** o.c. along framing members for wall or ceiling application.
 - b. Space fasteners in cementitious backer units a maximum of **8 inches (200 mm)** o.c. along framing members for wall applications and **6 inches (150 mm)** o.c. along framing members for ceiling applications.

C. Installing Panels

1. Install gypsum base panels for veneer plaster in the following locations:
 - a. Regular Type: As indicated on Drawings **OR** Vertical surfaces, unless otherwise indicated, **as directed**.
 - b. Ceiling Type: As indicated on Drawings **OR** Ceiling surfaces, **as directed**.
 - c. Type X: As indicated on Drawings **OR** Where required for fire-resistance-rated assembly **OR** Vertical surfaces, unless otherwise indicated, **as directed**.
 - d. Type C: As indicated on Drawings **OR** Where required for specific fire-resistance-rated assembly indicated, **as directed**.
 - e. Foil-Backed, Regular-Type Core: As indicated on Drawings **OR as directed**.
 - f. Abuse-Resistant Base: As indicated on Drawings **OR as directed**.
 - g. High-Impact Base: As indicated on Drawings **OR as directed**.
 - h. Moisture- and Mold-Resistant Base: As indicated on Drawings **OR as directed**.
2. Single-Layer Application:

- a. On ceilings, apply gypsum base panels before wall panels, to the greatest extent possible and at right angles to framing, unless otherwise indicated.
 - b. On walls, apply gypsum base panels vertically and parallel **OR** horizontally and perpendicular, **as directed**, to framing, unless otherwise indicated or required by fire-resistance-rated assembly, and minimize end joints.
 - 1) Stagger abutting end joints not less than one framing member in alternate courses of panels.
 - 2) At stairwells and other walls higher than **30 feet (9.0 m)**, install gypsum base panels horizontally unless otherwise indicated or required by fire-resistance-rated assembly.
 - c. On Z-furring, apply gypsum base panels vertically (parallel to framing) with no end joints. Locate edge joints over furring members.
 3. Multilayer Application on Ceilings: Apply backing panels for ceilings before applying backing panels for partitions; apply gypsum-base face layers in same sequence. Apply backing panels at right angles to framing members and offset gypsum-base face-layer joints a minimum of **16 inches (400 mm)** from parallel backing panel joints, unless otherwise required by fire-resistance-rated assembly.
 4. Multilayer Application on Partitions: Apply backing panels indicated and gypsum-base face layers vertically (parallel to framing) with joints of backing panels located over stud or furring members and gypsum-base face-layer joints offset at least one stud or furring member from backing-panel joints, unless otherwise required by fire-resistance-rated assembly. Stagger joints on opposite sides of partitions.
 - a. Z-Furring: Apply backing panels vertically (parallel to framing) and gypsum-base face layer either vertically or horizontally (perpendicular to framing) with vertical joints offset at least one furring member. Locate edge joints of backing panels over furring members.
 5. Single-Layer Fastening Methods: Apply gypsum base panels to supports with steel drill screws.
 6. Multilayer Fastening Methods: Fasten backing panels and gypsum-base face layers separately to supports with screws **OR** with screws; fasten gypsum-base face layers with adhesive and supplementary fasteners, **as directed**.
 7. Curved Partitions: Comply with gypsum base manufacturer's written installation recommendations.
 8. Cementitious Backer Units: Install according to ANSI A108.11.
 - a. Where cementitious backer units abut other types of panels in same plane, shim surfaces to produce a uniform plane across panel surfaces.
- D. Installing Trim Accessories
1. General: For trim with back flanges intended for fasteners, attach to framing with same fasteners used for panels. Otherwise, attach trim according to manufacturer's written instructions.
 2. Control Joints: Install at locations indicated on Drawings **OR** according to ASTM C 844 and in specific locations approved by the Owner, **as directed**.
 3. Trim: Install in the following locations:
 - a. Cornerbead: Use at outside corners, unless otherwise indicated.
 - b. Bullnose Bead: Use at outside corners **OR** where indicated, **as directed**.
 - c. LC-Bead: Use at exposed panel edges.
 - d. L-Bead: Use where indicated.
 - e. U-Bead: Use at exposed panel edges **OR** where indicated, **as directed**.
 - f. Curved-Edge Cornerbead: Use at curved openings.
 4. Aluminum Trim:
 - a. Install aluminum trim according to manufacturer's written recommendations.
 - b. Apply and embed joint tape over flanges of aluminum trim accessories if recommended by trim manufacturer.
- E. Installing Joint Reinforcement

1. Gypsum Base for Veneer Plaster: Reinforce interior angles and flat joints with joint tape and embedding material to comply with ASTM C 843 and with gypsum veneer plaster manufacturer's written recommendations.
 2. Abuse-Resistant Base: Reinforce joints between abuse-resistant panels with joint tape and embedding material according to panel manufacturer's written recommendations.
 3. Impact-Resistant Base: Reinforce joints between impact-resistant panels with joint tape and embedding material according to panel manufacturer's written recommendations.
 4. Moisture- and Mold-Resistant Base: Reinforce joints between moisture- and mold-resistant panels with joint tape and embedding material according to panel manufacturer's written recommendations.
 5. Cementitious Backer Units: Reinforce joints between cementitious backer units with joint tape and embedding material according to unit manufacturer's written recommendations.
- F. Gypsum Veneer Plastering
1. Bonding Agent: Apply bonding agent on dry monolithic concrete **OR** masonry **OR** abuse-resistant base panels **OR** cementitious backer units, **as directed**, according to gypsum veneer plaster manufacturer's written recommendations.
 2. Gypsum Veneer Plaster Application: Comply with ASTM C 843 and with veneer plaster manufacturer's written recommendations.
 - a. One-Component Gypsum Veneer Plaster: Trowel apply base coat over substrate to uniform thickness of **1/16 to 3/32 inch (1.6 to 2.4 mm)**. Fill all voids and imperfections. Allow plaster to set, then scratch and immediately double back with gypsum veneer plaster to uniform total thickness of **3/16 inch (4.8 mm)**.
 - b. Two-Component Gypsum Veneer Plaster:
 - 1) Base Coat: Trowel apply base coat over substrate to uniform thickness of **1/16 to 3/32 inch (1.6 to 2.4 mm)**. Fill all voids and imperfections.
 - 2) Finish Coat: Trowel apply finish-coat plaster over base-coat plaster to uniform thickness of **1/16 to 3/32 inch (1.6 to 2.4 mm)**.
 - c. Where gypsum veneer plaster abuts only metal door frames, windows, and other units, groove finish coat to eliminate spalling.
 - d. Do not apply veneer plaster to gypsum base if paper facing has degraded from exposure to sunlight. Before applying veneer plaster, use remedial methods to restore bonding capability to degraded paper facing according to manufacturer's written recommendations and as approved by the Owner.
 3. Radiant-Heat, Two-Component Gypsum Veneer Plaster Ceilings: Comply with ASTM C 843 and with radiant-heat veneer plaster manufacturer's written recommendations.
 - a. Base Coat: Apply plaster base coat to sufficiently cover electric heating cables. Trowel plaster parallel in direction of cables to uniform thickness of **3/16 inch (4.8 mm)**. Completely cover cables.
 - b. Finish Coat: After base coat has developed sufficient bond, apply finish coat. Trowel plaster to uniform thickness of **1/16 to 3/32 inch (1.6 to 2.4 mm)**.
 4. Concealed Surfaces: Do not omit gypsum veneer plaster behind cabinets, furniture, furnishings, and similar removable items. Omit veneer plaster in the following areas where it will be concealed from view in the completed Work unless otherwise indicated or required to maintain fire-resistance and STC ratings:
 - a. Above suspended ceilings.
 - b. Behind wood paneling.
 5. Gypsum Veneer Plaster Finish: Smooth-troweled finish, unless otherwise indicated **OR** Textured finish matching the Owner's sample, **as directed**.
- G. Protection
1. Protect installed gypsum veneer plaster from damage from weather, condensation, construction, and other causes during remainder of the construction period.
 2. Remove and replace gypsum veneer plaster and gypsum base panels that are wet, moisture damaged, or mold damaged.



- a. Indications that gypsum base panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, and irregular shape.
- b. Indications that gypsum base panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

END OF SECTION 09 22 13 13a

NOT FOR BID

SECTION 09 22 13 13b - PORTLAND CEMENT PLASTER

1.1 GENERAL

A. Description Of Work

1. This specification covers the furnishing and installation of materials for portland cement plaster. Products shall be as follows or as directed by the Owner. Installation procedures shall be in accordance with the product manufacturer's recommendations. Demolition and removal of materials shall be as required to support the work.

B. Summary

1. Section Includes:
 - a. Interior portland cement plasterwork on metal lath, unit masonry and monolithic concrete.
 - b. Exterior portland cement plasterwork (stucco) on metal lath, unit masonry and monolithic concrete.

C. Submittals

1. Product Data: For each type of product indicated.
2. LEED Submittals:
 - a. Product Data for Credit MR 4.1 and Credit MR 4.2, **as directed**: For products having recycled content, documentation indicating percentages by weight of postconsumer and preconsumer recycled content.
 - 1) Include statement indicating costs for each product having recycled content.
 - b. Product Data for Credit EQ 4.1: For sealants, including printed statement of VOC content.
3. Shop Drawings: Show locations and installation of control and expansion joints including plans, elevations, sections, details of components, and attachments to other work.
4. Samples: For each type of factory-prepared, colored or textured finish coat indicated; **12 by 12 inches (305 by 305 mm)**, and prepared on rigid backing.

D. Quality Assurance

1. Fire-Resistance Ratings: Where indicated, provide portland cement plaster assemblies identical to those of assemblies tested for fire resistance per ASTM E 119 by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
 - a. Indicate design designations from UL's "Fire Resistance Directory" or from the listings of another qualified testing agency.
2. Sound-Transmission Characteristics: Where indicated, provide portland cement plaster assemblies identical to those of assemblies tested for STC ratings per ASTM E 90 and classified according to ASTM E 413 by a qualified testing agency.
3. Preinstallation Conference: Conduct conference at Project site.

E. Delivery, Storage, And Handling

1. Store materials inside under cover and keep them dry and protected against damage from weather, direct sunlight, surface contamination, corrosion, construction traffic, and other causes.

F. Project Conditions

1. Comply with ASTM C 926 requirements.
2. Interior Plasterwork: Maintain room temperatures at greater than **40 deg F (4.4 deg C)** for at least 48 hours before plaster application, and continuously during and after application.
 - a. Avoid conditions that result in plaster drying out during curing period. Distribute heat evenly; prevent concentrated or uneven heat on plaster.
 - b. Ventilate building spaces as required to remove water in excess of that required for hydrating plaster in a manner that prevents drafts of air from contacting surfaces during plaster application and until plaster is dry.
3. Exterior Plasterwork:

- a. Apply and cure plaster to prevent plaster drying out during curing period. Use procedures required by climatic conditions, including moist curing, providing coverings, and providing barriers to deflect sunlight and wind.
- b. Apply plaster when ambient temperature is greater than **40 deg F (4.4 deg C)**.
- c. Protect plaster coats from freezing for not less than 48 hours after set of plaster coat has occurred.
4. **Factory-Prepared Finishes:** Comply with manufacturer's written recommendations for environmental conditions for applying finishes.

1.2 PRODUCTS

A. Metal Lath

1. **Expanded-Metal Lath:** ASTM C 847 with ASTM A 653/A 653M, **G60 (Z180)**, hot-dip galvanized zinc coating.
 - a. **Recycled Content:** Provide steel products with average recycled content such that postconsumer recycled content plus one-half of preconsumer recycled content is not less than 25 percent.
 - b. **Diamond-Mesh Lath:** Flat **OR** Self-furring, **as directed, 2.5 lb/sq. yd. (1.4 kg/sq. m) OR 3.4 lb/sq. yd. (1.8 kg/sq. m), as directed.**
 - c. **Flat Rib Lath:** Rib depth of not more than **1/8 inch (3.1 mm), 2.75 lb/sq. yd. (1.5 kg/sq. m) OR 3.4 lb/sq. yd. (1.8 kg/sq. m), as directed.**
 - d. **3/8-Inch (9.5-mm) Rib Lath:** **3.4 lb/sq. yd. (1.8 kg/sq. m) OR 4 lb/sq. yd. (2.2 kg/sq. m), as directed.**
2. **Wire-Fabric Lath:**
 - a. **Welded-Wire Lath:** ASTM C 933; self-furring, **1.4 lb/sq. yd. (0.8 kg/sq. m) OR 1.95 lb/sq. yd. (1.1 kg/sq. m), as directed.**
 - b. **Woven-Wire Lath:** ASTM C 1032; self-furring, with stiffener wire backing, **1.1 lb/sq. yd. (0.6 kg/sq. m) OR 1.4 lb/sq. yd. (0.8 kg/sq. m), as directed.**
3. **Paper Backing:** FS UU-B-790, Type I, Grade D, Style 2 vapor-permeable paper **OR** Grade B, Style 1a vapor-retardant paper, **as directed.**
 - a. Provide paper-backed lath unless otherwise indicated **OR** at exterior locations **OR** in locations indicated on Drawings, **as directed.**

B. Accessories

1. **General:** Comply with ASTM C 1063 and coordinate depth of trim and accessories with thicknesses and number of plaster coats required.
2. **Metal Accessories:**
 - a. **Foundation Weep Screed:** Fabricated from hot-dip galvanized-steel sheet, ASTM A 653/A 653M, **G60 (Z180)** zinc coating.
 - b. **Cornerite:** Fabricated from metal lath with ASTM A 653/A 653M, **G60 (Z180)**, hot-dip galvanized zinc coating.
 - c. **External-Corner Reinforcement:** Fabricated from metal lath with ASTM A 653/A 653M, **G60 (Z180)**, hot-dip galvanized zinc coating.
 - d. **Cornerbeads:** Fabricated from zinc or zinc-coated (galvanized) steel.
 - 1) Small nose cornerbead with expanded flanges; use unless otherwise indicated.
 - 2) Small nose cornerbead with perforated flanges; use on curved corners.
 - 3) Small nose cornerbead with expanded flanges reinforced by perforated stiffening rib; use on columns and for finishing masonry corners.
 - 4) Bull nose cornerbead, radius **3/4 inch (19.1 mm)** minimum, with expanded flanges; use at locations indicated on Drawings.
 - e. **Casing Beads:** Fabricated from zinc or zinc-coated (galvanized) steel; square-edged style; with expanded flanges.

- f. Control Joints: Fabricated from zinc or zinc-coated (galvanized) steel; one-piece-type, folded pair of unperforated screeds in M-shaped configuration; with perforated flanges and removable protective tape on plaster face of control joint.
- g. Expansion Joints: Fabricated from zinc or zinc-coated (galvanized) steel; folded pair of unperforated screeds in M-shaped configuration; with expanded flanges.
- h. Two-Piece Expansion Joints: Fabricated from zinc or zinc-coated (galvanized) steel; formed to produce slip-joint and square-edged reveal that is adjustable from **1/4 to 5/8 inch (6.34 to 16 mm)** wide; with perforated flanges.
3. Plastic Accessories: Fabricated from high-impact PVC.
 - a. Cornerbeads: With perforated flanges.
 - 1) Small nose cornerbead; use unless otherwise indicated.
 - 2) Bull nose cornerbead, radius **3/4 inch (19.1 mm)** minimum; use at locations indicated on Drawings.
 - b. Casing Beads: With perforated flanges in depth required to suit plaster bases indicated and flange length required to suit applications indicated.
 - 1) Square-edge style; use unless otherwise indicated.
 - 2) Bull-nose style, radius **3/4 inch (19.1 mm)** minimum; use at locations indicated on Drawings.
 - c. Control Joints: One-piece-type, folded pair of unperforated screeds in M-shaped configuration; with perforated flanges and removable protective tape on plaster face of control joint.
 - d. Expansion Joints: Two-piece type, formed to produce slip-joint and square-edged **1/2-inch- (13-mm-) OR 1-inch- (25-mm-) OR 1-1/2-inch- (38-mm-), as directed**, wide reveal; with perforated concealed flanges.
- C. Miscellaneous Materials
 1. Water for Mixing: Potable and free of substances capable of affecting plaster set or of damaging plaster, lath, or accessories.
 2. Fiber for Base Coat: Alkaline-resistant glass or polypropylene fibers, **1/2 inch (13 mm)** long, free of contaminants, manufactured for use in portland cement plaster.
 3. Bonding Compound: ASTM C 932.
 4. Steel Drill Screws: For metal-to-metal fastening, ASTM C 1002 or ASTM C 954, as required by thickness of metal being fastened; with pan head that is suitable for application; in lengths required to achieve penetration through joined materials of no fewer than three exposed threads.
 5. Fasteners for Attaching Metal Lath to Substrates: Complying with ASTM C 1063.
 6. Wire: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, not less than **0.0475-inch (1.21-mm)** diameter, unless otherwise indicated.
 7. Sound Attenuation Blankets: ASTM C 665, Type I (blankets without membrane facing) produced by combining thermosetting resins with mineral fibers manufactured from glass, slag wool, or rock wool.
 - a. Fire-Resistance-Rated Assemblies: Comply with mineral-fiber requirements of assembly.
 - b. Recycled Content: Provide blankets with recycled content such that postconsumer recycled content plus one-half of preconsumer recycled content constitutes a minimum of 25 percent by weight.
 8. Acoustical Sealant: As specified in Division 7 Section "Joint Sealants".
 - a. Provide sealants that have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- D. Plaster Materials
 1. Portland Cement: ASTM C 150, Type I **OR** Type II, **as directed**.
 - a. Color for Finish Coats: White **OR** Gray, **as directed**.
 2. Masonry Cement: ASTM C 91, Type N.
 - a. Color for Finish Coats: White **OR** Gray, **as directed**.
 3. Plastic Cement: ASTM C 1328.
 4. Colorants for Job-Mixed Finish Coats: Colorfast mineral pigments that produce finish plaster color to match sample.

5. Lime: ASTM C 206, Type S; or ASTM C 207, Type S.
6. Sand Aggregate: ASTM C 897.
 - a. Color for Job-Mixed Finish Coats: White **OR** In color matching sample, **as directed**.
7. Perlite Aggregate: ASTM C 35.
8. Exposed Aggregates for Finish Coats: For marblecrete finish, clean, sound, crushed marble matching color and size gradation of sample.
9. Ready-Mixed Finish-Coat Plaster: Mill-mixed portland cement, aggregates, coloring agents, and proprietary ingredients.
 - a. Color: As selected from manufacturer's full range.
10. Acrylic-Based Finish Coatings: Factory-mixed acrylic-emulsion coating systems, formulated with colorfast mineral pigments and fine aggregates; for use over portland cement plaster base coats. Include manufacturer's recommended primers and sealing topcoats for acrylic-based finishes.
 - a. Color: As selected from manufacturer's full range.

E. Plaster Mixes

1. General: Comply with ASTM C 926 for applications indicated.
 - a. Fiber Content: Add fiber to base-coat mixes after ingredients have mixed at least two minutes. Comply with fiber manufacturer's written instructions for fiber quantities in mixes, but do not exceed **1 lb of fiber/cu. yd. (0.6 kg of fiber/cu. m)** of cementitious materials.
2. Base-Coat Mixes for Use over Metal Lath: Scratch and brown coats for three-coat plasterwork as follows:
 - a. Portland Cement Mixes:
 - 1) Scratch Coat: For cementitious material, mix 1 part portland cement and 0 to 3/4 **OR** 3/4 to 1-1/2, **as directed**, parts lime. Use 2-1/2 to 4 parts aggregate per part of cementitious material.
 - 2) Brown Coat: For cementitious material, mix 1 part portland cement and 0 to 3/4 **OR** 3/4 to 1-1/2, **as directed**, parts lime. Use 3 to 5 parts aggregate per part of cementitious material, but not less than volume of aggregate used in scratch coat.
 - b. Masonry Cement Mixes:
 - 1) Scratch Coat: 1 part masonry cement and 2-1/2 to 4 parts aggregate.
 - 2) Brown Coat: 1 part masonry cement and 3 to 5 parts aggregate, but not less than volume of aggregate used in scratch coat.
 - c. Portland and Masonry Cement Mixes:
 - 1) Scratch Coat: For cementitious material, mix 1 part portland cement and 1 part masonry cement. Use 2-1/2 to 4 parts aggregate per part of cementitious material.
 - 2) Brown Coat: For cementitious material, mix 1 part portland cement and 1 part masonry cement. Use 3 to 5 parts aggregate per part of cementitious material, but not less than volume of aggregate used in scratch coat.
 - d. Plastic Cement Mixes:
 - 1) Scratch Coat: 1 part plastic cement and 2-1/2 to 4 parts aggregate.
 - 2) Brown Coat: 1 part plastic cement and 3 to 5 parts aggregate, but not less than volume of aggregate used in scratch coat.
 - e. Portland and Plastic Cement Mixes:
 - 1) Scratch Coat: For cementitious material, mix 1 part plastic cement and 1 part portland cement. Use 2-1/2 to 4 parts aggregate per part of cementitious material.
 - 2) Brown Coat: For cementitious material, mix 1 part plastic cement and 1 part portland cement. Use 3 to 5 parts aggregate per part of cementitious material, but not less than volume of aggregate used in scratch coat.
3. Base-Coat Mixes: Single base coats for two-coat plasterwork as follows:
 - a. Portland Cement Mix: For cementitious material, mix 1 part portland cement and 0 to 3/4 part lime. Use 2-1/2 to 4 parts aggregate per part of cementitious material.
 - b. Portland and Masonry Cement Mix: For cementitious material, mix 1 part portland cement and 1 part masonry cement. Use 2-1/2 to 4 parts aggregate per part of cementitious material.
 - c. Plastic Cement Mix: Use 1 part plastic cement and 2-1/2 to 4 parts aggregate.

4. Base-Coat Mixes: Single base coats for two-coat plasterwork as follows:
 - a. Portland Cement Mix: For cementitious material, mix 1 part portland cement and 3/4 to 1-1/2 parts lime. Use 2-1/2 to 4 parts aggregate per part of cementitious material.
 - b. Masonry Cement Mix: Use 1 part masonry cement and 2-1/2 to 4 parts aggregate.
 - c. Plastic Cement Mix: Use 1 part plastic cement and 2-1/2 to 4 parts aggregate.
5. Job-Mixed Finish-Coat Mixes:
 - a. Portland Cement Mix: For cementitious materials, mix 1 part portland cement and 3/4 to 1-1/2 **OR** 1-1/2 to 2, **as directed**, parts lime. Use 1-1/2 to 3 parts aggregate per part of cementitious material.
 - b. Masonry Cement Mix: 1 part masonry cement and 1-1/2 to 3 parts aggregate.
 - c. Portland and Masonry Cement Mix: For cementitious materials, mix 1 part portland cement and 1 part masonry cement. Use 1-1/2 to 3 parts aggregate per part of cementitious material.
 - d. Plastic Cement Mix: 1 part plastic cement and 1-1/2 to 3 parts aggregate.
6. Factory-Prepared Finish-Coat Mixes: For ready-mixed finish-coat plasters or acrylic-based finish coatings, comply with manufacturer's written instructions.

1.3 EXECUTION

- A. Examination
 1. Examine areas and substrates, with Installer present, and including welded hollow-metal frames, cast-in anchors, and structural framing, for compliance with requirements and other conditions affecting performance of the Work.
 2. Proceed with installation only after unsatisfactory conditions have been corrected.
- B. Preparation
 1. Protect adjacent work from soiling, spattering, moisture deterioration, and other harmful effects caused by plastering.
 2. Prepare solid substrates for plaster that are smooth or that do not have the suction capability required to bond with plaster according to ASTM C 926.
- C. Installation, General
 1. Fire-Resistance-Rated Assemblies: Install components according to requirements for design designations from listing organization and publication indicated on Drawings.
 2. Sound Attenuation Blankets: Where required, install blankets before installing lath unless blankets are readily installed after lath has been installed on one side.
 3. Acoustical Sealant: Where required, seal joints between edges of plasterwork and abutting construction with acoustical sealant.
- D. Installing Metal Lath
 1. Expanded-Metal Lath: Install according to ASTM C 1063.
 - a. Partition Framing and Vertical Furring: Install flat diamond-mesh **OR** flat rib **OR** welded-wire **OR** woven-wire, **as directed**, lath.
 - b. Flat-Ceiling and Horizontal Framing: Install flat diamond-mesh **OR** flat rib **OR** 3/8-inch (9.5-mm) rib lath **OR** welded-wire **OR** woven-wire, **as directed**, lath.
 - c. Curved-Ceiling Framing: Install flat diamond-mesh **OR** welded-wire **OR** flat woven-wire, **as directed**, lath.
 - d. On Solid Surfaces, Not Otherwise Furred: Install self-furring, diamond-mesh **OR** welded-wire **OR** woven-wire, **as directed**, lath.
- E. Installing Accessories
 1. Install according to ASTM C 1063 and at locations indicated on Drawings.
 2. Reinforcement for External Corners:
 - a. Install lath-type, external-corner reinforcement at exterior locations.
 - b. Install cornerbead at interior and exterior, **as directed**, locations.

3. Control Joints: Install control joints at locations indicated on Drawings **OR** in specific locations approved for visual effect as follows, **as directed**:
 - a. As required to delineate plasterwork into areas (panels) of the following maximum sizes:
 - 1) Vertical Surfaces: **144 sq. ft. (13.4 sq. m)**.
 - 2) Horizontal and other Nonvertical Surfaces: **100 sq. ft. (9.3 sq. m)**.
 - b. At distances between control joints of not greater than **18 feet (5.5 m)** o.c.
 - c. As required to delineate plasterwork into areas (panels) with length-to-width ratios of not greater than 2-1/2:1.
 - d. Where control joints occur in surface of construction directly behind plaster.
 - e. Where plasterwork areas change dimensions, to delineate rectangular-shaped areas (panels) and to relieve the stress that occurs at the corner formed by the dimension change.

F. Plaster Application

1. General: Comply with ASTM C 926.
 - a. Do not deviate more than plus or minus **1/4 inch in 10 feet (6.4 mm in 3 m)** from a true plane in finished plaster surfaces, as measured by a **10-foot (3-m)** straightedge placed on surface.
 - b. Finish plaster flush with metal frames and other built-in metal items or accessories that act as a plaster ground unless otherwise indicated. Where casing bead does not terminate plaster at metal frame, cut base coat free from metal frame before plaster sets and groove finish coat at junctures with metal.
 - c. Provide plaster surfaces that are ready to receive field-applied finishes indicated.
2. Bonding Compound: Apply on unit masonry and concrete plaster bases.
3. Walls; Base-Coat Mixes for Use over Metal Lath: Scratch and brown coats for three-coat plasterwork, on masonry or on concrete; **3/4-inch (19-mm)** thickness.
 - a. Portland cement mixes.
 - b. Masonry cement mixes.
 - c. Portland and masonry cement mixes.
 - d. Plastic cement mixes.
 - e. Portland and plastic cement mixes.
4. Ceilings; Base-Coat Mixes for Use over Metal Lath: Scratch and brown coats for three-coat plasterwork; **1/2 inch (13 mm)** thick **OR 3/4 inch (19 mm)** thick on concrete, **as directed**.
 - a. Portland cement mixes.
 - b. Masonry cement mixes.
 - c. Portland and masonry cement mixes.
 - d. Plastic cement mixes.
 - e. Portland and plastic cement mixes.
5. Walls; Base-Coat Mix: Scratch coat for two-coat plasterwork, **3/8 inch (10 mm)** thick on concrete masonry **OR 1/4 inch (6 mm)** thick on concrete, **as directed**.
 - a. Portland cement mixes.
 - b. Masonry cement mixes.
 - c. Portland and masonry cement mixes.
 - d. Plastic cement mixes.
 - e. Portland and plastic cement mixes.
6. Ceilings; Base-Coat Mix: Scratch coat for two-coat plasterwork, **1/4 inch (6 mm)** thick on concrete.
 - a. Portland cement mixes.
 - b. Masonry cement mixes.
 - c. Portland and masonry cement mixes.
 - d. Plastic cement mixes.
 - e. Portland and plastic cement mixes.
7. Plaster Finish Coats: Apply to provide float **OR** dash **OR** scraped trowel-textured **OR** skip trowel-textured **OR** brocade (knock-down dash) **OR** trowel sweep **OR** combed **OR** sacked (California mission) **OR** English **OR** marblecrete, **as directed**, finish to match sample.

8. Acrylic-Based Finish Coatings: Apply coating system, including primers, finish coats, and sealing topcoats, according to manufacturer's written instructions.
 9. Concealed Exterior Plasterwork: Where plaster application will be used as a base for adhered finishes, omit finish coat.
 10. Concealed Interior Plasterwork:
 - a. Where plaster application will be concealed behind built-in cabinets, similar furnishings, and equipment, apply finish coat.
 - b. Where plaster application will be concealed above suspended ceilings and in similar locations, finish coat may be omitted.
 - c. Where plaster application will be used as a base for adhesive application of tile and similar finishes, omit finish coat.
- G. Plaster Repairs
1. Repair or replace work to eliminate cracks, dents, blisters, buckles, crazing and check cracking, dry outs, efflorescence, sweat outs, and similar defects and where bond to substrate has failed.
- H. Protection
1. Remove temporary protection and enclosure of other work. Promptly remove plaster from door frames, windows, and other surfaces not indicated to be plastered. Repair floors, walls, and other surfaces stained, marred, or otherwise damaged during plastering.

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Task	Specification	Specification Description
09 22 13 23	09 22 13 13	Gypsum Plaster
09 22 13 23	09 22 13 13a	Gypsum Veneer Plaster
09 22 13 23	09 22 13 13b	Portland Cement Plaster

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SECTION 09 22 16 13 - NON-LOAD-BEARING STEEL FRAMING

1.1 GENERAL

- A. Description Of Work
 - 1. This specification covers the furnishing and installation of materials for non-load bearing steel framing. Products shall be as follows or as directed by the Owner. Installation procedures shall be in accordance with the product manufacturer's recommendations. Demolition and removal of materials shall be as required to support the work.
- B. Summary
 - 1. This Section includes non-load-bearing steel framing members for the following applications:
 - a. Interior framing systems (e.g., supports for partition walls, framed soffits, furring, etc.).
 - b. Interior suspension systems (e.g., supports for ceilings, suspended soffits, etc.).
- C. Submittals
 - 1. Product Data: For each type of product indicated.
 - 2. LEED Submittal:
 - a. Product Data for Credit MR 4.1 and Credit MR 4.2, **as directed**: For products having recycled content, documentation indicating percentages by weight of postconsumer and preconsumer recycled content.
 - 1) Include statement indicating costs for each product having recycled content.
- D. Quality Assurance
 - 1. Fire-Test-Response Characteristics: For fire-resistance-rated assemblies that incorporate non-load-bearing steel framing, provide materials and construction identical to those tested in assembly indicated according to ASTM E 119 by an independent testing agency.
 - 2. STC-Rated Assemblies: For STC-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E 90 and classified according to ASTM E 413 by an independent testing agency.

1.2 PRODUCTS

- A. Non-Load-Bearing Steel Framing, General
 - 1. Recycled Content of Steel Products: Provide products with average recycled content of steel products such that postconsumer recycled content plus one-half of preconsumer recycled content is not less than 25 percent.
 - 2. Framing Members, General: Comply with ASTM C 754 for conditions indicated.
 - a. Steel Sheet Components: Comply with ASTM C 645 requirements for metal, unless otherwise indicated.
 - b. Protective Coating: ASTM A 653/A 653M, **G40 (Z120) OR** ASTM A 653/A 653M, **G60 (Z180) OR** Coating with equivalent corrosion resistance of ASTM A 653/A 653M, **G40 (Z120), as directed**, hot-dip galvanized, unless otherwise indicated.
- B. Suspension System Components
 - 1. Tie Wire: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, **0.0625-inch- (1.59-mm-)** diameter wire, or double strand of **0.0475-inch- (1.21-mm-)** diameter wire.
 - 2. Hanger Attachments to Concrete:
 - a. Anchors: Fabricated from corrosion-resistant materials with holes or loops for attaching wire hangers and capable of sustaining, without failure, a load equal to 5 times that imposed by construction as determined by testing according to ASTM E 488 by an independent testing agency.

- 1) Type: Cast-in-place anchor, designed for attachment to concrete forms **OR** Postinstalled, chemical anchor **OR** Postinstalled, expansion anchor, **as directed**.
 - b. Powder-Actuated Fasteners: Suitable for application indicated, fabricated from corrosion-resistant materials with clips or other devices for attaching hangers of type indicated, and capable of sustaining, without failure, a load equal to 10 times that imposed by construction as determined by testing according to ASTM E 1190 by an independent testing agency.
 3. Wire Hangers: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, **0.162-inch (4.12-mm)** diameter.
 4. Flat Hangers: Steel sheet, in size indicated on Drawings **OR 1 by 3/16 inch (25.4 by 4.76 mm)** by length indicated, **as directed**.
 5. Carrying Channels: Cold-rolled, commercial-steel sheet with a base-metal thickness of **0.0538 inch (1.37 mm)** and minimum **1/2-inch- (12.7-mm-)** wide flanges.
 - a. Depth: As indicated on Drawings **OR 2-1/2 inches (64 mm) OR 2 inches (51 mm) OR 1-1/2 inches (38 mm), as directed**.
 6. Furring Channels (Furring Members):
 - a. Cold-Rolled Channels: **0.0538-inch (1.37-mm)** bare-steel thickness, with minimum **1/2-inch- (12.7-mm-)** wide flanges, **3/4 inch (19.1 mm)** deep.
 - b. Steel Studs: ASTM C 645.
 - 1) Minimum Base-Metal Thickness: As indicated on Drawings **OR 0.0179 inch (0.45 mm) OR 0.0312 inch (0.79 mm), as directed**.
 - 2) Depth: As indicated on Drawings **OR 1-5/8 inches (41.3 mm) OR 2-1/2 inches (63.5 mm) OR 3-5/8 inches (92.1 mm), as directed**.
 - c. Hat-Shaped, Rigid Furring Channels: ASTM C 645, **7/8 inch (22.2 mm)** deep.
 - 1) Minimum Base Metal Thickness: As indicated on Drawings **OR 0.0179 inch (0.45 mm) OR 0.0312 inch (0.79 mm), as directed**.
 - d. Resilient Furring Channels: **1/2-inch- (12.7-mm-)** deep members designed to reduce sound transmission.
 - 1) Configuration: Asymmetrical **OR** Hat shaped, **as directed**.
 7. Grid Suspension System for Ceilings: ASTM C 645, direct-hung system composed of main beams and cross-furring members that interlock.
- C. Steel Framing For Framed Assemblies
1. Steel Studs and Runners: ASTM C 645.
 - a. Minimum Base-Metal Thickness: As indicated on Drawings **OR 0.0179 inch (0.45 mm) OR 0.027 inch (0.7 mm) OR 0.0312 inch (0.79 mm), as directed**.
 - b. Depth: As indicated on Drawings **OR 3-5/8 inches (92.1 mm) OR 6 inches (152.4 mm) OR 4 inches (101.6 mm) OR 2-1/2 inches (63.5 mm) OR 1-5/8 inches (41.3 mm), as directed**.
 2. Slip-Type Head Joints: Where indicated, provide one of the following:
 - a. Single Long-Leg Runner System: ASTM C 645 top runner with **2-inch- (50.8-mm-)** deep flanges in thickness not less than indicated for studs, installed with studs friction fit into top runner and with continuous bridging located within **12 inches (305 mm)** of the top of studs to provide lateral bracing.
 - b. Double-Runner System: ASTM C 645 top runners, inside runner with **2-inch- (50.8-mm-)** deep flanges in thickness not less than indicated for studs and fastened to studs, and outer runner sized to friction fit inside runner.
 - c. Deflection Track: Steel sheet top runner manufactured to prevent cracking of finishes applied to interior partition framing resulting from deflection of structure above; in thickness not less than indicated for studs and in width to accommodate depth of studs.
 3. Firestop Tracks: Top runner manufactured to allow partition heads to expand and contract with movement of the structure while maintaining continuity of fire-resistance-rated assembly indicated; in thickness not less than indicated for studs and in width to accommodate depth of studs.
 4. Flat Strap and Backing Plate: Steel sheet for blocking and bracing in length and width indicated.
 - a. Minimum Base-Metal Thickness: As indicated on Drawings **OR 0.0179 inch (0.45 mm) OR 0.027 inch (0.7 mm) OR 0.0312 inch (0.79 mm), as directed**.

5. Cold-Rolled Channel Bridging: **0.0538-inch (1.37-mm)** bare-steel thickness, with minimum **1/2-inch- (12.7-mm-)** wide flanges.
 - a. Depth: As indicated on Drawings **OR 1-1/2 inches (38.1 mm), as directed.**
 - b. Clip Angle: Not less than **1-1/2 by 1-1/2 inches (38.1 by 38.1 mm), 0.068-inch- (1.73-mm-)** thick, galvanized steel.
6. Hat-Shaped, Rigid Furring Channels: ASTM C 645.
 - a. Minimum Base Metal Thickness: As indicated on Drawings **OR 0.0179 inch (0.45 mm) OR 0.0312 inch (0.79 mm), as directed.**
 - b. Depth: As indicated on Drawings **OR 7/8 inch (22.2 mm) OR 1-1/2 inches (38.1 mm), as directed.**
7. Resilient Furring Channels: **1/2-inch- (12.7-mm-)** deep, steel sheet members designed to reduce sound transmission.
 - a. Configuration: Asymmetrical **OR Hat shaped, as directed.**
8. Cold-Rolled Furring Channels: **0.0538-inch (1.37-mm)** bare-steel thickness, with minimum **1/2-inch- (12.7-mm-)** wide flanges.
 - a. Depth: As indicated on Drawings **OR 3/4 inch (19.1 mm), as directed.**
 - b. Furring Brackets: Adjustable, corrugated-edge type of steel sheet with minimum bare-steel thickness of **0.0312 inch (0.79 mm).**
 - c. Tie Wire: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, **0.0625-inch- (1.59-mm-)** diameter wire, or double strand of **0.0475-inch- (1.21-mm-)** diameter wire.
9. Z-Shaped Furring: With slotted or nonslotted web, face flange of **1-1/4 inches (31.8 mm)**, wall attachment flange of **7/8 inch (22.2 mm)**, minimum bare-metal thickness of **0.0179 inch (0.45 mm)**, and depth required to fit insulation thickness indicated.

D. Auxiliary Materials

1. General: Provide auxiliary materials that comply with referenced installation standards.
 - a. Fasteners for Metal Framing: Of type, material, size, corrosion resistance, holding power, and other properties required to fasten steel members to substrates.
2. Isolation Strip at Exterior Walls: Provide one of the following:
 - a. Asphalt-Saturated Organic Felt: ASTM D 226, Type I (No. 15 asphalt felt), nonperforated.
 - b. Foam Gasket: Adhesive-backed, closed-cell vinyl foam strips that allow fastener penetration without foam displacement, **1/8 inch (3.2 mm)** thick, in width to suit steel stud size.

1.3 EXECUTION

A. Preparation

1. Suspended Assemblies: Coordinate installation of suspension systems with installation of overhead structure to ensure that inserts and other provisions for anchorages to building structure have been installed to receive hangers at spacing required to support the Work and that hangers will develop their full strength.
 - a. Furnish concrete inserts and other devices indicated to other trades for installation in advance of time needed for coordination and construction.
2. Coordination with Sprayed Fire-Resistive Materials:
 - a. Before sprayed fire-resistive materials are applied, attach offset anchor plates or ceiling runners (tracks) to surfaces indicated to receive sprayed fire-resistive materials. Where offset anchor plates are required, provide continuous plates fastened to building structure not more than **24 inches (600 mm) o.c.**
 - b. After sprayed fire-resistive materials are applied, remove them only to extent necessary for installation of non-load-bearing steel framing. Do not reduce thickness of fire-resistive materials below that required for fire-resistance ratings indicated. Protect adjacent fire-resistive materials from damage.

B. Installation, General

1. Installation Standard: ASTM C 754, except comply with framing sizes and spacing indicated.

- a. Gypsum Plaster Assemblies: Also comply with requirements in ASTM C 841 that apply to framing installation.
 - b. Portland Cement Plaster Assemblies: Also comply with requirements in ASTM C 1063 that apply to framing installation.
 - c. Gypsum Veneer Plaster Assemblies: Also comply with requirements in ASTM C 844 that apply to framing installation.
 - d. Gypsum Board Assemblies: Also comply with requirements in ASTM C 840 that apply to framing installation.
2. Install supplementary framing, and blocking to support fixtures, equipment services, heavy trim, grab bars, toilet accessories, furnishings, or similar construction.
 3. Install bracing at terminations in assemblies.
 4. Do not bridge building control and expansion joints with non-load-bearing steel framing members. Frame both sides of joints independently.

C. Installing Suspension Systems

1. Install suspension system components in sizes and spacings indicated on Drawings, but not less than those required by referenced installation standards for assembly types and other assembly components indicated.
2. Isolate suspension systems from building structure where they abut or are penetrated by building structure to prevent transfer of loading imposed by structural movement.
3. Suspend hangers from building structure as follows:
 - a. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structural or suspension system.
 - 1) Splay hangers only where required to miss obstructions and offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.
 - b. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with locations of hangers required to support standard suspension system members, install supplemental suspension members and hangers in the form of trapezes or equivalent devices.
 - 1) Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced installation standards.
 - c. Wire Hangers: Secure by looping and wire tying, either directly to structures or to inserts, eye screws, or other devices and fasteners that are secure and appropriate for substrate, and in a manner that will not cause hangers to deteriorate or otherwise fail.
 - d. Flat Hangers: Secure to structure, including intermediate framing members, by attaching to inserts, eye screws, or other devices and fasteners that are secure and appropriate for structure and hanger, and in a manner that will not cause hangers to deteriorate or otherwise fail.
 - e. Do not attach hangers to steel roof deck.
 - f. Do not attach hangers to permanent metal forms. Furnish cast-in-place hanger inserts that extend through forms.
 - g. Do not attach hangers to rolled-in hanger tabs of composite steel floor deck.
 - h. Do not connect or suspend steel framing from ducts, pipes, or conduit.
4. Fire-Resistance-Rated Assemblies: Wire tie furring channels to supports.
5. Seismic Bracing: Sway-brace suspension systems with hangers used for support.
6. Grid Suspension Systems: Attach perimeter wall track or angle where grid suspension systems meet vertical surfaces. Mechanically join main beam and cross-furring members to each other and butt-cut to fit into wall track.
7. Installation Tolerances: Install suspension systems that are level to within **1/8 inch in 12 feet (3 mm in 3.6 m)** measured lengthwise on each member that will receive finishes and transversely between parallel members that will receive finishes.

D. Installing Framed Assemblies

1. Where studs are installed directly against exterior masonry walls or dissimilar metals at exterior walls, install isolation strip between studs and exterior wall.

2. Install studs so flanges within framing system point in same direction.
 - a. Space studs as follows:
 - 1) Single-Layer Application: **16 inches (406 mm) OR 24 inches (610 mm) OR 400 mm OR 600 mm, as directed**, o.c., unless otherwise indicated.
 - 2) Multilayer Application: **16 inches (406 mm) OR 24 inches (610 mm) OR 400 mm OR 600 mm, as directed**, o.c., unless otherwise indicated.
 - 3) Tile backing panels: **16 inches (406 mm) OR 400 mm, as directed**, o.c., unless otherwise indicated.
3. Install tracks (runners) at floors and overhead supports. Extend framing full height to structural supports or substrates above suspended ceilings, except where partitions are indicated to terminate at suspended ceilings. Continue framing around ducts penetrating partitions above ceiling.
 - a. Slip-Type Head Joints: Where framing extends to overhead structural supports, install to produce joints at tops of framing systems that prevent axial loading of finished assemblies.
 - b. Door Openings: Screw vertical studs at jambs to jamb anchor clips on door frames; install runner track section (for cripple studs) at head and secure to jamb studs.
 - 1) Install two studs at each jamb, unless otherwise indicated.
 - 2) Install cripple studs at head adjacent to each jamb stud, with a minimum **1/2-inch (12.7-mm)** clearance from jamb stud to allow for installation of control joint in finished assembly.
 - 3) Extend jamb studs through suspended ceilings and attach to underside of overhead structure.
 - c. Other Framed Openings: Frame openings other than door openings the same as required for door openings, unless otherwise indicated. Install framing below sills of openings to match framing required above door heads.
 - d. Fire-Resistance-Rated Partitions: Install framing to comply with fire-resistance-rated assembly indicated and support closures and to make partitions continuous from floor to underside of solid structure.
 - 1) Firestop Track: Where indicated, install to maintain continuity of fire-resistance-rated assembly indicated.
 - e. Sound-Rated Partitions: Install framing to comply with sound-rated assembly indicated.
 - f. Curved Partitions:
 - 1) Bend track to uniform curve and locate straight lengths so they are tangent to arcs.
 - 2) Begin and end each arc with a stud, and space intermediate studs equally along arcs. On straight lengths of not less than 2 studs at ends of arcs, place studs **6 inches (150 mm)** o.c.
4. Direct Furring:
 - a. Screw to wood framing.
 - b. Attach to concrete or masonry with stub nails, screws designed for masonry attachment, or powder-driven fasteners spaced **24 inches (610 mm)** o.c.
5. Z-Furring Members:
 - a. Erect insulation (specified in Division 7 Section "Building Insulation") vertically and hold in place with Z-furring members spaced **24 inches (610 mm) OR 600 mm, as directed**, o.c.
 - b. Except at exterior corners, securely attach narrow flanges of furring members to wall with concrete stub nails, screws designed for masonry attachment, or powder-driven fasteners spaced **24 inches (600 mm)** o.c.
 - c. At exterior corners, attach wide flange of furring members to wall with short flange extending beyond corner; on adjacent wall surface, screw-attach short flange of furring channel to web of attached channel. At interior corners, space second member no more than **12 inches (300 mm)** from corner and cut insulation to fit.
6. Installation Tolerance: Install each framing member so fastening surfaces vary not more than **1/8 inch (3 mm)** from the plane formed by faces of adjacent framing.

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Task	Specification	Specification Description
09 22 36 13	09 22 13 13	Gypsum Plaster
09 22 36 13	09 22 13 13a	Gypsum Veneer Plaster
09 22 36 13	09 22 13 13b	Portland Cement Plaster

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SECTION 09 22 36 23 - LATH AND PLASTER RENOVATION

GENERAL

Description Of Work

1. This specification covers the furnishing and installation of materials for lath and plaster renovation. Products shall be as directed by the Owner. Installation procedures shall be in accordance with the product manufacturer's recommendations. Demolition and removal of materials shall be as required to support the work.

Quality Assurance

2. Regulatory Requirements:
 - a. Plaster Partitions: Listed and labeled for fire-protective ratings as indicated or scheduled.
 - b. Plaster Floor/Ceilings and Roof/Ceiling Assemblies: Listed and labeled for fire-protective ratings as indicated or scheduled.
 - c. Fire Rated Assemblies: Comply with UL 05, FM P8016, or GA 600 for required fire-rated assembly.

Submittals

3. Product Data: Submit in accordance with Detailed Scope of Work. Include each type of plaster material, metal lath, and lathing accessories to be installed.

Delivery, Storage, And Handling

4. General:
 - a. Plastering Materials: Deliver in original unopened containers and store off ground and under cover.
 - b. Metal Lath and Accessories: Protect from rusting during storage.
 - c. Rusted or Water Damaged Materials: Subject to rejection before or after installation.

Project Conditions

5. Environmental Requirements: Comply with Detailed Scope of Work.
 - a. Cold-Weather Protection: Do not apply plaster if ambient temperature is less than 4 degrees C (40 degrees F) or more than 26 degrees C (80 degrees F). Maintain this temperature range in all areas 7 days prior to application, during application, and for 7 days after plaster is set.
 - b. Hot-Weather Protection: Protect plaster against uneven or excessive evaporation during dry, hot weather and from strong blasts of dry air, either natural or artificial.
 - c. Ventilation: Ventilate building spaces as required to remove water in excess of that required for hydration of plaster. Begin ventilation immediately after plaster is applied and continue until it sets.
6. Existing Conditions: See Division 1 Section "Summary of Work". Do not interfere with use of occupied buildings or portions of buildings. Maintain free and safe passage to and from occupied areas.
7. Protection: Protect grounds, plantings, buildings, and any other facilities or property from damage caused by construction operations.

Scheduling And Sequencing

8. Scheduling and Completion: Comply with Detailed Scope of Work.
 - a. Sequence plaster application with installation and protection of other work so that neither will be damaged by installation of other.

PRODUCTS

Materials

9. **Materials for Patching, Extending, and Matching:**
 - a. Provide same products or types of construction as existing structure, as needed to patch, extend, or match existing work.
 - 1) Generally, Contract Documents will not define products or standards of workmanship present in existing construction. Determine products by inspection and any necessary testing, and workmanship by use of existing as sample of comparison.
 - 2) Patching, extending, and matching of existing work and systems shall result in complete, finished system.
 - b. Presence of product, finish, or type of construction, requires that patching, extending, or matching shall be performed as necessary to make work complete and consistent.
10. **Partition Metals: ASTM C 645, galvanized steel:**
 - a. Interior Steel Studs: Minimum 0.46 mm (25 gage), provide sizes and gages to match existing, or as indicated.
 - 1) Provide minimum of 0.84 mm (20 gage) studs both sides of hollow metal frames.
 - b. Steel Stud Runners: Match studs. Provide long leg runners for slip joint at structure above to allow for deflection.
 - c. Furring Channels: Hat-shaped furring channels, minimum 0.46 mm (25 gage).
 - d. Sheet Metal Reinforcement (Alternate to Wood Blocking): 1.52 mm (16 gage) minimum.
11. **Suspended Ceiling Metals:**
 - a. Main Runners (Primary Members): ASTM C 754 cold-rolled steel channels with rust-inhibitive finish.
 - 1) 50 mm (2 inches) deep, 88 kg per 100 m (590 pounds per 1,000 LF).
 - 2) 38 mm (1-1/2 inch) deep, 70 kg per 100 m (475 pounds per 1,000 LF).
 - 3) 19 mm (3/4 inch) deep, 45 kg per 100 m (300 pounds per 1,000 LF).
 - b. Cross Furring (Furring Channels): Hat-shaped galvanized steel furring channels, minimum 0.46 mm (25 gage).
 - c. Wire for Hangers and Ties: ASTM A 641, Class 1 zinc coating, soft temper.
 - 1) Hanger Wire: Minimum 4.1 mm (8 gage).
 - 2) Tie Wire: 6 mm (16 gage).
12. **Lath:**
 - a. Metal Lath: ASTM C 847, galvanized expanded metal.
 - 1) Weight: In compliance with ASTM C 841 for conditions and spacing of supports.
 - b. Gypsum Lath: ASTM C 37, plain. Provide Type X at fire-rated assemblies.
 - 1) Thickness: As indicated or specified and in compliance with ASTM C 841 for conditions and spacing of supports.
13. **Fasteners:**
 - a. Screws: ASTM C 1002, corrosion-resistant. Provide types as recommended by manufacturer for each application.
 - 1) To Metal Framing: Minimum 25 mm (1 inch), Type S.
 - 2) To Wood Framing: Minimum 32 mm (1-1/4 inch), Type W bugle head.
14. **Accessories: ASTM C 841, galvanized steel.**
 - a. Comer Beads: Small nose with expanded flanges, unless otherwise indicated.
 - b. Casing Beads: Square-edged style. with short or expanded flanges to suit kinds of plaster bases indicated.
 - c. Control Joints: Prefabricated folded pair of non-perforated screeds in M-shaped configuration, with expanded or perforated flanges.
 - 1) Provide removable protective tape on plaster face of control joints.
 - d. Cornerite: Galvanized expanded metal lath in accordance with ASTM C 841.
15. **Gypsum Plaster Materials: ASTM C 28.**
 - a. Base Coat Plasters: One of following:
 - 1) Gypsum ready-mixed plaster with mill-mixed perlite aggregate.
 - 2) Gypsum wood-fibered plaster, ASTM C 28, Type N.
 - b. Finish Coat Plasters: One of following:

- 1) Gypsum ready-mixed finished plaster, manufacturers standard mill-mixed gauged interior finish.
- 2) Gypsum Gauging Plaster: ASTM C 28, Type G.
- c. Quicklime: ASTM C 5.
- d. Sand: ASTM C 35.
- e. Finishing Hydrated Limes: ASTM C 206, Type S, special hydrated lime for finishing purposes.
- f. Bonding Compound for Gypsum Plaster: ASTM C 631.
- g. Water: Clean and free from injurious amounts of oils, acids, alkalis, salts, organic materials, or substances that may be deleterious to plaster or metals in contact with plaster.
16. Sound-Isolation Materials:
 - a. Sound Insulation: ASTM C 665, Type I (unfaced) mineral-fiber blankets, 12 to 16 kg per cu m (0.75 to 1 PCF), thickness as indicated or scheduled, or required by fire-rated assembly.
 - b. Acoustical Sealant:
 - 1) Concealed: ASTM C 919 nondrying, non-hardening, non-skinning, non-bleeding, and non-staining.
 - 2) Exposed: ASTM C 919 non-oxidizing and skinning, permanently elastic, and paintable.
 - c. Ductwork Penetrations Packing: Low-density fiberglass.
17. Gypsum Plaster Mixes: As recommended by manufacturer:
 - a. Scratch Coat:
 - 1) Over Metal Lath: Gypsum wood-fibered plaster, neat or with job-mixed sand.
 - 2) Over Gypsum Lath: Gypsum neat plaster with job-mixed sand.
 - 3) Over Unit Masonry: Gypsum wood-fibered plaster, neat or with job-mixed sand.
 - b. Brown Coat:
 - 1) Over Metal Lath: Gypsum wood-fibered plaster, with job-mixed sand.
 - 2) Over Gypsum Lath: Gypsum neat plaster with job-mixed sand.
 - 3) Over Unit Masonry: Gypsum wood-fibered plaster with job-mixed sand.
 - c. Finish Coat: Proportion materials for finish coats to comply with ASTM C 842 for each type of finish coat and texture indicated.
 - 1) Gypsum Gauging Plaster 1 part plaster and 2 parts lime.
 - a) Over lightweight aggregate base coats, add 15 L (1/2 cubic foot) of perlite fines or 23 kg (50 pounds) of No. 1 white silica sand per 45 kg (100 pounds) of plaster.
 - 2) Gypsum Ready-mixed Finish Plaster Neat.
 - d. Mechanically mix cementitious and aggregate materials for plasters to comply with applicable referenced application standard and with recommendations of plaster manufacturer.

EXECUTION

Examination

18. Units, Spaces, and Areas to be renovated: Comply with Detailed Scope of Work.
 - a. Verify that surfaces to receive rough carpentry are prepared to required grades and dimensions.

Preparation

19. Dust Protection: Comply with Detailed Scope of Work.
20. Building Occupation: Carry out demolition and renovation work to cause as little inconvenience to occupants as possible. See Detailed Scope of Work.
21. Protection: Comply with Detailed Scope of Work.
 - a. Protection: Provide drapes and drop cloths necessary to protect walls, floors, ductwork and piping, electrical work, etc. during plastering operations.
22. Selective Demolition: Comply with Detailed Scope of Work.

23. Surface Preparation: Clean projections, dust, loose particles, grease, bond breakers, and foreign matter from surfaces to receive plaster.
 - a. Do not apply plaster directly to surfaces (1) of masonry or concrete that have been coated with bituminous compound or other waterproofing agents, or (2) that have been painted or previously plastered.
 - b. Before plaster work is started, wet masonry and concrete surfaces thoroughly with fine fog spray of clean water to produce uniformly moist surface.
 - c. Do not apply plaster to surfaces containing frost.

Laying-Out Work

24. Discrepancies: Verify dimensions and elevations indicated in layout of existing work.
 - a. Prior to commencing work, carefully compare and check Drawings (if any) for discrepancies in locations or elevations of work to be executed.
 - b. Refer discrepancies among Drawings (if any), Specifications, and existing conditions to the Owner for adjustment before work affected is performed.
 - 1) Failure to make such notification shall place responsibility on Contractor to carry out work in satisfactory, workmanlike manner.
25. Contractor: Responsible for location and elevation of construction contemplated by Construction Documents.

Performance

26. Patching: Patch and extend existing work using skilled mechanics who are capable of matching existing quality of workmanship.
 - a. Quality of Patched or Extended Work: Not less than specified for new work. If similar new work is not specified, equal to existing work.
27. Damaged Surfaces: Comply with Detailed Scope of Work.
28. Transitions from Existing to New Work: Comply with Detailed Scope of Work.
29. Isolation: Where lathing and metal support system abuts building structure horizontally and where partition/wall work abuts overhead structure, isolate work from structural movement sufficiently to prevent transfer of loads to work from building structure. Install slip or cushion-type joints to absorb deflections but maintain lateral support.
 - a. Frame both sides of control and expansion joints independently, and do not bridge joints with furring and lathing or accessories.

Installation Of Suspended Steel Framing

30. General: Construct ceilings of lath and plaster on suspended steel framing system in accordance with manufacturer's recommendations and Reference Standards.
31. Hanger Installation: Attach hangers to structure above ceiling to comply with NAAMM ML/SFA 920.
32. Ceiling Suspension System Components: Install in sizes and at spacings indicated but not in smaller sizes or greater spacings than those required by ASTM C 841 and NAAMM ML/SFA 920.
 - a. Wire Hangers: Space and install wire hangers in accordance with ASTM C 841 and within 150 mm (6 inches) of channel ends, unless closer spacing indicated or required for fire-resistance rated assembly.
 - b. Main Runners (Primary Members): Space and install channels in accordance with ASTM C 841, unless closer spacing indicated or required for fire-resistance rated assembly.
 - c. Cross Furring (Furring Channels): Space and install furring channels in accordance with ASTM C 841, unless closer spacing indicated or required for fire-resistance rated assembly.
33. Framing Around Openings: Frame channels and lath on suspended soffits and ceilings and at furring to receive electric lights, etc. as indicated or as necessary to complete work. Furnish and install in furring, plaster rings or access panels furnished under other sections.

Installation Of Steel Stud Partitions

34. General: Install steel stud partition support systems in accordance with manufacturer's recommendations and Reference Standards.
35. Steel Stud Systems: Comply with ASTM C 754.
 - a. To Receive Metal Lath: Space studs in accordance with ASTM C 841 and NAAMM ML/SFA 920.
 - b. To Receive Gypsum Lath: Space studs in accordance with ASTM C 841.
36. Extend partition support systems to finish ceilings and attach to ceiling suspension members, unless otherwise indicated.

Metal Furring

37. General: Install in accordance with ASTM C 841 and NAAMM ML/SFA 920.
 - a. Install supplementary framing, blocking, and bracing at terminations in work and for support of fixtures, equipment services, heavy trim, grab bars, bath accessories, furnishings, and similar work to comply with manufacturer's recommendations.
38. Metal Furring to Receive Gypsum Lath: Space furring channels in accordance with ASTM C 841.
39. Metal Furring Systems:
 - a. To Receive Metal Lath: Space furring in accordance with ASTM C 841 and NAAMM ML/SFA 920.
 - b. To Receive Gypsum Lath: Space furring in accordance with ASTM C 841.
40. Isolation: Where lathing and metal support system abuts building structure horizontally and where partition/wall work abuts overhead structure, isolate work from structural movement sufficiently to prevent transfer of loads to work from building structure. Install slip or cushion-type joints to absorb deflections but maintain lateral support.
 - a. Frame both sides of control and expansion joints independently, and do not bridge joints with furring and lathing or accessories.

Installation Of Suspended Steel Framing

41. General: Construct ceilings of lath and plaster on suspended steel framing system in accordance with manufacturer's recommendations and Reference Standards.
42. Hanger Installation: Attach hangers to structure above ceiling to comply with NAAMM ML/SFA 920.
43. Ceiling Suspension System Components: Install in sizes and at spacings indicated but not in smaller sizes or greater spacings than those required by ASTM C 841 and NAAMM ML/SFA 920.
 - a. Wire Hangers: Space and install wire hangers in accordance with ASTM C 841 and within 150 mm (6 inches) of channel ends, unless closer spacing indicated or required for fire-resistance rated assembly.
 - b. Main Runners (Primary Members): Space and install channels in accordance with ASTM C 841, unless closer spacing indicated or required for fire-resistance rated assembly.
 - c. Cross Furring (Furring Channels): Space and install furring channels in accordance with ASTM C 841, unless closer spacing indicated or required for fire-resistance rated assembly.
44. Framing Around Openings: Frame channels and lath on suspended soffits and ceilings and at furring to receive electric lights, etc. as indicated or as necessary to complete work. Furnish and install in furring, plaster rings or access panels furnished under other sections.

Installation Of Steel Stud Partitions

45. General: Install steel stud partition support systems in accordance with manufacturer's recommendations and Reference Standards.
46. Steel Stud Systems: Comply with ASTM C 754.
 - a. To Receive Metal Lath: Space studs in accordance with ASTM C 841 and NAAMM ML/SFA 920.
 - b. To Receive Gypsum Lath: Space studs in accordance with ASTM C 841.
47. Extend partition support systems to finish ceilings and attach to ceiling suspension members, unless otherwise indicated.

Metal Furring

48. General: Install in accordance with ASTM C 841 and NAAMM ML/SFA 920.
 - a. Install supplementary framing, blocking, and bracing at terminations in work and for support of fixtures, equipment services, heavy trim, grab bars, bath accessories, furnishings, and similar work to comply with manufacturer's recommendations.
49. Metal Furring to Receive Gypsum Lath: Space furring channels in accordance with ASTM C 841.
50. Metal Furring Systems:
 - a. To Receive Metal Lath: Space furring in accordance with ASTM C 841 and NAAMM ML/SFA 920.
 - b. To Receive Gypsum Lath: Space furring in accordance with ASTM C 841.

Lathing

51. Metal Lathing: Install in accordance with ASTM C 841 and NAAMM ML/SFA 920.
 - a. At Metal Framing: Attach metal lath to furring channels with long dimension of sheet at right angles to furring channels with gage wire ties spaced not over 150 mm (6 inches) apart.
 - b. At Wood Framing: Nail metal lath to wood framing with long dimension of sheet at right angles to framing member.
 - c. Place ties where sides of sheets laps at supports and at side laps of sheets between supports. Lap metal lath not less than 13 mm (1/2 inch) at sides of sheets and 25 mm (1 inch) at ends of sheets.
 - d. Suspended and Furred Ceilings: Use 1.8 kg/sq m (3.4 pounds/SY) minimum weight diamond mesh lath.
 - e. Ceramic Tile Setting Beds: Use 1.8 kg/sq m (3.4 pounds/SY) minimum weight diamond mesh lath.
52. Gypsum Lath: Install in accordance with ASTM C 841.
 - a. Wood Framing and Furring: Install lath as follows:
 - 1) With screws to comply with lath manufacturer's directions.
 - 2) With nails.
 - 3) Provide floating angle construction.
 - b. Suspended and Furred Ceilings: Install lath to furring members with clips.
 - c. Vertical Metal Framing and Furring: Install lath as follows:
 - 1) With screws.
 - 2) With clips, supplemented by screws where required by lath manufacturer.
 - 3) Where sound-rated partitions are indicated, attach lath with resilient clips.

Installation Of Accessories

53. Accessories: Install as required to repair area of work to match existing. Install in accordance with ASTM C 841. Miter or cope accessories at comers; Install with tight joints and in alignment. Attach accessories securely to plaster bases to hold accessories in place and alignment during plastering.
54. Interior Corners: Apply cornerite.
55. Corner Beads: Install corner beads tightly secured to lath at exposed exterior corners.
56. Casing Beads: Install at terminations of plaster work, except where plaster passes behind and is concealed by other work and where metal screeds, bases, or metal frames act as casing beads.
57. Control Joints: Install at locations indicated or, if not indicated, at spacings and locations required by Reference Standards. Coordinate specific locations with the Owner.
58. Access Panels: Provide access panels as required for maintenance of concealed plumbing work in coordination with Division 15 Section "Plumbing." Tiled Areas: Coordinate with Division 9 Section "Ceramic Tile."
59. Sound-Rated Plaster Work: Where sound-rated plaster work is indicated by STC ratings or other notation:
 - a. Acoustical Sealant: Seal work at perimeters, control joints, openings, and penetrations with continuous bead of acoustical sealant. Comply with ASTM C 919 and plastering manufacturer's recommendations for location of sealant beads.

- b. Sound Insulation: Install insulation blankets within stud cavities of sound-rated partition assemblies where indicated.

Plastering

- 60. Plastering: Comply with ASTM C 842 in thickness to match existing.
 - a. Preparation: Remove loose, fractured, or separated plaster to face of substrate. repairing lath at substrate to ensure repair area bounded by solid and sound existing plaster construction.
 - 1) Prepare monolithic surfaces for bonded base coats and use bonding compound to comply with Reference Standards for conditioning of monolithic surfaces.
 - b. Grout hollow metal frames, bases, and similar work with base-mat plaster material, and prior to lathing where necessary. Except where full grouting is indicated or required for fire-resistance rating, grout at least 150 mm (6 inches) at each jamb anchor dip.
 - c. Plaster flush with metal frames and other built-in metal items or accessories that act as plaster ground, unless otherwise indicated. Where plaster is not terminated at metal by casing beads, cut base coat free from metal before plaster sets and groove finish coat at junctures with metal.
- 61. Preparation: Check metal grounds, corner beads, screeds, and other accessories carefully for alignment before starting plaster application. Check expansion and control joints and supporting metal structures to ensure that expansion and control joints can move unrestrained.
- 62. Plaster: Apply in accordance with ASTM C 842 in thickness to match existing:
 - a. Use three-coat work over following plaster bases:
 - 1) Metal lath.
 - 2) Gypsum lath attached to ceiling supports by clips.
 - 3) Gypsum lath attached to ceiling supports spaced over 400 mm (16 inches) OC.
 - 4) Gypsum lath, 9.5 mm (3/8 inch) thick, with separate vapor retarder behind.
 - b. Use two-coat work over following bases.
 - 1) Gypsum lath except for installations requiring three-coat work.
 - 2) Unit masonry.
 - 3) Concrete, cast-in-place or precast when surface condition complies with ASTM C 842 for plaster bonded to solid base.
 - c. First Coat: Apply first coat of plaster with such force to secure good key.
 - d. Finish Coats: Apply troweled finish coats unless otherwise indicated.
- 63. Workmanship: Perform work true to line, straight, and plumb.
 - a. Finished Surfaces: Free from waves, dents, bumps, cracks, pits, checks, streaks, catfaces, blisters, or other defects. Cutout and properly replace defective areas.
 - b. Execute work to avoid any irregularity occurring at point or place where one section is joined to another.
 - c. Arises and Angles: True and sharp.
- 64. Tolerances: Plaster surface plane within plus/minus 3 mm in 3 000 mm (1/8 inch in 10 feet).

Integrating Existing Work

- 65. Protection: Comply with Detailed Scope of Work.

Adjustments

- 66. Partition Removal: Comply with Detailed Scope of Work.

Dust Control

- 67. Dust: Comply with Detailed Scope of Work.

Patching And Cleaning

- 68. Cutting and Patching: Do necessary cutting, patching, and repairing and pointing up of plastering after other work is in place to restore defective areas. Repair or replace work to eliminate blisters, buckles, excessive crazing and check-cracking, dry outs, efflorescence, sweat-outs, and similar defects and where bond to substrate has failed.
 - a. Sand smooth-troweled finishes lightly to remove trowel marks and arises.



69. Cleaning: As rapidly as plastering is completed in each space, clean up rubbish, utensils, and surplus material, sweep floor and leave in neat condition for work of others.
- a. When general plastering is concluded, remove plastering rubbish, equipment, and surplus materials from premises.
 - b. Clean surfaces splattered with plaster.

END OF SECTION 09 22 36 23

NOT FOR BID

Task	Specification	Specification Description
09 22 36 23	09 22 13 13	Gypsum Plaster
09 22 36 23	09 22 13 13a	Gypsum Veneer Plaster
09 22 36 23	09 22 13 13b	Portland Cement Plaster
09 22 36 33	09 22 13 13	Gypsum Plaster
09 22 36 33	09 22 13 13a	Gypsum Veneer Plaster
09 22 36 33	09 22 13 13b	Portland Cement Plaster
09 22 36 33	09 22 36 23	Lath and Plaster Renovation

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SECTION 09 23 13 00 - GYPSUM BOARD RENOVATION

GENERAL

Description Of Work

1. This specification covers the furnishing and installation of materials for gypsum board renovation. Products shall be as directed by the Owner. Installation procedures shall be in accordance with the product manufacturer's recommendations. Demolition and removal of materials shall be as required to support the work.

Submittals

2. Quality Assurance/Control Submittals
 - a. Certificates: Manufacturer's written certification that gypsum products meet or exceed specified requirements.

Quality Assurance

3. Regulatory Requirements:
 - a. Gypsum Board Partitions: Listed and labeled for fire-protective ratings as indicated or scheduled.
 - b. Gypsum Board Floor/Ceilings and Roof/Ceiling Assemblies: Listed and labeled for fire protective ratings as indicated or scheduled.
 - c. Fire-Rated Assemblies: Comply with UL 05, FM P8016, or GA 600 for required fire-rated assembly.

Delivery, Storage, And Handling

4. Storage and Protection: Store wallboard off ground to protect it from weather and damage due to moisture damage.
 - a. Wallboard: Dry, free of warpage, and have bundling tape intact immediately prior to use.

Project Conditions

5. Environmental Requirements: Comply with Detailed Scope of Work.
 - a. During gypsum-panel application and finishing, maintain indoor temperatures within range of 13 degrees C (55 degrees F) to 21 degrees C (70 degrees F). Provide adequate ventilation to carry off excess moisture.
6. Existing Conditions: See Division 1 Section "Summary of Work". Do not interfere with use of occupied buildings or portions of buildings. Maintain free and safe passage to and from occupied areas.
7. Protection: Protect grounds, plantings, buildings and any other facilities or property from damage caused by construction operations.

Scheduling And Sequencing

8. Scheduling and Completion: Comply with Detailed Scope of Work.

PRODUCTS

Materials

9. Materials for Patching, Extending, and Matching:

- a. Provide same products or types of construction as in existing structure, as needed to patch, extend, or match existing work.
 - 1) Generally, Contract Documents will not define products present in existing construction. Determine products by Inspection and any necessary testing.
 - 2) Patching, extending, and matching of existing work and systems shall result in a complete, finished system.
- b. Presence of product, finish, or type of construction requires that patching, extending, or matching be performed as necessary to make work complete and consistent.

Metals

10. Partition Metals: ASTM C 645, galvanized steel:
 - a. Interior Steel Studs: Minimum 0.46 mm (25 gage), provide sizes and gages to match existing or as indicated.
 - 1) Provide minimum of 0.84 mm (20 gage) studs both sides of hollow metal frames.
 - b. Steel Stud Runners: Match studs. Provide long leg runners for slip joint at structure above to allow for deflection.
 - c. Furring Channels: Hat-shaped furring channels, minimum 0.46 mm (25 gage).
 - d. Resilient Furring Channels: Manufacturer's standard product designed to reduce sound transmission by resilient attachment of gypsum board, 13 mm (1/2 inch) deep.
 - e. Sheet-Metal Reinforcement (Alternate to Wood Blocking): 1.52 mm (16 gage) minimum.
11. Suspended Coiling Metals:
 - a. Runner Channels: ASTM C 754 cold-rolled steel channels with rust-inhibitive finish.
 - 1) 50 mm (2 Inches) deep, 88 kg per 100 m (590 pounds per 1,000 LF).
 - 2) 38 mm (1-1/2 inch) deep, 70 kg per 100 m (475 pounds per 1,000 LF).
 - 3) 19 mm (3/4 Inch) deep, 45 kg per 100 m (300 pounds per 1,000 LF).
 - b. Furring Channels: Hat-shaped galvanized-steel furring channels, minimum 0.46 mm (25 gage).
 - c. Steel Studs: Galvanized steel as specified above, minimum 0.46 mm (25 gage).
 - d. Wire for Hangers and Ties: ASTM A 641, Class 1 zinc coating, soft temper.
 - 1) Hanger Wire: Minimum 4.1 mm (8 gage).
 - 2) Tie Wire: 6 mm (16 gage).

Gypsum Board And Related Materials

12. Gypsum Board: GA216 and ASTM C 36
 - a. Size: 12.7 mm and 15.9 mm (1/2 inch and 5/8 inch) thick to match existing, as indicated or scheduled. Provide boards 1 200 mm (48 inches) wide by length required to minimize cross joints.
 - b. Regular Tapered-edge gypsum panels.
 - 1) Provide Type X gypsum panels at fire-rated assemblies.
 - c. Water-Resistant: ASTM C 630, paintable, tapered-edge gypsum panels.
 - 1) Provide Type X water-resistant gypsum panels at fire-rated assemblies.
13. Cementitious Backer Units (CBU): ANSI A118.9, nailable/screwable backer board composed of stable portland cement, aggregates, and reinforcements with ability to remain unaffected by prolonged exposure to moisture, 12.7 mm (1/2 inch) thick.
14. Fasteners:
 - a. Screws: ASTM C 1002, drywall screws, corrosion resistant. Provide types as recommended by manufacturer for each application.
 - 1) Wallboard to Metal Framing: Minimum 25 mm (1 inch), Type S.
 - 2) Wall board to Wood Framing: Minimum 32 mm (1-1/4 inch) Type W bugle head.

- 3) Wall board to Wallboard: Type G.
 - b. Nails: ASTM C 514.
- 15. Accessories: GA 216 and ASTM C 1047, galvanized steel.
 - a. Comer Bead: GA 216 Type CB-114 x 114.
 - b. Metal Trim (Casing Beads): GA 216 Type L, in depth to match gypsum-board thickness.
 - c. Control Joint: V-shaped control joint.
 - d. Adhesive: ASTM C 557 multi-purpose adhesive.
- 16. Finishing Materials: ASTM C 475.
 - a. Joint Tape: Provide type as recommended by panel manufacturer.
 - b. Joint Treatment: Joint compound, adhesive, water, and fasteners.
- 17. Sound-Isolation Materials:
 - a. Sound Insulation: ASTM C 665, Type I (unfaced) mineral fiber blankets, 3.7 to 4.9 kg per sq m (3/4 to 1 PCF), thickness as indicated, scheduled, or required by fire-rated assembly.
 - b. Acoustical Sealant:
 - 1) Concealed: ASTM C 919 nondrying, non-hardening, and non-skinning; non-bleeding; and non-staining.
 - 2) Exposed: ASTM C 919 non-oxidizing and skinning; permanently elastic; and paintable.
 - c. Ductwork Penetrations Packing: Low-density fiberglass.

EXECUTION

Examination

- 18. Units, Spaces, and Areas to be Renovated: Comply with Detailed Scope of Work.
 - a. Existing Conditions: Before beginning installation, examine substrates and framing to receive gypsum board for defects or conditions adversely affecting quality and execution of installation.

Preparation

- 19. Dust Protection: Comply with Detailed Scope of Work.
- 20. Building Occupation: Carry out demolition and renovation work to cause as little inconvenience to occupants as possible. See Detailed Scope of Work.
- 21. Protection: Comply with Detailed Scope of Work.
 - a. Protection: Provide drapes and drop cloths necessary to protect walls, floors, ductwork and piping, electrical work, etc. during drywall finishing operations.
- 22. Selective Demolition: Comply with Detailed Scope of Work.

Laying Out Work

- 23. Discrepancies: Verify dimensions and elevations indicated in layout of existing work.
 - a. Prior to commencing work, carefully compare and check Drawings (if any) for discrepancies in locations or elevations of work to be executed.
 - b. Refer discrepancies among Drawings (if any), Specifications, and existing conditions to the Owner or adjustment before work affected is performed.
 - 1) Failure to make such notification shall place responsibility on Contractor to carry out work in satisfactory, workmanlike manner.
 - c. Contractor: Responsible for location and elevation of construction indicated by Construction Documents.

Performance

24. Patching: Patch and extend existing work using skilled mechanics capable of matching existing quality of workmanship.
 - a. Quality of Patched or Extended Work: Not less than specified for new work. If similar new work is not specified, equal to existing work.
25. Damaged Surfaces: Comply with Detailed Scope of Work.
26. Transitions from Existing to New Work: Comply with Detailed Scope of Work.

Erection Of Drywall Stud Partitions

27. Reference Standard: Erect steel framing in accordance with ASTM C 754.
28. Layouts: Align partition studs accurately according to partition layout.
29. Anchoring: Anchor runner channels to concrete slabs with concrete stub nails or power-driven anchors at 600 mm (24 inches) OC. Anchor runner channels to coiling grid, where applicable, with stove bolts. Where studs extend above ceiling system, install headers where required to receive runners.
30. Studs: Position studs vertically in runners. Where studs are located adjacent to openings or partition intersections and comers, anchor studs to runners with manufacturer's metal lock fastener or with 13 mm (1/2 inch) Type S pan-head screws.
 - a. Space studs at 400 mm (16 Inches) and 600 mm (24 inches) OC as indicated or scheduled.
 - 1) Cementitious Backer Units (CBU): Space studs at maximum of 400 mm (16 inches) OC.
 - 2) Limiting Heights: Comply with ASTM C 754 for transverse load of 240 Pa (5 lb-force/SF) without exceeding either allowable stress or deflection of L/240. Comers and Intersections: Locate studs no more than 50 mm (2 inches) from abutting partitions, comers, etc.
 - b. Openings: Locate studs not more than 50 mm (2 inches) from opening frames. Anchor studs to frame anchor clips by bolt or screw attachment. Install headers over openings as recommended by the manufacturer.
 - 1) Solid-Core Wood Doors and Hollow Metal Doors: Provide two full-height studs at jambs fastened together back to back.
 - 2) Fire-Rated Openings: Comply with GA 219.
31. Bracing: Provide diagonal bracing at head of studs that terminate above the ceiling level. Bracing shall consist of metal studs bent to V-shape and extending at 45 degrees from partition head to structure above. Locate bracing 1 200 mm (48 inches) maximum OC.
32. Wood Blocking or Metal Reinforcement:
 - a. Wood Blocking: See Division 6 Section "Rough Carpentry."
 - b. Install metal reinforcement of size required for support of toilet and bath accessories, hardware, cabinets, shelving, counters, and other wall-mounted items.
 - c. Set true to line, level, or plumb well-secured in stud wall and flush with back of drywall or other wall finish.
 - d. Coordinate exact locations with other sections.

Miscellaneous Framing And Furring

33. General: Provide necessary framing and furring for special framing at recesses, offsets, specialty Items, and at wall-mounted casework, shelving, and equipment.
34. Furring Channels: Install furring channels over back-up material. Position channels vertically at 600 mm (24 inches) OC. Use power-activated fasteners or stub nails at 600 mm (24 Inches) OC along alternating flanges. Shim channels level as required.
 - a. Cementitious Backer Units (CBU): Space furring at maximum of 400 mm (16 inches) OC.

35. Resilient Furring Channels: Screw-attach In accordance with manufacturer's recommendations.
 - a. Spacing: 600 mm (24 inches) OC for framing at 16 inches OC and 400 mm (16 inches) OC for framing at 24 Inches OC.

Ceiling Grillage Erection

36. Reference Standard: Erect steel framing In accordance with ASTM C 754.
37. Hangers: Install wire hangers spaced not over 1 200 mm (48 inches) OC in direction of 38 mm (1-1/2 inch) main runner channels and within 150 mm (6 inches) of ends of main runners or interruptions of ceiling continuity. Hang from structure above.
38. Runners: Place main runners not over 1 200 mm (48 inches) OC. Provide, position, and level hangers with hangers saddle-tied along runners. Space furring channels at 600 mm (24 inches) OC at right angles to runner channels and secure with furring channel clips.
39. Reinforcement: At light troffers or other openings, reinforce grillage with 19 mm (3/4 inch) cold-rolled channels wired atop and parallel to main runner channels.
 - a. Provide lateral seismic bracing as required by code.
40. Special Shapes: Provide necessary framing and suspension for off sets, verticals, etc.

Insulation

41. Sound Insulation: Place sound Insulation blankets in partitions tight within spaces, around cut openings. behind and around electrical and mechanical items within partitions, and tight to items passing through partitions.
 - a. Ductwork Penetrations: Provide one-inch wide clearance around ductwork and pack with fiberglass ready for joint sealers.

Installation Of Gypsum Drywall

42. Reference Standards: Apply and finish gypsum board in accordance with GA 216 and ASTM C 840.
43. Partition Gypsum Board Layout: Apply gypsum wallboard panels vertically with abutting ends and edges occurring over stud flanges or furring.
 - a. Joints on Opposite Sides of Partitions: Stagger; joints shall not occur over same stud.
 - b. Two Layer Construction: Stagger Joints between layers.
44. Ceiling Gypsum Board: Apply gypsum board of maximum practical length with long dimensions at right angles to furring channels. End and edge joints shall occur over furring channels with end joints staggered. Properly support gypsum board around cutouts and openings.
45. Fasteners: Apply board to studs or furring with drywall screws spaced 300 mm (12 inches) OC in field of board and 200 mm (8 inches) OC staggered along abutting edges.
46. Water-Resistant: Apply gypsum wallboard manufacturer's recommended sealant to raw cut edges and screw heads.
47. Cementitious Backer Units (CBU): Install in accordance with ANSI A108.11 and manufacturer's recommendations.
48. Accessories:
 - a. Comer Bead: Apply as recommended by manufacturer at exposed outer corners.
 - b. Trim (Casing Beads): Apply as recommended by manufacturer, where gypsum board abuts other materials, and as indicated.
 - c. Control Joints: Comply with GA 216.
 - 1) Walls: Install at not more than 9 m (30 feet) OC.
 - 2) Ceilings: Install at not more than 15 m (50 feet) OC and where framing changes direction.
 - 3) Coordinate locations with the Owner.
49. Access Panels: Securely install access panels furnished under other sections. Set plumb and square to align with finish surface.

50. Acoustical Sealant: Seal perimeter and penetrations on both sides of sound-rated partitions and partitions with sound-attenuation blankets with minimum of single 6 mm (1/4 inch) bead of sealant
 - a. Locations:
 - 1) Seal around gypsum-board perimeter in angle formed by gypsum-board panels and abutting dissimilar materials.
 - 2) Seal intersections of gypsum board with dissimilar materials.
 - 3) Seal pipe, conduit, ductwork, penetrations, etc.
 - 4) Seal around cutouts for lights, cabinets, pipes, ductwork, electrical boxes, etc.
 - 5) Seal gypsum board panel terminations in door and window frames.
 - 6) Seal control-joint locations before installing control Joints to panels.
 - b. Installation: Comply with ASTM C 919 and requirements of indicated sound-rated assembly. Provide number and positions of beads to comply with sound rating of assembly.
51. Tolerances: Gypsum-board surface plane within plus or minus 3 mm in 3 000 mm (1/8 inch in 10 feet).
52. Finishing: Finish in accordance with GA 214.
 - a. Concealed Locations (Not Exposed to View in Rooms): Level 1
 - b. Beneath Tile: Level 2.
 - c. Other Finished Areas: Level 4. Finish joints, trim, and fastener dimples. Sand smooth.
 - d. Cementitious Backer Units (CBU): Treat joints in accordance with ANSI A108.11 and manufacturer's recommendations.

END OF SECTION 09 23 13 00



Task	Specification	Specification Description
09 23 13 00	09 22 13 13	Gypsum Plaster
09 23 13 00	09 22 13 13a	Gypsum Veneer Plaster
09 23 13 00	09 22 13 13b	Portland Cement Plaster
09 23 13 00	09 22 36 23	Lath and Plaster Renovation
09 24 13 00	09 22 13 13	Gypsum Plaster
09 24 13 00	09 22 13 13a	Gypsum Veneer Plaster
09 24 33 00	01 22 16 00	No Specification Required

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SECTION 09 28 13 00 - GYPSUM BOARD

1.1 GENERAL

A. Description Of Work

1. This specification covers the furnishing and installation of materials for gypsum board. Products shall be as follows or as directed by the Owner. Installation procedures shall be in accordance with the product manufacturer's recommendations. Demolition and removal of materials shall be as required to support the work.

B. Summary

1. This Section includes the following:
 - a. Interior gypsum board.
 - b. Exterior gypsum board for ceilings and soffits.
 - c. Tile backing panels.

C. Submittals

1. Product Data: For each type of product indicated.
2. Samples: For the following products:
 - a. Trim Accessories: Full-size Sample in ~~12-inch-~~ (300-mm-) long length for each trim accessory indicated.
 - b. Textured Finishes: Manufacturer's standard size for each textured finish indicated and on same backing indicated for Work.
3. LEED Submittals:
 - a. Product Data for Credit MR 4.1 and MR 4.2, **as directed**: For products having recycled content, documentation indicating percentages by weight of postconsumer and preconsumer recycled content.
 - 1) Include statement indicating costs for each product having recycled content.
 - b. Product Data for Credit EQ 4.1: For adhesives used to laminate gypsum board panels to substrates, including printed statement of VOC content.

D. Quality Assurance

1. Fire-Resistance-Rated Assemblies: For fire-resistance-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E 119 by an independent testing agency.
2. STC-Rated Assemblies: For STC-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E 90 and classified according to ASTM E 413 by an independent testing agency.

E. Storage And Handling

1. Store materials inside under cover and keep them dry and protected against damage from weather, condensation, direct sunlight, construction traffic, and other causes. Stack panels flat to prevent sagging.

F. Project Conditions

1. Environmental Limitations: Comply with ASTM C 840 requirements or gypsum board manufacturer's written recommendations, whichever are more stringent.
2. Do not install interior products until installation areas are enclosed and conditioned.
3. Do not install panels that are wet, those that are moisture damaged, and those that are mold damaged.
 - a. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
 - b. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

1.2 PRODUCTS

A. Panels, General

1. Recycled Content: Provide gypsum panel products with recycled content such that postconsumer recycled content plus one-half of preconsumer recycled content constitutes a minimum of 25 percent by weight.
2. Size: Provide in maximum lengths and widths available that will minimize joints in each area and that correspond with support system indicated.

B. Interior Gypsum Board

1. General: Complying with ASTM C 36/C 36M or ASTM C 1396/C 1396M, as applicable to type of gypsum board indicated and whichever is more stringent.
2. Regular Type:
 - a. Thickness: **1/2 inch (12.7 mm)**.
 - b. Long Edges: Tapered **OR** Tapered and featured (rounded or beveled) for prefilling, **as directed**.
3. Type X:
 - a. Thickness: **5/8 inch (15.9 mm)**.
 - b. Long Edges: Tapered **OR** Tapered and featured (rounded or beveled) for prefilling, **as directed**.
4. Type C:
 - a. Thickness: As required by fire-resistance-rated assembly indicated on Drawings.
 - b. Long Edges: Tapered.
5. Flexible Type: Manufactured to bend to fit radii and to be more flexible than standard regular-type gypsum board of same thickness.
 - a. Thickness: **1/4 inch (6.4 mm)**.
 - b. Long Edges: Tapered.
6. Ceiling Type: Manufactured to have more sag resistance than regular-type gypsum board.
 - a. Thickness: **1/2 inch (12.7 mm)**.
 - b. Long Edges: Tapered.
7. Foil-Backed Type:
 - a. Core: As indicated on Drawings **OR 3/8 inch (9.5 mm)**, regular type **OR 1/2 inch (12.7 mm)**, regular type **OR 5/8 inch (15.9 mm)**, Type X **OR** Type C as required by fire-resistance-rated assembly indicated on Drawings, **as directed**.
 - b. Long Edges: Tapered **OR** Tapered and featured (rounded or beveled) for prefilling, **as directed**.
8. Abuse-Resistant Type: Manufactured to produce greater resistance to surface indentation, through-penetration (impact resistance), and abrasion than standard, regular-type and Type X gypsum board.
 - a. Core: As indicated on Drawings **OR 1/2 inch (12.7 mm)**, regular type **OR 5/8 inch (15.9 mm)**, Type X, **as directed**.
 - b. Long Edges: Tapered.
9. High-Impact Type: Manufactured with Type X core, plastic film laminated to back side for greater resistance to through-penetration (impact resistance).
 - a. Core: As indicated on Drawings **OR 5/8 inch (15.9 mm)** thick, **as directed**.
 - b. Plastic-Film Thickness: **0.010 inch (0.254 mm)** **OR 0.020 inch (0.508 mm)** **OR 0.030 inch (0.762 mm)** **OR 0.081 inch (2.057 mm)**, **as directed**.
10. Moisture- and Mold-Resistant Type: With moisture- and mold-resistant core and surfaces.
 - a. Core: **5/8 inch (15.9 mm)**, Type X.
 - b. Long Edges: Tapered.

C. Exterior Gypsum Board For Ceilings And Soffits

1. Exterior Gypsum Soffit Board: ASTM C 931/C 931M or ASTM C 1396/C 1396M, with manufacturer's standard edges.

- 1) Core: As indicated **OR 1/2 inch (12.7 mm)**, regular type **OR 5/8 inch (15.9 mm)**, Type X, **as directed**.
2. Glass-Mat Gypsum Sheathing Board: ASTM C 1177/C 1177M.
 - a. Core: As indicated **OR 1/2 inch (12.7 mm)**, regular type **OR 5/8 inch (15.9 mm)**, Type X, **as directed**.
- D. Tile Backing Panels
 1. Water-Resistant Gypsum Backing Board: ASTM C 630/C 630M or ASTM C 1396/C 1396M.
 - a. Core: As indicated on Drawings **OR 1/2 inch (12.7 mm)**, regular type **OR 5/8 inch (15.9 mm)**, Type X **OR** Type C as required by fire-resistance-rated assembly indicated on Drawings, **as directed**.
 2. Glass-Mat, Water-Resistant Backing Board:
 - a. Complying with ASTM C 1178/C 1178M.
 - b. Complying with ASTM C 1177/C 1177M.
 - c. Core: As indicated on Drawings **OR 1/2 inch (12.7 mm)**, regular type **OR 5/8 inch (15.9 mm)**, Type X, **as directed**.
 3. Cementitious Backer Units: ANSI A118.9.
 - a. Thickness: As indicated on Drawings **OR 1/2 inch (12.7 mm)**, **as directed**.
- E. Trim Accessories
 1. Interior Trim: ASTM C 1047.
 - a. Material: Galvanized or aluminum-coated steel sheet, rolled zinc, plastic, or paper-faced galvanized steel sheet **OR** Galvanized or aluminum-coated steel sheet or rolled zinc **OR** Plastic **OR** Paper-faced galvanized steel sheet, **as directed**.
 - b. Shapes:
 - 1) Cornerbead.
 - 2) Bullnose bead.
 - 3) LC-Bead: J-shaped; exposed long flange receives joint compound.
 - 4) L-Bead: L-shaped; exposed long flange receives joint compound.
 - 5) U-Bead: J-shaped; exposed short flange does not receive joint compound.
 - 6) Expansion (control) joint.
 - 7) Curved-Edge Cornerbead: With notched or flexible flanges.
 2. Exterior Trim: ASTM C 1047.
 - a. Material: Hot-dip galvanized steel sheet, plastic, or rolled zinc.
 - b. Shapes:
 - 1) Cornerbead.
 - 2) LC-Bead: J-shaped; exposed long flange receives joint compound.
 - 3) Expansion (Control) Joint: One-piece, rolled zinc with V-shaped slot and removable strip covering slot opening.
 3. Aluminum Trim: Extruded accessories of profiles and dimensions indicated.
 - a. Aluminum: Alloy and temper with not less than the strength and durability properties of **ASTM B 221 (ASTM B 221M)**, Alloy 6063-T5.
 - b. Finish: Corrosion-resistant primer compatible with joint compound and finish materials specified.
- F. Joint Treatment Materials
 1. General: Comply with ASTM C 475/C 475M.
 2. Joint Tape:
 - a. Interior Gypsum Wallboard: Paper.
 - b. Exterior Gypsum Soffit Board: Paper.
 - c. Glass-Mat Gypsum Sheathing Board: 10-by-10 glass mesh.
 - d. Tile Backing Panels: As recommended by panel manufacturer.
 3. Joint Compound for Interior Gypsum Wallboard: For each coat use formulation that is compatible with other compounds applied on previous or for successive coats.
 - a. Prefilling: At open joints, rounded or beveled panel edges, and damaged surface areas, use setting-type taping compound.

- b. Embedding and First Coat: For embedding tape and first coat on joints, fasteners, and trim flanges, use setting-type taping **OR** drying-type, all-purpose, **as directed**, compound.
 - 1) Use setting-type compound for installing paper-faced metal trim accessories.
- c. Fill Coat: For second coat, use setting-type, sandable topping **OR** drying-type, all-purpose, **as directed**, compound.
- d. Finish Coat: For third coat, use setting-type, sandable topping **OR** drying-type, all-purpose, **as directed**, compound.
- e. Skim Coat: For final coat of Level 5 finish, use setting-type, sandable topping compound **OR** drying-type, all-purpose compound **OR** high-build interior coating product designed for application by airless sprayer and to be used instead of skim coat to produce Level 5 finish, **as directed**.
- 4. Joint Compound for Exterior Applications:
 - a. Exterior Gypsum Soffit Board: Use setting-type taping compound and setting-type, sandable topping compound.
 - b. Glass-Mat Gypsum Sheathing Board: As recommended by sheathing board manufacturer.
- 5. Joint Compound for Tile Backing Panels:
 - a. Water-Resistant Gypsum Backing Board: Use setting-type taping compound and setting-type, sandable topping compound.
 - b. Glass-Mat, Water-Resistant Backing Panel: As recommended by backing panel manufacturer.
 - c. Cementitious Backer Units: As recommended by backer unit manufacturer.

G. Auxiliary Materials

- 1. General: Provide auxiliary materials that comply with referenced installation standards and manufacturer's written recommendations.
- 2. Laminating Adhesive: Adhesive or joint compound recommended for directly adhering gypsum panels to continuous substrate.
 - a. Use adhesives that have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- 3. Steel Drill Screws: ASTM C 1002, unless otherwise indicated.
 - a. Use screws complying with ASTM C 954 for fastening panels to steel members from **0.033 to 0.112 inch (0.84 to 2.84 mm)** thick.
 - b. For fastening cementitious backer units, use screws of type and size recommended by panel manufacturer.
- 4. Sound Attenuation Blankets: ASTM C 665, Type I (blankets without membrane facing) produced by combining thermosetting resins with mineral fibers manufactured from glass, slag wool, or rock wool.
 - a. Fire-Resistance-Rated Assemblies: Comply with mineral-fiber requirements of assembly.
 - b. Recycled Content: Provide blankets with recycled content such that postconsumer recycled content plus one-half of preconsumer recycled content constitutes a minimum of 25 percent by weight.
- 5. Acoustical Sealant: As specified in Division 07 Section "Joint Sealants".
 - a. Provide sealants that have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- 6. Thermal Insulation: As specified in Division 07 Section "Thermal Insulation".
- 7. Vapor Retarder: As specified in Division 07 Section "Thermal Insulation".

H. Texture Finishes

- 1. Primer: As recommended by textured finish manufacturer.
- 2. Polystyrene Aggregate Ceiling Finish: Water-based, job-mixed, polystyrene aggregate finish with flame-spread and smoke-developed indexes of not more than 25 when tested according to ASTM E 84.
 - a. Texture: Fine **OR** Medium **OR** Coarse, **as directed**.
- 3. Aggregate Finish: Water-based, job-mixed, aggregated, drying-type texture finish for spray application.

- a. Texture: Light spatter **OR** Spatter knock-down, **as directed**.
4. Acoustical Finish: Water-based, chemical-setting or drying-type, job-mixed texture finish for spray application.
 - a. Application Thickness: **1/2 inch (12.7 mm)**.
 - b. Fire-Test-Response Characteristics: Indices when tested according to ASTM E 84 as follows:
 - 1) Flame Spread: Less than 25.
 - 2) Smoke Developed: Less than 450.
 - c. NRC: 0.55 according to ASTM C 423.

1.3 EXECUTION

A. Examination

1. Examine areas and substrates, with Installer present, and including welded hollow-metal frames and framing, for compliance with requirements and other conditions affecting performance.
2. Examine panels before installation. Reject panels that are wet, moisture damaged, and mold damaged.
3. Proceed with installation only after unsatisfactory conditions have been corrected.

B. Applying And Finishing Panels, General

1. Comply with ASTM C 840.
2. Install ceiling panels across framing to minimize the number of abutting end joints and to avoid abutting end joints in central area of each ceiling. Stagger abutting end joints of adjacent panels not less than one framing member.
3. Install panels with face side out. Butt panels together for a light contact at edges and ends with not more than **1/16 inch (1.5 mm)** of open space between panels. Do not force into place.
4. Locate edge and end joints over supports, except in ceiling applications where intermediate supports or gypsum board back-blocking is provided behind end joints. Do not place tapered edges against cut edges or ends. Stagger vertical joints on opposite sides of partitions. Do not make joints other than control joints at corners of framed openings.
5. Form control and expansion joints with space between edges of adjoining gypsum panels.
6. Cover both faces of support framing with gypsum panels in concealed spaces (above ceilings, etc.), except in chases braced internally.
 - a. Unless concealed application is indicated or required for sound, fire, air, or smoke ratings, coverage may be accomplished with scraps of not less than **8 sq. ft. (0.7 sq. m)** in area.
 - b. Fit gypsum panels around ducts, pipes, and conduits.
 - c. Where partitions intersect structural members projecting below underside of floor/roof slabs and decks, cut gypsum panels to fit profile formed by structural members; allow **1/4- to 3/8-inch- (6.4- to 9.5-mm-)** wide joints to install sealant.
7. Isolate perimeter of gypsum board applied to non-load-bearing partitions at structural abutments, except floors. Provide **1/4- to 1/2-inch- (6.4- to 12.7-mm-)** wide spaces at these locations, and trim edges with edge trim where edges of panels are exposed. Seal joints between edges and abutting structural surfaces with acoustical sealant.
8. Attachment to Steel Framing: Attach panels so leading edge or end of each panel is attached to open (unsupported) edges of stud flanges first.
9. Wood Framing: Install gypsum panels over wood framing, with floating internal corner construction. Do not attach gypsum panels across the flat grain of wide-dimension lumber, including floor joists and headers. Float gypsum panels over these members, or provide control joints to counteract wood shrinkage.
10. STC-Rated Assemblies: Seal construction at perimeters, behind control joints, and at openings and penetrations with a continuous bead of acoustical sealant. Install acoustical sealant at both faces of partitions at perimeters and through penetrations. Comply with ASTM C 919 and with manufacturer's written recommendations for locating edge trim and closing off sound-flanking paths around or through assemblies, including sealing partitions above acoustical ceilings.

11. Install sound attenuation blankets before installing gypsum panels, unless blankets are readily installed after panels have been installed on one side.

C. Applying Interior Gypsum Board

1. Install interior gypsum board in the following locations:
 - a. Regular Type: As indicated on Drawings **OR** Vertical surfaces, unless otherwise indicated, **as directed**.
 - b. Type X: As indicated on Drawings **OR** Where required for fire-resistance-rated assembly **OR** Vertical surfaces, unless otherwise indicated, **as directed**.
 - c. Type C: As indicated on Drawings **OR** Where required for specific fire-resistance-rated assembly indicated, **as directed**.
 - d. Flexible Type: As indicated on Drawings **OR** Apply in double layer at curved assemblies, **as directed**.
 - e. Ceiling Type: As indicated on Drawings **OR** Ceiling surfaces, **as directed**.
 - f. Foil-Backed Type: As indicated on Drawings **OR as directed**.
 - g. Abuse-Resistant Type: As indicated on Drawings **OR as directed**.
 - h. High-Impact Type: As indicated on Drawings **OR as directed**.
 - i. Moisture- and Mold-Resistant Type: As indicated on Drawings **OR as directed**.
2. Single-Layer Application:
 - a. On ceilings, apply gypsum panels before wall/partition board application to greatest extent possible and at right angles to framing, unless otherwise indicated.
 - b. On partitions/walls, apply gypsum panels vertically (parallel to framing) **OR** horizontally (perpendicular to framing), **as directed**, unless otherwise indicated or required by fire-resistance-rated assembly, and minimize end joints.
 - 1) Stagger abutting end joints not less than one framing member in alternate courses of panels.
 - 2) At stairwells and other high walls, install panels horizontally, unless otherwise indicated or required by fire-resistance-rated assembly.
 - c. On Z-furring members, apply gypsum panels vertically (parallel to framing) with no end joints. Locate edge joints over furring members.
 - d. Fastening Methods: Apply gypsum panels to supports with steel drill screws.
3. Multilayer Application:
 - a. On ceilings, apply gypsum board indicated for base layers before applying base layers on walls/partitions; apply face layers in same sequence. Apply base layers at right angles to framing members and offset face-layer joints 1 framing member, **16 inches (400 mm)** minimum, from parallel base-layer joints, unless otherwise indicated or required by fire-resistance-rated assembly.
 - b. On partitions/walls, apply gypsum board indicated for base layers and face layers vertically (parallel to framing) with joints of base layers located over stud or furring member and face-layer joints offset at least one stud or furring member with base-layer joints, unless otherwise indicated or required by fire-resistance-rated assembly. Stagger joints on opposite sides of partitions.
 - c. On Z-furring members, apply base layer vertically (parallel to framing) and face layer either vertically (parallel to framing) or horizontally (perpendicular to framing) with vertical joints offset at least one furring member. Locate edge joints of base layer over furring members.
 - d. Fastening Methods: Fasten base layers and face layers separately to supports with screws **OR** Fasten base layers with screws; fasten face layers with adhesive and supplementary fasteners, **as directed**.
4. Laminating to Substrate: Where gypsum panels are indicated as directly adhered to a substrate (other than studs, joists, furring members, or base layer of gypsum board), comply with gypsum board manufacturer's written recommendations and temporarily brace or fasten gypsum panels until fastening adhesive has set.
5. Curved Surfaces:

- a. Install panels horizontally (perpendicular to supports) and unbroken, to extent possible, across curved surface plus **12-inch- (300-mm-)** long straight sections at ends of curves and tangent to them.
 - b. For double-layer construction, fasten base layer to studs with screws **16 inches (400 mm)** o.c. Center gypsum board face layer over joints in base layer, and fasten to studs with screws spaced **12 inches (300 mm)** o.c.
- D. Applying Exterior Gypsum Panels For Ceilings And Soffits
1. Apply panels perpendicular to supports, with end joints staggered and located over supports.
 - a. Install with **1/4-inch (6.4-mm)** open space where panels abut other construction or structural penetrations.
 - b. Fasten with corrosion-resistant screws.
- E. Applying Tile Backing Panels
1. Water-Resistant Gypsum Backing Board: Install at showers, tubs, and where indicated. Install with **1/4-inch (6.4-mm)** gap where panels abut other construction or penetrations.
 2. Glass-Mat, Water-Resistant Backing Panel: Comply with manufacturer's written installation instructions and install at showers, tubs, and where indicated **OR** locations indicated to receive tile, **as directed**. Install with **1/4-inch (6.4-mm)** gap where panels abut other construction or penetrations.
 3. Cementitious Backer Units: ANSI A108.11, at showers, tubs, and where indicated **OR** locations indicated to receive tile, **as directed**.
 4. Areas Not Subject to Wetting: Install regular-type gypsum wallboard panels to produce a flat surface except at showers, tubs, and other locations indicated to receive water-resistant panels.
 5. Where tile backing panels abut other types of panels in same plane, shim surfaces to produce a uniform plane across panel surfaces.
- F. Installing Trim Accessories
1. General: For trim with back flanges intended for fasteners, attach to framing with same fasteners used for panels. Otherwise, attach trim according to manufacturer's written instructions.
 2. Control Joints: Install control joints at locations indicated on Drawings **OR** according to ASTM C 840 and in specific locations approved by the Owner for visual effect, **as directed**.
 3. Interior Trim: Install in the following locations:
 - a. Cornerbead: Use at outside corners, unless otherwise indicated.
 - b. Bullnose Bead: Use at outside corners **OR** where indicated, **as directed**.
 - c. LC-Bead: Use at exposed panel edges.
 - d. L-Bead: Use where indicated.
 - e. U-Bead: Use at exposed panel edges **OR** where indicated, **as directed**.
 - f. Curved-Edge Cornerbead: Use at curved openings.
 4. Exterior Trim: Install in the following locations:
 - a. Cornerbead: Use at outside corners.
 - b. LC-Bead: Use at exposed panel edges.
 5. Aluminum Trim: Install in locations indicated on Drawings.
- G. Finishing Gypsum Board
1. General: Treat gypsum board joints, interior angles, edge trim, control joints, penetrations, fastener heads, surface defects, and elsewhere as required to prepare gypsum board surfaces for decoration. Promptly remove residual joint compound from adjacent surfaces.
 2. Prefill open joints, rounded or beveled edges, and damaged surface areas.
 3. Apply joint tape over gypsum board joints, except those with trim having flanges not intended for tape.
 4. Gypsum Board Finish Levels: Finish panels to levels indicated below and according to ASTM C 840:
 - a. Level 1: Ceiling plenum areas, concealed areas, and where indicated.
 - b. Level 2: Panels that are substrate for tile **OR** Panels that are substrate for acoustical tile **OR** Where indicated on Drawings, **as directed**.

- c. Level 3: For surfaces receiving medium- or heavy-textured finishes before painting or heavy wallcoverings where lighting conditions are not critical **OR** Where indicated on Drawings, **as directed**.
- d. Level 4: For surfaces receiving light-textured finishes, wallcoverings, and flat paints **OR** At panel surfaces that will be exposed to view, unless otherwise indicated, **as directed**. This is generally the standard exposed finish. Gloss and semi-gloss enamel paints are not usually recommended over this level of finish. ASTM C 840 requires application of "drywall primer" on surfaces before final decoration
 - 1) Primer and its application to surfaces are specified in other Division 07.
- e. Level 5: For surfaces receiving gloss and semigloss enamels and other surfaces subject to severe lighting **OR** Where indicated on Drawings, **as directed**.
 - 1) Primer and its application to surfaces are specified in other Division 07.
- f. Glass-Mat Gypsum Sheathing Board: Finish according to manufacturer's written instructions for use as exposed soffit board.
- g. Glass-Mat, Water-Resistant Backing Panels: Finish according to manufacturer's written instructions.
- h. Cementitious Backer Units: Finish according to manufacturer's written instructions.

H. Applying Texture Finishes

- 1. Surface Preparation and Primer: Prepare and apply primer to gypsum panels and other surfaces receiving texture finishes. Apply primer to surfaces that are clean, dry, and smooth.
- 2. Texture Finish Application: Mix and apply finish using powered spray equipment, to produce a uniform texture free of starved spots or other evidence of thin application or of application patterns.
- 3. Prevent texture finishes from coming into contact with surfaces not indicated to receive texture finish by covering them with masking agents, polyethylene film, or other means. If, despite these precautions, texture finishes contact these surfaces, immediately remove droppings and overspray to prevent damage according to texture-finish manufacturer's written recommendations.

I. Protection

- 1. Protect installed products from damage from weather, condensation, direct sunlight, construction, and other causes during remainder of the construction period.
- 2. Remove and replace panels that are wet, moisture damaged, and mold damaged.
 - a. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
 - b. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

END OF SECTION 09 28 13 00

SECTION 09 28 13 00a - GYPSUM BOARD SHAFT-WALL ASSEMBLIES

1.1 GENERAL

A. Description Of Work

1. This specification covers the furnishing and installation of materials for gypsum board shaft-wall assemblies. Products shall be as follows or as directed by the Owner. Installation procedures shall be in accordance with the product manufacturer's recommendations. Demolition and removal of materials shall be as required to support the work.

B. Summary

1. This Section includes gypsum board shaft-wall assemblies for the following:
 - a. Shaft-wall enclosures.
 - b. Chase enclosures.
 - c. Stair enclosures.
 - d. Horizontal enclosures.

C. Submittals

1. Product Data: For each gypsum board shaft-wall assembly indicated.
2. LEED Submittals:
 - a. Product Data for Credit EQ 4.1: For adhesives and sealants, including printed statement of VOC content.
 - b. Product Data for Credit MR 4.1 and Credit MR 4.2, **as directed**: For products having recycled content, documentation indicating percentages by weight of postconsumer and preconsumer recycled content.
 - 1) Include statement indicating costs for each product having recycled content.

D. Quality Assurance

1. Fire-Resistance Ratings: Provide materials and construction identical to those of assemblies with fire-resistance ratings determined according to ASTM E 119 by a testing and inspecting agency.
2. STC-Rated Assemblies: Provide materials and construction identical to those of assemblies tested according to ASTM E 90 and classified according to ASTM E 413 by a testing and inspecting agency.
3. Preinstallation Conference: Conduct conference at Project site.

E. Delivery, Storage, And Handling

1. Deliver materials in original packages, containers, and bundles bearing brand name and identification of manufacturer or supplier.
2. Store materials inside under cover and keep them dry and protected against damage from weather, direct sunlight, surface contamination, corrosion, construction traffic, and other causes.
3. Stack panels flat on leveled supports off floor or slab to prevent sagging.

F. Project Conditions

1. Environmental Limitations: Comply with ASTM C 840 requirements or with gypsum board manufacturer's written recommendations, whichever are more stringent.
2. Do not install interior products until installation areas are enclosed and conditioned.
3. Do not install panels that are wet, moisture damaged, or mold damaged.
 - a. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, and irregular shape.
 - b. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

PART 2 - PRODUCTS

- A. Gypsum Board Shaft-Wall Assemblies, General
1. Provide materials and components complying with requirements of fire-resistance-rated assemblies indicated.
 - a. Provide panels in maximum lengths available to eliminate or minimize end-to-end butt joints.
 - b. Provide auxiliary materials complying with gypsum board shaft-wall assembly manufacturer's written recommendations.
- B. Panel Products
1. Recycled Content: Provide gypsum panel products with recycled content such that postconsumer recycled content plus one-half of preconsumer recycled content constitutes a minimum of 25 percent by weight.
 2. Gypsum Liner Panels: Comply with ASTM C 442/C 442M.
 - a. Type X: Manufacturer's proprietary liner panels with moisture-resistant paper faces.
 - 1) Core: 1 inch (25.4 mm) thick.
 - 2) Long Edges: Double bevel.
 - b. Moisture- and Mold-Resistant Type X: Manufacturer's proprietary liner panels with moisture- and mold-resistant core and surfaces; comply with ASTM D 3273.
 - 1) Core: 1 inch (25.4 mm) thick.
 - 2) Long Edges: Double bevel.
 3. Gypsum Base for Gypsum Veneer Plaster: As specified in Division 09 Section "Gypsum Veneer Plastering".
 4. Gypsum Board: As specified in Division 09 Section "Gypsum Board".
 5. Water-Resistant Gypsum Backing Board: As specified in Division 09 Section "Gypsum Board".
 6. Cementitious Backer Units: As specified in Division 09 Section "Tiling".
- C. Non-Load-Bearing Steel Framing
1. Framing Members: Comply with ASTM C 754 for conditions indicated.
 2. Steel Sheet Components: Comply with ASTM C 645 requirements for metal, unless otherwise indicated.
 - a. Recycled Content: Provide steel sheet with average recycled content such that postconsumer recycled content plus one-half of preconsumer recycled content is not less than 25 percent.
 - b. Protective Coating: ASTM A 653/A 653M, G40 (Z120) OR ASTM A 653/A 653M, G60 (Z180) OR Coating with equivalent corrosion resistance of ASTM A 653/A 653M, G40 (Z120), as directed, hot-dip galvanized, unless otherwise indicated.
- D. Auxiliary Materials
1. General: Provide auxiliary materials that comply with referenced product standards and manufacturer's written recommendations.
 2. Trim Accessories: Cornerbead, edge trim, and control joints of material and shapes specified in Division 09 Section(s) "Gypsum Veneer Plastering" OR "Gypsum Board", as directed, that comply with gypsum board shaft-wall assembly manufacturer's written recommendations for application indicated.
 3. Gypsum Base Joint-Reinforcing Materials: As specified in Division 09 Section "Gypsum Veneer Plastering".
 4. Gypsum Veneer Plaster: As specified in Division 09 Section "Gypsum Veneer Plastering".
 5. Gypsum Board Joint-Treatment Materials: As specified in Division 09 Section "Gypsum Board".
 6. Laminating Adhesive: Adhesive or joint compound recommended by manufacturer for directly adhering gypsum face-layer panels and gypsum-base face-layer panels to backing-layer panels in multilayer construction.
 - a. Use adhesives that have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

7. Steel Drill Screws: ASTM C 1002, unless otherwise indicated.
 - a. For fastening cementitious backer units, use screws of type and size recommended by panel manufacturer.
 8. Track Fasteners: Power-driven fasteners of size and material required to withstand loading conditions imposed on shaft-wall assemblies without exceeding allowable design stress of track, fasteners, or structural substrates in which anchors are embedded.
 - a. Expansion Anchors: Fabricated from corrosion-resistant materials, with capability to sustain, without failure, a load equal to 5 times design load, as determined by testing per ASTM E 488 conducted by a qualified testing agency.
 - b. Power-Actuated Anchors: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with capability to sustain, without failure, a load equal to 10 times design load, as determined by testing per ASTM E 1190 conducted by a qualified testing agency.
 9. Sound Attenuation Blankets: ASTM C 665, Type I (blankets without membrane facing), produced by combining thermosetting resins with mineral fibers manufactured from glass, slag wool, or rock wool.
 - a. Fire-Resistance-Rated Assemblies: Comply with mineral-fiber requirements of assembly.
 - b. Recycled Content: Provide blankets with recycled content such that postconsumer recycled content plus one-half of preconsumer recycled content constitutes a minimum of 25 percent by weight.
 10. Acoustical Sealant: As specified in Division 07 Section "Thermal Insulation".
 - a. Provide sealants that have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- E. Gypsum Board Shaft-Wall Assemblies
1. Basis-of-Design Product: As indicated on Drawings by design designation of a qualified testing agency.
 2. Fire-Resistance Rating: As indicated **OR** 1 hour **OR** 2 hours **OR** 3 hours **OR** 4 hours, **as directed**.
 3. STC Rating: As indicated **OR** 51, minimum, **as directed**.
 4. Studs: Manufacturer's standard profile for repetitive members, corner and end members, and fire-resistance-rated assembly indicated.
 - a. Depth: As indicated **OR** 2-1/2 inches (64 mm) **OR** 4 inches (102 mm) **OR** 6 inches (152 mm), **as directed**.
 - b. Minimum Base-Metal Thickness: As indicated **OR** 0.0179 inch (0.45 mm) **OR** 0.0220 inch (0.55 mm) **OR** 0.0329 inch (0.84 mm), **as directed**.
 5. Runner Tracks: Manufacturer's standard J-profile track with long-leg length as standard with manufacturer, but at least 2 inches (51 mm) long and in depth matching studs.
 - a. Minimum Base-Metal Thickness: As indicated **OR** Matching steel studs **OR** 0.0179 inch (0.45 mm) **OR** 0.0220 inch (0.55 mm) **OR** 0.0329 inch (0.84 mm), **as directed**.
 6. Firestop Tracks: Top runner manufactured to allow partition heads to expand and contract with movement of structure while maintaining continuity of fire-resistance-rated assembly indicated; in thickness not less than indicated for studs and in width to accommodate depth of studs.
 7. Jamb Struts: Manufacturer's standard J-profile strut with long-leg length of 3 inches (76 mm), in depth matching studs, and not less than 0.0329 inch (0.84 mm) thick.
 8. Room-Side Finish: As indicated **OR** Gypsum board **OR** Gypsum veneer plaster **OR** Cementitious backer units, **as directed**.
 9. Shaft-Side Finish: As indicated **OR** As indicated by fire-resistance-rated assembly design designation, **as directed**.
 10. Insulation: Sound attenuation blankets.

2.2 EXECUTION

A. Preparation

1. Sprayed Fire-Resistive Materials: Coordinate with gypsum board shaft-wall assemblies so both elements of Work remain complete and undamaged. Patch or replace sprayed fire-resistive materials removed or damaged during installation of shaft-wall assemblies to comply with requirements specified in Division 07 Section "Applied Fireproofing".
 - a. Before sprayed fire-resistive materials are applied, attach offset anchor plates or ceiling runner tracks to surfaces indicated to receive sprayed fire-resistive materials. Where offset anchor plates are required, provide continuous plates fastened to building structure not more than **24 inches (610 mm)** o.c.
2. After sprayed fire-resistive materials are applied, remove only to extent necessary for installation of gypsum board shaft-wall assemblies and without reducing the fire-resistive material thickness below that which is required to obtain fire-resistance rating indicated. Protect remaining fire-resistive materials from damage.

B. Installation

1. General: Install gypsum board shaft-wall assemblies to comply with requirements of fire-resistance-rated assemblies indicated, manufacturer's written installation instructions, and the following:
 - a. ASTM C 754 for installing steel framing except comply with framing spacing indicated.
 - b. Division 09 Section(s) "Gypsum Veneer Plastering" OR "Gypsum Board", **as directed**, for applying and finishing panels.
 - c. Division 09 Section "Tiling" for cementitious backer units.
2. Do not bridge architectural or building expansion joints with shaft-wall assemblies; frame both sides of expansion joints with furring and other support.
3. Install supplementary framing in gypsum board shaft-wall assemblies around openings and as required for blocking, bracing, and support of gravity and pullout loads of fixtures, equipment, services, heavy trim, furnishings, and similar items that cannot be supported directly by shaft-wall assembly framing.
 - a. At elevator hoistway entrance door frames, provide jamb struts on each side of door frame.
 - b. Where handrails directly attach to gypsum board shaft-wall assemblies, provide galvanized steel reinforcing strip with **0.0312-inch (0.79-mm)** minimum thickness of base (uncoated) metal, accurately positioned and secured behind at least 1 gypsum base for veneer plaster **OR** gypsum board **OR** cementitious backer unit, **as directed**, face-layer panel.
4. Integrate stair hanger rods with gypsum board shaft-wall assemblies by locating cavity of assemblies where required to enclose rods.
5. At penetrations in shaft wall, maintain fire-resistance rating of shaft-wall assembly by installing supplementary steel framing around perimeter of penetration and fire protection behind boxes containing wiring devices, elevator call buttons, elevator floor indicators, and similar items.
6. Isolate perimeter of gypsum panels from building structure to prevent cracking of panels, while maintaining continuity of fire-rated construction.
7. Firestop Tracks: Where indicated, install to maintain continuity of fire-resistance-rated assembly indicated.
8. Control Joints: Install control joints at locations indicated on Drawings **OR** according to ASTM C 840 and in specific locations approved by the Owner, **as directed**, while maintaining fire-resistance rating of gypsum board shaft-wall assemblies.
9. Seal gypsum board shaft walls with acoustical sealant at perimeter of each assembly where it abuts other work and at joints and penetrations within each assembly. Install acoustical sealant to withstand dislocation by air-pressure differential between shaft and external spaces; maintain an airtight and smoke-tight seal; and comply with ASTM C 919 requirements or with manufacturer's written instructions, whichever are more stringent.
10. In elevator shafts where gypsum board shaft-wall assemblies cannot be positioned within **4 inches (102 mm)** of the shaft face of structural beams, floor edges, and similar projections into shaft, install **1/2- or 5/8-inch- (13- or 16-mm-)** thick, gypsum board cants covering tops of projections. No recesses allowed (at steel beams especially).

- a. Slope cant panels at least 75 degrees from horizontal. Set base edge of panels in adhesive and secure top edges to shaft walls at **24 inches (610 mm)** o.c. with screws fastened to shaft-wall framing.
 - b. Where steel framing is required to support gypsum board cants, install framing at **24 inches (610 mm)** o.c. and extend studs from the projection to shaft-wall framing.
 11. Installation Tolerance: Install each framing member so fastening surfaces vary not more than **1/8 inch (3mm)** from the plane formed by faces of adjacent framing.
- C. Protection
1. Protect installed products from damage from weather, condensation, direct sunlight, construction, and other causes during remainder of the construction period.
 2. Remove and replace panels that are wet, moisture damaged, or mold damaged.
 - a. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, and irregular shape.
 - b. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

END OF SECTION 09 28 13 00a

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Task	Specification	Specification Description
09 28 13 00	09 22 13 13a	Gypsum Veneer Plaster
09 28 13 00	09 01 30 91	Ceramic Tile
09 29 10 00	01 22 16 00	No Specification Required
09 29 10 00	09 28 13 00	Gypsum Board
09 29 10 00	09 23 13 00	Gypsum Board Renovation
09 29 10 00	09 28 13 00a	Gypsum Board Shaft-Wall Assemblies
09 29 82 00	09 28 13 00	Gypsum Board
09 29 82 00	09 28 13 00a	Gypsum Board Shaft-Wall Assemblies
09 30 13 00	09 01 30 91	Ceramic Tile
09 30 16 00	09 01 30 91	Ceramic Tile
09 34 00 00	09 01 30 91	Ceramic Tile
09 39 00 00	01 22 16 00	No Specification Required
09 39 00 00	09 01 30 91	Ceramic Tile

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SECTION 09 51 13 00 - ACOUSTICAL PANEL CEILINGS

1.1 GENERAL

A. Description Of Work

1. This specification covers the furnishing and installation of materials for acoustical panel ceilings. Products shall be as follows or as directed by the Owner. Installation procedures shall be in accordance with the product manufacturer's recommendations. Demolition and removal of materials shall be as required to support the work.

B. Summary

1. This Section includes acoustical panels and exposed suspension systems for ceilings.
2. Products furnished, but not installed under this Section, include anchors, clips, and other ceiling attachment devices to be cast in concrete at ceilings.

C. Definitions

1. AC: Articulation Class.
2. CAC: Ceiling Attenuation Class.
3. LR: Light Reflectance coefficient.
4. NRC: Noise Reduction Coefficient.

D. Submittals

1. Product Data: For each type of product indicated.
2. Coordination Drawings: Drawn to scale and coordinating acoustical panel ceiling installation with hanger attachment to building structure and ceiling mounted items:
3. Samples: For each exposed finish.
4. LEED Submittals:
 - a. Product Data for Credit MR 4.1 and MR 4.2, **as directed**: For products having recycled content, documentation indicating percentages by weight of postconsumer and preconsumer recycled content.
 - 1) Include statement indicating costs for each product having recycled content.
 - b. Product Data for Credit EQ 4.1: For sealants, including printed statement of VOC content.
5. Product test reports.
6. Research/evaluation reports.
7. Maintenance data.

E. Quality Assurance

1. Acoustical Testing Agency Qualifications: An independent testing laboratory, or an NVLAP-accredited laboratory, with the experience and capability to conduct the testing indicated. NVLAP-accredited laboratories must document accreditation, based on a "Certificate of Accreditation" and a "Scope of Accreditation" listing the test methods specified.
2. Fire-Test-Response Characteristics
 - a. Fire-Resistance Characteristics: Where indicated, provide acoustical panel ceilings identical to those of assemblies tested for fire resistance per ASTM E 119 by UL or another testing and inspecting agency acceptable to authorities having jurisdiction.
 - 1) Fire-Resistance Ratings: Indicated by design designations from UL's "Fire Resistance Directory" or from the listings of another testing and inspecting agency.
 - 2) Identify materials with appropriate markings of applicable testing and inspecting agency.
 - b. Surface-Burning Characteristics: Provide acoustical panels with the following surface-burning characteristics complying with ASTM E 1264 for Class A **OR B OR C, as directed**, materials as determined by testing identical products per ASTM E 84:
 - 1) Smoke-Developed Index: 450 or less.

3. Seismic Standard: Provide acoustical panel ceilings designed and installed to withstand the effects of earthquake motions according to the following:
 - a. Standard for Ceiling Suspension Systems Requiring Seismic Restraint: Comply with ASTM E 580.
 - b. Cisca's Recommendations for Acoustical Ceilings: Comply with Cisca's "Recommendations for Direct-Hung Acoustical Tile and Lay-in Panel Ceilings--Seismic Zones 0-2."
 - c. Cisca's Guidelines for Systems Requiring Seismic Restraint: Comply with Cisca's "Guidelines for Seismic Restraint of Direct-Hung Suspended Ceiling Assemblies--Seismic Zones 3 & 4."
 - d. IBC Standard for Metal Suspension Systems for Acoustical Tile and for Lay-in Panel Ceilings.
 - e. ASCE 7, "Minimum Design Loads for Buildings and Other Structures": Section 9, "Earthquake Loads."
4. Preinstallation Conference: Conduct conference at Project site.

F. Delivery, Storage, And Handling

1. Deliver acoustical panels, suspension system components, and accessories to Project site in original, unopened packages and store them in a fully enclosed, conditioned space where they will be protected against damage from moisture, humidity, temperature extremes, direct sunlight, surface contamination, and other causes.
2. Before installing acoustical panels, permit them to reach room temperature and a stabilized moisture content.
3. Handle acoustical panels carefully to avoid chipping edges or damaging units in any way.

1.2 PRODUCTS

A. Acoustical Panels, General

1. Acoustical Panel Standard: Provide manufacturer's standard panels of configuration indicated that comply with ASTM E 1264 classifications as designated by types, patterns, acoustical ratings, and light reflectances, unless otherwise indicated.
 - a. Mounting Method for Measuring NRC: Type E-400; plenum mounting in which face of test specimen is 15-3/4 inches (400 mm) away from test surface per ASTM E 795.
2. Acoustical Panel Colors and Patterns: Match appearance characteristics indicated for each product type.
 - a. Where appearance characteristics of acoustical panels are indicated by referencing pattern designations in ASTM E 1264 and not manufacturers' proprietary product designations, provide products selected by the Owner from each manufacturer's full range that comply with requirements indicated for type, pattern, color, light reflectance, acoustical performance, edge detail, and size.
3. Broad Spectrum Antimicrobial Fungicide and Bactericide Treatment: Provide acoustical panels treated with manufacturer's standard antimicrobial formulation that inhibits fungus, mold, mildew, and gram-positive and gram-negative bacteria and showing no mold, mildew, or bacterial growth when tested according to ASTM D 3273 and evaluated according to ASTM D 3274 or ASTM G 21.
4. Antimicrobial Fungicide Treatment: Provide acoustical panels with face and back surfaces coated with antimicrobial treatment consisting of manufacturer's standard formulation with fungicide added to inhibit growth of mold and mildew and showing no mold or mildew growth when tested according to ASTM D 3273 and evaluated according to ASTM D 3274 or ASTM G 21.

B. Acoustical Panels For Acoustical Panel Ceiling

1. Classification: Provide fire-resistance-rated, **as directed**, panels complying with ASTM E 1264 for type, form, and pattern as follows:

- a. Type and Form: Type III, mineral base with painted finish; Form 1, nodular **OR** 2, water felted **OR** 4, cast or molded, **as directed**.
 - b. Type and Form: Type IV, mineral base with membrane-faced overlay; Form 1, nodular; with glass-fiber cloth **OR** washable vinyl-film, **as directed**, overlay.
 - c. Type and Form: Type IV, mineral base with membrane-faced overlay; Form 2, water felted; with vinyl overlay on face **OR** vinyl overlay on face and back **OR** vinyl overlay on face, back, and sealed edges **OR** fiberglass-fabric overlay on face, **as directed**.
 - d. Type and Form: Type XII, glass-fiber base with membrane-faced overlay; Form 1, plastic **OR** 2, cloth **OR** 3, other, **as directed**.
 - e. Type and Form: Type XX, other types; described as high-density, ceramic- and mineral-base panels with scrubbable finish, resistant to heat, moisture, and corrosive fumes.
 - f. Pattern: C (perforated, small holes) **OR** CD (perforated, small holes and fissured) **OR** CE (perforated, small holes and lightly textured) **OR** D (fissured) **OR** E (lightly textured) **OR** F (heavily textured) **OR** G (smooth) **OR** GH (smooth and printed) **OR** I (embossed) **OR** J (embossed-in-register) **OR** K (surface scored) **OR** Z (other patterns as described) **OR** As indicated by manufacturer's designation, **as directed**.
 2. Color: White **OR** As selected from manufacturer's full range **OR** Match sample **OR** As indicated by manufacturer's designation **OR** As indicated on Drawings **OR** As indicated in a schedule, **as directed**.
 3. LR: Not less than 0.65 **OR** 0.70 **OR** 0.75 **OR** 0.80 **OR** 0.85 **OR** 0.90, **as directed**.
 4. NRC: Not less than 0.10 **OR** 0.35 **OR** 0.40 **OR** 0.50 **OR** 0.55 **OR** 0.60 **OR** 0.65 **OR** 0.70 **OR** 0.75 **OR** 0.80 **OR** 0.85 **OR** 0.90 **OR** 0.95 **OR** 1.00, **as directed**.
 5. CAC: Not less than 20 **OR** 25 **OR** 30 **OR** 35 **OR** 40, **as directed**.
 6. AC: Not less than 170 **OR** 180 **OR** 190 **OR** 200 **OR** 210, **as directed**.
 7. Edge/Joint Detail: Square **OR** Reveal sized to fit flange of exposed suspension system members **OR** Flush reveal sized to fit flange of exposed suspension system members **OR** Beveled, kerfed and rabbeted long edges and square, butt-on short edges, **as directed**.
 8. Thickness: 5/8 inch (15 mm) **OR** 3/4 inch (19 mm) **OR** 7/8 inch (22 mm) **OR** As indicated on Drawings **OR** As indicated in a schedule, **as directed**.
 9. Thickness (For glass-fiber-based panels): 1/8 inch (3 mm) **OR** 9/16 inch (15 mm) **OR** 5/8 inch (15 mm) **OR** 7/16 inch (22 mm) **OR** 3/4 inch (19 mm) **OR** 1 inch (25 mm) **OR** 1-1/2 inches (38 mm) **OR** 2 inches (51 mm) **OR** 3 inches (76 mm) **OR** As indicated on Drawings **OR** As indicated in a schedule, **as directed**.
 10. Modular Size: 24 by 24 inches (610 by 610 mm) **OR** 24 by 48 inches (610 by 1220 mm) **OR** 600 by 600 mm **OR** 600 by 1200 mm **OR** As indicated on Drawings **OR** As indicated in a schedule, **as directed**.
 11. Antimicrobial Treatment: Broad spectrum fungicide and bactericide **OR** Fungicide, **as directed**, based.
- C. Metal Suspension Systems, General
1. Recycled Content: Provide products made from steel sheet with average recycled content such that postconsumer recycled content plus one-half of preconsumer recycled content is not less than 25 percent.
 2. Metal Suspension System Standard: Provide manufacturer's standard direct-hung metal suspension systems of types, structural classifications, and finishes indicated that comply with applicable requirements in ASTM C 635.
 3. Finishes and Colors, General: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes. Provide manufacturer's standard factory-applied finish for type of system indicated.
 - a. High-Humidity Finish: Comply with ASTM C 635 requirements for "Coating Classification for Severe Environment Performance" where high-humidity finishes are indicated.
 4. Attachment Devices: Size for five times the design load indicated in ASTM C 635, Table 1, "Direct Hung," unless otherwise indicated. Comply with seismic design requirements.
 - a. Anchors in Concrete: Anchors of type and material indicated below, with holes or loops for attaching hangers of type indicated and with capability to sustain, without failure, a load equal to five times that imposed by ceiling construction, as determined by testing per

ASTM E 488 or ASTM E 1512 as applicable, conducted by a qualified testing and inspecting agency.

- 1) Type: Cast-in-place **OR** Postinstalled expansion **OR** Postinstalled bonded, **as directed**, anchors.
- 2) Corrosion Protection: Carbon-steel components zinc plated to comply with ASTM B 633, Class Fe/Zn 5 (0.005 mm) for Class SC 1 service condition.
- 3) Corrosion Protection: Stainless-steel components complying with ASTM F 593 and ASTM F 594, Group 1 Alloy 304 or 316 for bolts; Alloy 304 or 316 for anchor.
- 4) Corrosion Protection: Components fabricated from nickel-copper-alloy rods complying with ASTM B 164 for UNS No. N04400 alloy.
- b. Power-Actuated Fasteners in Concrete: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with clips or other accessory devices for attaching hangers of type indicated, and with capability to sustain, without failure, a load equal to 10 times that imposed by ceiling construction, as determined by testing per ASTM E 1190, conducted by a qualified testing and inspecting agency.
5. Wire Hangers, Braces, and Ties: Provide wires complying with the following requirements:
 - a. Zinc-Coated, Carbon-Steel Wire: ASTM A 641/A 641M, Class 1 zinc coating, soft temper.
OR
Stainless-Steel Wire: ASTM A 580/A 580M, Type 304, nonmagnetic.
OR
Nickel-Copper-Alloy Wire: ASTM B 164, nickel-copper-alloy UNS No. N04400.
 - b. Size: Select wire diameter so its stress at 3 times hanger design load (ASTM C 635, Table 1, "Direct Hung") will be less than yield stress of wire, but provide not less than **0.106-inch- (2.69-mm-)** **OR** **0.135-inch- (3.5-mm-)**, **as directed**, diameter wire.
6. Hanger Rods **OR** Flat Hangers, **as directed**: Mild steel, zinc coated or protected with rust-inhibitive paint.
7. Angle Hangers: Angles with legs not less than **7/8-inch (22 mm)** wide; formed with **0.04-inch- (1-mm-)** thick, galvanized steel sheet complying with ASTM A 653/A 653M, **G90 (Z275)** coating designation; with bolted connections and **5/16-inch- (8-mm-)** diameter bolts.
8. Seismic Stabilizer Bars: Manufacturer's standard perimeter stabilizers designed to accommodate seismic forces.
9. Seismic Struts: Manufacturer's standard compression struts designed to accommodate seismic forces.
10. Seismic Clips: Manufacturer's standard seismic clips designed and spaced to secure acoustical panels in-place.
11. Hold-Down Clips: Where indicated, provide manufacturer's standard hold-down clips spaced **24 inches (610 mm)** o.c. on all cross tees.
12. Impact Clips: Where indicated, provide manufacturer's standard impact-clip system designed to absorb impact forces against acoustical panels.
13. Clean-Room Gasket System: Where indicated, provide manufacturer's standard system, including manufacturer's standard **OR** closed-cell PVC **OR** neoprene **OR** antimicrobial, **as directed**, gasket and related adhesives, tapes, seals, and retention clips, designed to seal out foreign material from and maintain positive pressure in clean room.
- D. Metal Suspension System For Acoustical Panel Ceiling
 1. Wide-Face, Capped, Double-Web, Fire-Rated, **as directed**, Steel Suspension System: Main and cross runners roll formed from cold-rolled steel sheet, prepainted, electrolytically zinc coated, or hot-dip galvanized according to ASTM A 653/A 653M, not less than **G30 (Z90)** coating designation, with prefinished **15/16-inch- (24-mm-)** wide metal caps on flanges.
 - a. Structural Classification: Intermediate-duty **OR** Heavy-duty, **as directed**, system.
 - b. End Condition of Cross Runners: Override (stepped) **OR** Butt-edge, **as directed**, type.
 - c. Face Design: Flat, flush.
 - d. Cap Material: Steel **OR** Aluminum, **as directed**, cold-rolled sheet.
 - e. Cap Finish: Painted white **OR** Painted in color as selected from manufacturer's full range **OR** Painted to match color indicated by manufacturer's designation **OR** Painted to match

- color of acoustical unit **OR** Plated with metallic finish, as selected from manufacturer's full range **OR** Plated with metallic finish indicated by manufacturer's designation **OR** Natural finish for aluminum, **as directed**.
2. Narrow-Face, Capped, Double-Web, Steel Suspension System: Main and cross runners roll formed from cold-rolled steel sheet, prepainted, electrolytically zinc coated, or hot-dip galvanized according to ASTM A 653/A 653M, not less than **G30 (Z90)** coating designation, with prefinished **9/16-inch- (15-mm-)** wide metal caps on flanges.
 - a. Structural Classification: Intermediate-duty **OR** Heavy-duty, **as directed**, system.
 - b. End Condition of Cross Runners: Override (stepped) **OR** Butt-edge, **as directed**, type.
 - c. Face Design: Flat, flush **OR** Flanges formed with an integral center reveal, **as directed**.
 - d. Cap Material: Steel **OR** Aluminum, **as directed**, cold-rolled sheet.
 - e. Cap Finish: Painted white **OR** Painted in color as selected from manufacturer's full range **OR** Painted to match color indicated by manufacturer's designation **OR** Painted to match color of acoustical unit **OR** Plated with metallic finish, as selected from manufacturer's full range **OR** Plated with metallic finish indicated by manufacturer's designation **OR** Natural finish for aluminum, **as directed**.
 3. Narrow-Face, Steel-Capped, Double-Web, Fire-Rated Steel Suspension System: Main and cross runners roll formed from cold-rolled steel sheet, prepainted, electrolytically zinc coated, or hot-dip galvanized according to ASTM A 653/A 653M, not less than **G30 (Z90)** coating designation, with prefinished, cold-rolled, **9/16-inch- (15-mm-)** wide metal caps on flanges.
 - a. Structural Classification: Intermediate-duty system.
 - b. Face Design: Flat, flush.
 - c. Cap Finish: Painted white **OR** Painted in color as selected from manufacturer's full range **OR** Painted to match color indicated by manufacturer's designation **OR** Painted to match color of acoustical unit **OR** Plated with metallic finish, as selected from manufacturer's full range **OR** Plated with metallic finish indicated by manufacturer's designation **OR** Natural finish for aluminum, **as directed**.
 4. Narrow-Face, Uncapped, Double-Web, Steel Suspension System: Main and cross runners roll formed from cold-rolled steel sheet, prepainted, electrolytically zinc coated, or hot-dip galvanized, to produce structural members with **9/16-inch- (15-mm-)** wide faces.
 - a. Structural Classification: Intermediate-duty **OR** Heavy-duty, **as directed**, system.
 - b. Face Design: With **1/8-inch- (3.2-mm-)** wide, slotted, box-shaped flange **OR** With **1/4-inch- (6.35-mm-)** wide, slotted, box-shaped flange **OR** Flanges formed in stepped design with a center protrusion projecting **19/64 inch (7.54 mm)** below flange surfaces supporting panel faces and forming **3/16-inch- (4.76-mm-)** wide reveals between edges of protrusion and those of panels, **as directed**.
 - c. Face Finish: Painted white **OR** in color as selected from manufacturer's full range **OR** to match color indicated by manufacturer's designation **OR** to match color of acoustical unit, **as directed**.
 - d. Reveal Finish: Painted to match flange color **OR** white **OR** black **OR** in color other than flange color as selected from manufacturer's full range of contrasting reveal colors, **as directed**.
 5. Wide-Face, Capped, Double-Web, Fire-Rated, **as directed**, Hot-Dip Galvanized, **G60 (Z180)**, Steel Suspension System: Main and cross runners roll formed from cold-rolled steel sheet, hot-dip galvanized according to ASTM A 653/A 653M, **G60 (Z180)** coating designation, with prefinished, cold-rolled, **15/16-inch- (24-mm-)** wide, aluminum caps on flanges.
 - a. Structural Classification: Intermediate-duty **OR** Heavy-duty, **as directed**, system.
 - b. Face Design: Flat, flush.
 - c. Face Finish: Painted white **OR** Painted to match color indicated by manufacturer's designation **OR** Painted to match color of acoustical unit **OR** Natural finish, **as directed**.
 6. Wide-Face, Single-Web, Steel Suspension System: Main and cross runners roll formed from cold-rolled steel sheet electrolytically zinc coated, with prefinished flanges of width indicated.
 - a. Structural Classification: Heavy-duty system.
 - b. Face Finish: Painted white **OR** black, **as directed**.

7. Wide-Face, Capped, Double-Web, Stainless-Steel Suspension System: Main and cross runners roll formed from Type 304 or 316, stainless-steel sheet, with prefinished **15/16-inch- (24-mm-)** wide, stainless-steel caps on flanges.
 - a. Structural Classification: Intermediate-duty system.
 - b. Face Design: Flat, flush.
8. Narrow-Face, Single-Web, Extruded-Aluminum Suspension System: Main and cross runners formed from extruded aluminum to produce structural members with **9/16-inch- (15-mm-)** wide faces.
 - a. Structural Classification: Intermediate-duty **OR** Heavy-duty, **as directed**, system.
 - b. Face Design: Screw-slot profile.
 - c. Face Finish: Painted white **OR** Satin anodized per AA-M12C22A31 and AAMA 611, **as directed**.
 - d. Reveal Finish: Match face finish **OR** Painted white **OR** Painted black, **as directed**.
9. Extra-Wide-Face, Double-Web **OR** Single-Web, **as directed**, Metal Suspension System: Main and cross runners formed from extruded aluminum **OR** aluminum-capped steel **OR** steel-capped steel, **as directed**, to produce structural members with **1-1/2-inch- (50-mm-)** **OR** **2-inch- (50-mm-)**, **as directed**, wide flanges.
 - a. Structural Classification: Intermediate-duty **OR** Heavy-duty, **as directed**, system.
 - b. Face Design: Flat, flush.
 - c. Face Finish: Painted white **OR** Satin anodized per AA-M12C22A31 and AAMA 611, **as directed**.
 - d. Gasket System: Clean-room type.

E. Metal Edge Moldings And Trim

1. Roll-Formed, Sheet-Metal Edge Moldings and Trim: Type and profile indicated or, if not indicated, manufacturer's standard moldings for edges and penetrations that comply with seismic design requirements; formed from sheet metal of same material, finish, and color as that used for exposed flanges of suspension system runners.
 - a. Provide manufacturer's standard edge moldings that fit acoustical panel edge details and suspension systems indicated and that match width and configuration of exposed runners, unless otherwise indicated.
 - b. For lay-in panels with reveal edge details, provide stepped edge molding that forms reveal of same depth and width as that formed between edge of panel and flange at exposed suspension member.
 - c. For circular penetrations of ceiling, provide edge moldings fabricated to diameter required to fit penetration exactly.
2. Extruded-Aluminum Edge Moldings and Trim: Where indicated, provide manufacturer's extruded-aluminum edge moldings and trim of profile indicated or referenced by manufacturer's designations, including splice plates, corner pieces, and attachment and other clips, complying with seismic design requirements and the following:
 - a. Aluminum Alloy: Alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated, and with not less than the strength and durability properties of aluminum extrusions complying with **ASTM B 221 (ASTM B 221M)** for Alloy and Temper 6063-T5.
 - b. Finish designations prefixed by AA comply with system established by the Aluminum Association for designating aluminum finishes.
 - c. Conversion-Coated Finish: AA-M12C42 (Chemical Finish: cleaned with inhibited chemicals; acid-chromate-fluoride-phosphate conversion coating).
 - d. Conversion-Coated and Factory-Primed Finish: AA-M12C42R1x (Chemical Finish: cleaned with inhibited chemicals; acid-chromate-fluoride-phosphate conversion coating; organic coating as follows):
 - 1) Manufacturer's standard, factory-applied prime-coat finish ready for field painting.
 - e. Class II, Clear Anodic Finish: AA-M12C22A31 (Mechanical Finish: nonspecular as fabricated; Chemical Finish: etched, medium matte; Anodic Coating: Architectural Class II, clear coating 0.010 mm or thicker) complying with AAMA 611.

- f. Baked-Enamel Finish: AA-C12C42R1x (Chemical Finish: cleaned with inhibited chemicals; Chemical Finish: acid-chromate-fluoride-phosphate conversion coating; organic coating: as specified below). Apply baked enamel complying with paint manufacturer's written instructions for cleaning, conversion coating, and painting.
 - 1) Organic Coating: Thermosetting, primer/topcoat system with a minimum dry film thickness of **0.8 to 1.2 mils** (0.02 to 0.03 mm).

F. Acoustical Sealant

1. Acoustical Sealant for Exposed and Concealed Joints: Manufacturer's standard nonsag, paintable, nonstaining latex sealant, with a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24), complying with ASTM C 834 and effective in reducing airborne sound transmission through perimeter joints and openings in building construction as demonstrated by testing representative assemblies according to ASTM E 90.
2. Acoustical Sealant for Concealed Joints: Manufacturer's standard nondrying, nonhardening, nonskinning, nonstaining, gunnable, synthetic-rubber sealant, with a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24), recommended for sealing interior concealed joints to reduce airborne sound transmission.

1.3 EXECUTION

A. Preparation

1. Measure each ceiling area and establish layout of acoustical panels to balance border widths at opposite edges of each ceiling. Avoid using less-than-half-width panels at borders, and comply with layout shown on reflected ceiling plans.

B. Installation

1. General: Install acoustical panel ceilings to comply with ASTM C 636 **OR** IBC Standard, **as directed**, and seismic design requirements indicated, per manufacturer's written instructions and CISCA's "Ceiling Systems Handbook."
 - a. Fire-Rated Assembly: Install fire-rated ceiling systems according to tested fire-rated design.
2. Suspend ceiling hangers from building's structural members and as follows:
 - a. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structure or of ceiling suspension system.
 - b. Splay hangers only where required to miss obstructions; offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.
 - c. Splay hangers only where required and, if permitted with fire-resistance-rated ceilings, to miss obstructions; offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.
 - d. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with location of hangers at spacings required to support standard suspension system members, install supplemental suspension members and hangers in form of trapezes or equivalent devices.
 - e. Secure wire hangers to ceiling suspension members and to supports above with a minimum of three tight turns. Connect hangers directly either to structures or to inserts, eye screws, or other devices that are secure and appropriate for substrate and that will not deteriorate or otherwise fail due to age, corrosion, or elevated temperatures.
 - f. Secure flat, angle, channel, and rod hangers to structure, including intermediate framing members, by attaching to inserts, eye screws, or other devices that are secure and appropriate for both structure to which hangers are attached and type of hanger involved. Install hangers in a manner that will not cause them to deteriorate or fail due to age, corrosion, or elevated temperatures.
 - g. Do not support ceilings directly from permanent metal forms or floor deck. Fasten hangers to cast-in-place hanger inserts, postinstalled mechanical or adhesive anchors, or power-actuated fasteners that extend through forms into concrete.

- h. When steel framing does not permit installation of hanger wires at spacing required, install carrying channels or other supplemental support for attachment of hanger wires.
- i. Do not attach hangers to steel deck tabs.
- j. Do not attach hangers to steel roof deck. Attach hangers to structural members.
- k. Space hangers not more than **48 inches (1200 mm)** o.c. along each member supported directly from hangers, unless otherwise indicated; provide hangers not more than **8 inches (200 mm)** from ends of each member.
- l. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced standards and publications.
- 3. Secure bracing wires to ceiling suspension members and to supports with a minimum of four tight turns. Suspend bracing from building's structural members as required for hangers, without attaching to permanent metal forms, steel deck, or steel deck tabs. Fasten bracing wires into concrete with cast-in-place or postinstalled anchors.
- 4. Install edge moldings and trim of type indicated at perimeter of acoustical ceiling area and where necessary to conceal edges of acoustical panels.
 - a. Apply acoustical sealant in a continuous ribbon concealed on back of vertical legs of moldings before they are installed.
 - b. Screw attach moldings to substrate at intervals not more than **16 inches (400 mm)** o.c. and not more than **3 inches (75 mm)** from ends, leveling with ceiling suspension system to a tolerance of **1/8 inch in 12 feet (3.2 mm in 3.6 m)**. Miter corners accurately and connect securely.
 - c. Do not use exposed fasteners, including pop rivets, on moldings and trim.
- 5. Install suspension system runners so they are square and securely interlocked with one another. Remove and replace dented, bent, or kinked members.
- 6. Install acoustical panels with undamaged edges and fit accurately into suspension system runners and edge moldings. Scribe and cut panels at borders and penetrations to provide a neat, precise fit.
 - a. Arrange directionally patterned acoustical panels as follows:
 - 1) As indicated on reflected ceiling plans.
OR
Install panels with pattern running in one direction parallel to long **OR** short, **as directed**, axis of space.
OR
Install panels in a basket-weave pattern.
 - b. For square-edged panels, install panels with edges fully hidden from view by flanges of suspension system runners and moldings.
 - c. For reveal-edged panels on suspension system runners, install panels with bottom of reveal in firm contact with top surface of runner flanges.
 - d. For reveal-edged panels on suspension system members with box-shaped flanges, install panels with reveal surfaces in firm contact with suspension system surfaces and panel faces flush with bottom face of runners.
 - e. Paint cut edges of panel remaining exposed after installation; match color of exposed panel surfaces using coating recommended in writing for this purpose by acoustical panel manufacturer.
 - f. Install hold-down clips in areas indicated, in areas required by authorities having jurisdiction, and for fire-resistance ratings; space as recommended by panel manufacturer's written instructions, unless otherwise indicated.
 - g. Install clean-room gasket system in areas indicated, sealing each panel and fixture as recommended by panel manufacturer's written instructions.
 - h. Protect lighting fixtures and air ducts to comply with requirements indicated for fire-resistance-rated assembly.

C. Field Quality Control

- 1. Testing Agency: Engage a qualified testing agency to perform tests and inspections and prepare test reports.

2. Tests and Inspections: Testing and inspecting of completed installations of acoustical panel ceiling hangers and anchors and fasteners shall take place in successive stages, in areas of extent and using methods as follows. Do not proceed with installations of acoustical panel ceiling hangers for the next area until test results for previously completed installations of acoustical panel ceiling hangers show compliance with requirements.
 - a. Extent of Each Test Area: When installation of ceiling suspension systems on each floor has reached 20 percent completion but no panels have been installed.
 - 1) Within each test area, testing agency will select 1 of every 10 power-actuated fasteners and postinstalled anchors used to attach hangers to concrete and will test them for 200 lbf (890 N) of tension; it will also select one of every 2 postinstalled anchors used to attach bracing wires to concrete and will test them for 440 lbf (1957 N) of tension.
 - 2) When testing discovers fasteners and anchors that do not comply with requirements, testing agency will test those anchors not previously tested until 20 pass consecutively and then will resume initial testing frequency.
3. Remove and replace acoustical panel ceiling hangers and anchors and fasteners that do not pass tests and inspections and retest as specified above.

D. Cleaning

1. Clean exposed surfaces of acoustical panel ceilings, including trim, edge moldings, and suspension system members. Comply with manufacturer's written instructions for cleaning and touchup of minor finish damage. Remove and replace ceiling components that cannot be successfully cleaned and repaired to permanently eliminate evidence of damage.

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SECTION 09 51 23 00 - ACOUSTICAL TILE CEILINGS

1.1 GENERAL

A. Description Of Work

1. This specification covers the furnishing and installation of materials for acoustical tile ceilings. Products shall be as follows or as directed by the Owner. Installation procedures shall be in accordance with the product manufacturer's recommendations. Demolition and removal of materials shall be as required to support the work.

B. Summary

1. This Section includes acoustical tiles for ceilings and the following:
 - a. Concealed suspension systems.
 - b. Direct attachment of tiles to substrates with adhesive.
 - c. Direct attachment of tiles to substrates with staples.
2. Products furnished, but not installed under this Section, include anchors, clips, and other ceiling attachment devices to be cast in concrete at ceilings.

C. Definitions

1. AC: Articulation Class.
2. CAC: Ceiling Attenuation Class.
3. LR: Light-Reflectance coefficient.
4. NRC: Noise Reduction Coefficient.

D. Submittals

1. Product Data: For each type of product indicated.
2. Coordination Drawings: Drawn to scale and coordinating acoustical tile ceiling installation with hanger attachment to building structure and ceiling mounted items. Show size and location of initial access modules.
3. Samples: For each exposed finish.
4. LEED Submittals:
 - a. Product Data for Credit MR 4.1 and MR 4.2, **as directed**: For products having recycled content, documentation indicating percentages by weight of postconsumer and preconsumer recycled content.
 - 1) Include statement indicating costs for each product having recycled content.
 - b. Product Data for Credit EQ 4.1: For adhesives and sealants, including printed statement of VOC content.
5. Field quality-control test reports.
6. Product test reports.
7. Research/evaluation reports.
8. Maintenance data.

E. Quality Assurance

1. Acoustical Testing Agency Qualifications: An independent testing laboratory, or an NVLAP-accredited laboratory, with the experience and capability to conduct the testing indicated. NVLAP-accredited laboratories must document accreditation, based on a "Certificate of Accreditation" and a "Scope of Accreditation" listing the test methods specified.
2. Fire-Test-Response Characteristics: Provide acoustical tile ceilings that comply with the following requirements:
 - a. Fire-Resistance Characteristics: Where indicated, provide acoustical tile ceilings identical to those of assemblies tested for fire resistance per ASTM E 119 by UL or another testing and inspecting agency acceptable to authorities having jurisdiction.
 - 1) Fire-Resistance Ratings: Indicated by design designations from UL's "Fire Resistance Directory" or from the listings of another testing and inspecting agency.

- 2) Identify materials with appropriate markings of applicable testing and inspecting agency.
 - b. Surface-Burning Characteristics: Provide acoustical tiles with the following surface-burning characteristics complying with ASTM E 1264 for Class A **OR** B **OR** C, **as directed**, materials as determined by testing identical products per ASTM E 84:
 - 1) Smoke-Developed Index: 450 or less.
 3. Seismic Standard: Provide acoustical tile ceilings designed and installed to withstand the effects of earthquake motions according to the following:
 - a. Standard for Ceiling Suspension Systems Requiring Seismic Restraint: Comply with ASTM E 580.
 - b. CISCA's Recommendations for Acoustical Ceilings: Comply with CISCA's "Recommendations for Direct-Hung Acoustical Tile and Lay-in Panel Ceilings--Seismic Zones 0-2."
 - c. CISCA's Guidelines for Systems Requiring Seismic Restraint: Comply with CISCA's "Guidelines for Seismic Restraint of Direct-Hung Suspended Ceiling Assemblies--Seismic Zones 3 & 4."
 - d. IBC Standard for Metal Suspension Systems for Acoustical Tile and for Lay-in Panel Ceilings.
 - e. ASCE 7, "Minimum Design Loads for Buildings and Other Structures": Section 9, "Earthquake Loads."
 4. Preinstallation Conference: Conduct conference at Project site.
- F. Delivery, Storage, And Handling
1. Deliver acoustical tiles, suspension system components, and accessories to Project site in original, unopened packages and store them in a fully enclosed, conditioned space where they will be protected against damage from moisture, humidity, temperature extremes, direct sunlight, surface contamination, and other causes.
 2. Before installing acoustical tiles, permit them to reach room temperature and a stabilized moisture content.
 3. Handle acoustical tiles carefully to avoid chipping edges or damaging units in any way.

1.2 PRODUCTS

A. Acoustical Tiles, General

1. Acoustical Tile Standard: Provide manufacturer's standard tiles of configuration indicated that comply with ASTM E 1264 classifications as designated by types, patterns, acoustical ratings, and light reflectances, unless otherwise indicated.
 - a. Mounting Method for Measuring NRC: Type E-400; plenum mounting in which face of test specimen is **15-3/4 inches (400 mm)** away from test surface per ASTM E 795.
2. Acoustical Tile Colors and Patterns: Match appearance characteristics indicated for each product type.
 - a. Where appearance characteristics of acoustical tiles are indicated by referencing pattern designations in ASTM E 1264 and not manufacturers' proprietary product designations, provide products selected by the Owner from each manufacturer's full range that comply with requirements indicated for type, pattern, color, light reflectance, acoustical performance, edge detail, and size.
3. Broad Spectrum Antimicrobial Fungicide and Bactericide Treatment: Provide acoustical tiles treated with manufacturer's standard antimicrobial formulation that inhibits fungus, mold, mildew, and gram-positive and gram-negative bacteria and showing no mold, mildew, or bacterial growth when tested according to ASTM D 3273 and evaluated according to ASTM D 3274 or ASTM G 21.
4. Antimicrobial Fungicide Treatment: Provide acoustical tiles with face and back surfaces coated with antimicrobial treatment consisting of manufacturer's standard formulation with fungicide

added to inhibit growth of mold and mildew and showing no mold or mildew growth when tested according to ASTM D 3273 and evaluated according to ASTM D 3274 or ASTM G 21.

B. Acoustical Tiles For Acoustical Tile Ceiling

1. Classification: Provide fire-resistance-rated, **as directed**, tiles complying with ASTM E 1264 for type, form, and pattern as follows:
 - a. Type III, mineral base with painted finish; Form 1, nodular **OR** 2, water felted **OR** 4, cast or molded, **as directed**.
 - b. Pattern: C (perforated, small holes) **OR** CD (perforated, small holes and fissured) **OR** CE (perforated, small holes and lightly textured) **OR** D (fissured) **OR** E (lightly textured) **OR** F (heavily textured) **OR** G (smooth) **OR** I (embossed) **OR** J (embossed-in-register) **OR** As indicated by manufacturer's designation, **as directed**.
2. Color: White **OR** As selected from manufacturer's full range **OR** Match sample **OR** As indicated by manufacturer's designation **OR** As indicated on Drawings **OR** As indicated in a schedule, **as directed**.
3. LR: Not less than 0.65 **OR** 0.70 **OR** 0.75 **OR** 0.80, **as directed**.
4. NRC: Not less than 0.50 **OR** 0.55 **OR** 0.60 **OR** 0.65 **OR** 0.70, **as directed**.
5. CAC: Not less than 20 **OR** 25 **OR** 30 **OR** 35 **OR** 40, **as directed**.
6. AC: Not less than 170 **OR** 180 **OR** 190 **OR** 200 **OR** 210, **as directed**.
7. Edge/Joint Detail: Square, kerfed and rabbeted, or tongue and grooved, or butt **OR** Beveled, kerfed and rabbeted, or tongue and grooved, or butt **OR** Beveled, kerfed and rabbeted long edges and square, butt on short edges, **as directed**.
8. Thickness: **5/8 inch (15 mm)** **OR** **3/4 inch (19 mm)** **OR** As indicated on Drawings **OR** As indicated in a schedule, **as directed**.
9. Modular Size: **12 by 12 inches (305 by 305 mm)** **OR** 300 by 300 mm **OR** As indicated on Drawings **OR** As indicated in a schedule, **as directed**.
10. Antimicrobial Treatment: Broad spectrum fungicide and bactericide **OR** Fungicide, **as directed**, based.

C. Metal Suspension Systems, General

1. Recycled Content: Provide products made from steel sheet with average recycled content such that postconsumer recycled content plus one-half of preconsumer recycled content is not less than 25 percent.
2. Metal Suspension System Standard: Provide manufacturer's standard metal suspension systems of types, structural classifications, and finishes indicated that comply with applicable requirements in ASTM C 635.
3. Finishes and Colors, General: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes. Provide manufacturer's standard factory-applied finish for type of system indicated.
4. Attachment Devices: Size for five times the design load indicated in ASTM C 635, Table 1, "Direct Hung," unless otherwise indicated. Comply with seismic design requirements.
 - a. Anchors in Concrete: Anchors of type and material indicated below, with holes or loops for attaching hangers of type indicated and with capability to sustain, without failure, a load equal to five times that imposed by ceiling construction, as determined by testing per ASTM E 488 or ASTM E 1512 as applicable, conducted by a qualified testing and inspecting agency.
 - 1) Type: Cast-in-place **OR** Postinstalled expansion **OR** Postinstalled bonded, **as directed**, anchors.
 - 2) Corrosion Protection: Carbon-steel components zinc plated to comply with ASTM B 633, Class Fe/Zn 5 (0.005 mm) for Class SC 1 service condition.
 - 3) Corrosion Protection: Stainless-steel components complying with ASTM F 593 and ASTM F 594, Group 1 Alloy 304 or 316 for bolts; Alloy 304 or 316 for anchors.
 - b. Power-Actuated Fasteners in Concrete: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with clips or other accessory devices for attaching hangers of type indicated, and with capability to sustain, without

failure, a load equal to 10 times that imposed by ceiling construction, as determined by testing per ASTM E 1190, conducted by a qualified testing and inspecting agency.

5. Wire Hangers, Braces, and Ties: Provide wires complying with the following requirements:
 - a. Zinc-Coated, Carbon-Steel Wire: ASTM A 641/A 641M, Class 1 zinc coating, soft temper.
 - b. Size: Select wire diameter so its stress at 3 times hanger design load (ASTM C 635, Table 1, "Direct Hung") will be less than yield stress of wire, but provide not less than **0.106-inch- (2.69-mm-) OR 0.135-inch- (3.5-mm-), as directed**, diameter wire.
6. Hanger Rods **OR** Flat Hangers, **as directed**: Mild steel, zinc coated or protected with rust-inhibitive paint.
7. Angle Hangers: Angles with legs not less than **7/8 inch (22 mm)** wide; formed with **0.04-inch- (1-mm-)** thick, galvanized steel sheet complying with ASTM A 653/A 653M, **G90 (Z275)** coating designation; with bolted connections and **5/16-inch- (8-mm-)** diameter bolts.
8. Seismic Struts: Manufacturer's standard compression struts designed to accommodate lateral forces.
9. Seismic Clips: Manufacturer's standard seismic clips designed and spaced to secure acoustical tiles in-place.

D. Metal Suspension System For Acoustical Tile Ceiling

1. Direct-Hung, Double-Web, Fire-Rated, **as directed**, Suspension System: Main and cross runners roll formed from and capped with cold-rolled steel sheet, prepainted, electrolytically zinc coated, or hot-dip galvanized according to ASTM A 653/A 653M, **G30 (Z90)** coating designation.
 - a. Structural Classification: Intermediate-duty **OR** Heavy-duty, **as directed**, system.
 - b. Access: Upward **OR** Downward, **as directed**, and end pivoted, **OR** side pivoted, **as directed**, with initial access openings of size indicated below and located throughout ceiling within each module formed by main and cross runners, with additional access available by progressively removing remaining acoustical tiles.
2. Indirect-Hung, Fire-Rated, **as directed**, Suspension System: Main and cross runners roll formed from cold-rolled steel sheet, prepainted, electrolytically zinc coated, or hot-dip galvanized according to ASTM A 653/A 653M, **G30 (Z90)** coating designation.
 - a. Structural Classification: Intermediate-duty **OR** Heavy-duty, **as directed**, system.
 - b. Carrying Channels: Cold-rolled steel, **0.059850-inch- (1.52-mm-)** minimum base (uncoated) metal thickness, not less than **3/16-inch- (4.7-mm-)** wide flanges by **1-1/2-inch- (38-mm-)** deep steel channels, **475 lb/1000 feet (0.707 kg/m)**, with rust-inhibitive paint finish **OR** hot-dip galvanized according to ASTM A 653/A 653M, **G60 (Z180)** coating designation, **as directed**.
 - c. Access: Where access is indicated, provide special cross runners or split splines to allow for removal of acoustical units in indicated access areas. Identify access tile with manufacturer's standard unobtrusive markers for each access unit.

E. Metal Edge Moldings And Trim

1. Roll-Formed, Sheet-Metal Edge Moldings and Trim: Type and profile indicated or, if not indicated, manufacturer's standard moldings for edges and penetrations that comply with seismic design requirements; formed from sheet metal of same material, finish, and color as that used for exposed flanges of suspension system runners.
 - a. Provide manufacturer's standard edge moldings that fit acoustical tile edge details and suspension systems indicated and that match width and configuration of exposed runners, unless otherwise indicated.
 - b. For circular penetrations of ceiling, provide edge moldings fabricated to diameter required to fit penetration exactly.
2. Extruded-Aluminum Edge Moldings and Trim: Where indicated, provide manufacturer's extruded-aluminum edge moldings and trim of profile indicated or referenced by manufacturer's designations, including splice plates, corner pieces, and attachment and other clips, complying with seismic design requirements and the following:
 - a. Aluminum Alloy: Alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated, and with not less than the strength and durability

properties of aluminum extrusions complying with **ASTM B 221 (ASTM B 221M)** for Alloy and Temper 6063-T5.

- b. Finish designations prefixed by AA comply with system established by the Aluminum Association for designating aluminum finishes.
- c. Conversion-Coated Finish: AA-M12C42 (Chemical Finish: cleaned with inhibited chemicals; acid-chromate-fluoride-phosphate conversion coating).
- d. Conversion-Coated and Factory-Primed Finish: AA-M12C42R1x (Chemical Finish: cleaned with inhibited chemicals; acid-chromate-fluoride-phosphate conversion coating; organic coating as follows):
 - 1) Manufacturer's standard factory-applied prime-coat finish ready for field painting.
- e. Class II, Clear Anodic Finish: AA-M12C22A31 (Mechanical Finish: nonspecular as fabricated; Chemical Finish: etched, medium matte; Anodic Coating: Architectural Class II, clear coating 0.010 mm or thicker) complying with AAMA 611.
- f. Baked-Enamel Finish: AA-C12C42R1x (Chemical Finish: cleaned with inhibited chemicals; Chemical Finish: acid-chromate-fluoride-phosphate conversion coating; organic coating: as specified below). Apply baked enamel complying with paint manufacturer's written instructions for cleaning, conversion coating, and painting.
 - 1) Organic Coating: Thermosetting, enamel primer/topcoat system with a minimum dry film thickness of **0.8 to 1.2 mils (0.02 to 0.03 mm)**.

F. Acoustical Sealant

1. Acoustical Sealant for Exposed and Concealed Joints: Manufacturer's standard nonsag, paintable, nonstaining latex sealant, with a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24), complying with ASTM C 834 and effective in reducing airborne sound transmission through perimeter joints and openings in building construction as demonstrated by testing representative assemblies according to ASTM E 90.
2. Acoustical Sealant for Concealed Joints: Manufacturer's standard nondrying, nonhardening, nonskinning, nonstaining, gunnable, synthetic-rubber sealant, with a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24), recommended for sealing interior concealed joints to reduce airborne sound transmission.

G. Miscellaneous Materials

1. Tile Adhesive: Type recommended by tile manufacturer, bearing UL label for Class 0-25 flame spread.
 - a. Use adhesives that have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
2. Staples: **5/16-inch- (8-mm-)** long, divergent-point staples.

1.3 EXECUTION

A. Preparation

1. Testing Substrates: Before installing adhesively applied tiles on wet-placed substrates such as cast-in-place concrete or plaster, test and verify that moisture level is below tile manufacturer's recommended limits.
2. Measure each ceiling area and establish layout of acoustical tiles to balance border widths at opposite edges of each ceiling. Avoid using less-than-half-width tiles at borders, and comply with layout shown on reflected ceiling plans.

B. Installation, Suspended Acoustical Tile Ceilings

1. General: Install acoustical tile ceilings to comply with ASTM C 636 **OR** IBC Standard, **as directed**, and seismic design requirements indicated, per manufacturer's written instructions and CISCA's "Ceiling Systems Handbook."
 - a. Fire-Rated Assembly: Install fire-rated ceiling systems according to tested fire-rated design.
2. Suspend ceiling hangers from building's structural members and as follows:

- a. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structure or of ceiling suspension system.
- b. Splay hangers only where required to miss obstructions; offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.
OR
Splay hangers only where required and, if permitted with fire-resistance-rated ceilings, to miss obstructions; offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.
- c. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with location of hangers at spacings required to support standard suspension system members, install supplemental suspension members and hangers in form of trapezes or equivalent devices.
- d. Secure wire hangers to ceiling suspension members and to supports above with a minimum of three tight turns. Connect hangers directly either to structures or to inserts, eye screws, or other devices that are secure and appropriate for substrate and that will not deteriorate or otherwise fail due to age, corrosion, or elevated temperatures.
OR
Secure flat, angle, channel, and rod hangers to structure, including intermediate framing members, by attaching to inserts, eye screws, or other devices that are secure and appropriate for both structure to which hangers are attached and type of hanger involved. Install hangers in a manner that will not cause them to deteriorate or fail due to age, corrosion, or elevated temperatures.
- e. Do not support ceilings directly from permanent metal forms or floor deck. Fasten hangers to cast-in-place hanger inserts, postinstalled mechanical or adhesive anchors, or power-actuated fasteners that extend through forms into concrete.
- f. When steel framing does not permit installation of hanger wires at spacing required, install carrying channels or other supplemental support for attachment of hanger wires.
- g. Do not attach hangers to steel deck tabs.
- h. Do not attach hangers to steel roof deck. Attach hangers to structural members.
- i. Space hangers not more than **48 inches (1200 mm)** o.c. along each member supported directly from hangers, unless otherwise indicated; provide hangers not more than **8 inches (200 mm)** from ends of each member.
- j. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced standards and publications.
3. Secure bracing wires to ceiling suspension members and to supports with a minimum of four tight turns. Suspend bracing from building's structural members as required for hangers, without attaching to permanent metal forms, steel deck, or steel deck tabs. Fasten bracing wires into concrete with cast-in-place or postinstalled anchors.
4. Install edge moldings and trim of type indicated at perimeter of acoustical tile ceiling area and where necessary to conceal edges of acoustical tiles.
 - a. Apply acoustical sealant in a continuous ribbon concealed on back of vertical legs of moldings before they are installed.
 - b. Screw attach moldings to substrate at intervals not more than **16 inches (400 mm)** o.c. and not more than **3 inches (75 mm)** from ends, leveling with ceiling suspension system to a tolerance of **1/8 inch in 12 feet (3.2 mm in 3.6 m)**. Miter corners accurately and connect securely.
 - c. Do not use exposed fasteners, including pop rivets, on moldings and trim.
5. Install suspension system runners so they are square and securely interlocked with one another. Remove and replace dented, bent, or kinked members.
6. Arrange directionally patterned acoustical tiles as follows:
 - a. As indicated on reflected ceiling plans.
OR
Install tiles with pattern running in one direction parallel to long **OR** short, **as directed**, axis of space.
OR

- Install tiles in a basket-weave pattern.
7. Install acoustical tiles in coordination with suspension system and exposed moldings and trim. Place splines or suspension system flanges into kerfed edges so tile-to-tile joints are closed by double lap of material.
 - a. Fit adjoining tile to form flush, tight joints. Scribe and cut tile for accurate fit at borders and around penetrations through tile.
 - b. Hold tile field in compression by inserting leaf-type, spring-steel spacers between tile and moldings, spaced **12 inches (305 mm)** o.c.
 - c. Protect lighting fixtures and air ducts to comply with requirements indicated for fire-resistance-rated assembly.
- C. Installation, Directly Attached Acoustical Tile Ceilings
1. Adhesive Installation: Install acoustical tile by bonding to substrate, using amount of adhesive and procedure recommended in writing by tile manufacturer and as follows:
 - a. Remove loose dust from backs of tiles by brushing and prime them with a thin coat of adhesive.
 - b. Install splines in joints between tiles; maintain level of bottom surface of tiles to a tolerance of **1/8 inch in 12 feet (3 mm in 3.6 m)** and not exceeding **1/4 inch (6.35 mm)** cumulatively.
 - c. Maintain tight butt joints, aligned in both directions and coordinated with ceiling fixtures.
 2. Stapled Installation: Fasten acoustical tile to substrate using a minimum of two staples per tile that are installed in flanges of tile and as follows:
 - a. Form double-lapped joint between tiles by securely pressing tile tongues into corresponding tile grooves.
 - b. Maintain level of bottom surface of tiles to a tolerance of **1/8 inch in 12 feet (3 mm in 3.6 m)** and not exceeding **1/4 inch (6.35 mm)** cumulatively. Shim tile or correct substrate as required to maintain tolerance.
 - c. Maintain tight butt joints, aligned in both directions and coordinated with ceiling fixtures.
 3. Install edge moldings and trim of type indicated at perimeter of acoustical tile ceiling area and where necessary to conceal edges of acoustical units.
 4. Arrange directionally patterned acoustical tiles as follows:
 - a. As indicated on reflected ceiling plans.
OR
Install tiles with pattern running in one direction parallel to long axis of space.
OR
Install tiles with pattern running in one direction parallel to short axis of space.
OR
Install tiles in a basket-weave pattern.
- D. Field Quality Control
1. Testing Agency: Engage a qualified testing agency to perform tests and inspections and prepare test reports.
 2. Tests and Inspections: Testing and inspecting of completed installations of acoustical tile ceiling hangers and anchors and fasteners shall take place in successive stages, in areas of extent and using methods as follows. Do not proceed with installations of acoustical tile ceiling hangers for the next area until test results for previously completed installations of acoustical tile ceiling hangers show compliance with requirements.
 - a. Extent of Each Test Area: When installation of ceiling suspension systems on each floor has reached 20 percent completion but no tiles have been installed.
 - 1) Within each test area, testing agency will select 1 of every 10 power-actuated fasteners and postinstalled anchors used to attach hangers to concrete and will test them for **200 lbf (890 N)** of tension; it will also select one of every 2 postinstalled anchors used to attach bracing wires to concrete and will test them for **440 lbf (1957 N)** of tension.
 - 2) When testing discovers fasteners and anchors that do not comply with requirements, testing agency will test those anchors not previously tested until 20 pass consecutively and then will resume initial testing frequency.



3. Remove and replace acoustical tile ceiling hangers and anchors and fasteners that do not pass tests and inspections and retest as specified above.

E. Cleaning

1. Clean exposed surfaces of acoustical tile ceilings, including trim and edge moldings. Comply with manufacturer's written instructions for cleaning and touchup of minor finish damage. Remove and replace tiles and other ceiling components that cannot be successfully cleaned and repaired to permanently eliminate evidence of damage.

END OF SECTION 09 51 23 00

NOT FOR BID



Task	Specification	Specification Description
09 53 23 00	09 51 13 00	Acoustical Panel Ceilings

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SECTION 09 54 23 00 - ACOUSTICAL METAL PAN CEILINGS

1.1 GENERAL

A. Description Of Work

1. This specification covers the furnishing and installation of materials for acoustical metal pan ceilings. Products shall be as follows or as directed by the Owner. Installation procedures shall be in accordance with the product manufacturer's recommendations. Demolition and removal of materials shall be as required to support the work.

B. Summary

1. Section includes clip-in, lay-in, snap-in, and torsion-spring acoustical metal pans and the following suspension system for ceilings:
 - a. Direct hung, exposed tee and slot-bolt grid.
 - b. Direct-hung and Indirect-hung, concealed grid designed to support metal pans.
2. Products furnished, but not installed under this Section, include anchors, clips, and other ceiling attachment devices to be cast in concrete at ceilings.

C. Definitions

1. CAC: Ceiling Attenuation Class.
2. LR: Light Reflectance coefficient.
3. NRC: Noise Reduction Coefficient.

D. Performance Requirements

1. Structural Performance: Exterior snap-in metal pan ceilings shall withstand exterior exposure and the effects of gravity loads and the following loads and stresses without showing permanent deformation of ceiling system components including pans and suspension system; noise or metal fatigue caused by vibration, deflection, and displacement of ceiling units; or permanent damage to fasteners and anchors.
 - a. Wind Load: Uniform pressure of 20 lbf/sq. ft. (960 Pa) OR of 30 lbf/sq. ft. (1436 Pa) OR as indicated on Drawings, **as directed**, acting inward or outward.
2. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes. Base calculations on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.
 - a. Temperature Change (Range): 100 deg F (55 deg C).

E. Submittals

1. Product Data: For each type of product indicated.
2. LEED Submittals:
 - a. Product Data for Credit MR 4.1 and MR 4.2, **as directed**: For products having recycled content, documentation indicating percentages by weight of postconsumer and preconsumer recycled content.
 - 1) Include statement indicating costs for each product having recycled content.
 - b. Product Data for Credit EQ 4.1: For sealants, including printed statement of VOC content.
3. Samples: For each exposed finish.
4. Performance Data: For installed products indicated to comply with design loads and other criteria, include structural analysis and other analytical data signed and sealed by the qualified professional engineer responsible for their preparation.
5. Coordination Drawings: Drawn to scale and coordinating and showing the following:
 - a. Ceiling suspension members.
 - b. Method of attaching hangers to building structure.
 - c. Ceiling-mounted items.
 - d. Ceiling perimeter and penetrations through the ceiling; and trim and moldings.
6. Product test reports.

7. Evaluation reports.
8. Field quality-control reports.
9. Maintenance data.

F. Quality Assurance

1. Acoustical Testing Agency Qualifications: An independent testing laboratory or an NVLAP-accredited laboratory, with the experience and capability to conduct the testing indicated. NVLAP-accredited laboratories must document accreditation, based on a "Certificate of Accreditation" and a "Scope of Accreditation" listing the test methods specified.
2. Surface-Burning Characteristics: Complying with ASTM E 1264 for Class A materials as determined by testing identical products according to ASTM E 84 by UL or another testing and inspecting agency acceptable to authorities having jurisdiction.
3. Seismic Standard: Provide acoustical metal pan ceilings designed and installed to withstand the effects of earthquake motions according to the following:
 - a. Standard for Ceiling Suspension Systems Requiring Seismic Restraint: Comply with ASTM E 580.
 - b. CISCAs Recommendations for Acoustical Ceilings: Comply with CISCAs "Recommendations for Direct-Hung Acoustical Tile and Lay-in Panel Ceilings - Seismic Zones 0-2."
 - c. CISCAs Guidelines for Systems Requiring Seismic Restraint: Comply with CISCAs "Guidelines for Seismic Restraint of Direct-Hung Suspended Ceiling Assemblies - Seismic Zones 3 & 4."
 - d. IBC Standard for Metal Suspension Systems for Acoustical Tile and for Lay-in Panel Ceilings.
 - e. SEI/ASCE 7, "Minimum Design Loads for Buildings and Other Structures": Section 9, "Earthquake Loads."
4. Preinstallation Conference: Conduct conference at Project site.

G. Delivery, Storage, And Handling

1. Deliver acoustical metal pans, suspension system components, and accessories to Project site in original, unopened packages and store them in a fully enclosed, conditioned space where they will be protected against damage from moisture, humidity, temperature extremes, direct sunlight, surface contamination, and other causes.
2. Handle acoustical metal pans, suspension system components, and accessories carefully to avoid damaging units and finishes in any way.

1.2 PRODUCTS

A. Acoustical Metal Ceiling Pans

1. Acoustical Metal Pan Standard: Provide manufacturer's standard acoustical metal pans of configuration indicated that comply with ASTM E 1264 classifications as designated by types, acoustical ratings, and light reflectances unless otherwise indicated.
 - a. Mounting Method for Measuring NRC: Type E-400; plenum mounting in which face of test specimen is 15-3/4 inches (400 mm) away from test surface per ASTM E 795.
2. Sheet Metal Characteristics: For metal components exposed to view in the completed Work, provide materials with smooth, flat surfaces without blemishes. Do not use materials with exposed pitting, seam marks, roller marks, roughness, stains, or discolorations.
 - a. Aluminum Sheet: Roll-formed aluminum sheet, complying with ASTM B 209 (ASTM B 209M); alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated.
 - b. Steel Sheet: Commercial-quality, cold-rolled, carbon-steel sheet; stretcher leveled; with protective coating complying with ASTM C 635.

- 1) Recycled Content: Provide products made from steel sheet with average recycled content such that postconsumer recycled content plus one-half of preconsumer recycled content is not less than 25 percent.
- 2) Painted Finishes: Electrolytic zinc-coated steel complying with ASTM A 591/A 591M, 40Z (12G) coating, surface treatment as recommended by finish manufacturer for type of use and finish indicated.
- 3) Chemical/Mechanical Finishes: Uncoated steel sheet complying with ASTM A 1008/A 1008M with luster or bright finish as required by finisher for applying electroplating or other metallic-finishing processes.
- c. Stainless-Steel Sheet: Complying with ASTM A 240/A 240M, Type 304 **OR** Type 430, **as directed**.
3. Sound-Absorbent Fabric Layer: Provide fabric layer, sized to fit concealed surface of pan, and consisting of black, nonwoven, nonflammable, sound-absorbent material with surface-burning characteristics for flame-spread index of 25 or less and smoke-developed index of 50 or less, as determined by testing per ASTM E 84.
 - a. Bond fabric layer to panels in the factory with manufacturer's standard nonflammable adhesive.
4. Sound-Absorbent Pads: Provide width and length to completely fill concealed surface of pan, with surface-burning characteristics for flame-spread index of 25 or less and smoke-developed index of 50 or less, as determined by testing per ASTM E 84, and to comply with the following requirements:
 - a. Plastic Sheet-Wrapped Mineral-Fiber Insulation: Pads consisting of nonrigid, PVC plastic sheet encapsulating unfaced mineral-fiber insulation complying with ASTM C 553, Type I, II, or III, and as follows:
 - 1) Mineral-Fiber Type and Thickness: Glass fiber; 1 inch (25 mm) **OR** 1-1/2 inches (38 mm) **OR** 3 inches (76 mm), **as directed**.
 - 2) Mineral-Fiber Density: 3/4 lb/cu. ft. (12 kg/cu. m) **OR** 1 lb/cu. ft. (16 kg/cu. m) **OR** 1-1/2 lb/cu. ft. (24 kg/cu. m), **as directed**.
 - 3) Plastic Sheet Thickness and Color: Not less than 0.003 inch (0.076 mm); clear **OR** flat black **OR** white, **as directed**.
 - b. Unwrapped, Glass-Fiber Insulation: Black coated, unfaced, complying with ASTM C 553, Type I, II, or III; not less than 1-lb/cu. ft. (16-kg/cu. m) density; treated to be nondusting; and as follows:
 - 1) Thickness: 1 inch (25 mm) **OR** 1-1/2 inches (38 mm), **as directed**.
 - c. Spacer Grids: Provide manufacturer's standard aluminum **OR** galvanized-steel, **as directed**, grid units that provide an air cushion between metal pans and insulation pads and that act to improve sound absorption.
 - d. Sound Attenuation Panels: Provide manufacturer's standard aluminum **OR** galvanized-steel, **as directed**, unperforated metal backing unit that acts as a sound-attenuating pan to reduce the travel of sound through ceiling plenum into adjoining rooms.
 - 1) Sound-Absorbent Pads: Provide secondary sound-absorbent pads, same as specified for primary pads, for placement over sound attenuation pan to reduce plenum sound.
- B. Aluminum Pans For Acoustical Metal Pan Ceiling
 1. Classification: Units complying with ASTM E 1264 for Type VII, perforated aluminum facing (pan) with mineral- or glass-fiber-base backing **OR** Type XX, other types described as perforated aluminum facing (pan) units with sound-absorbent fabric backing **OR** Type XX, other types described as unperforated aluminum facing (pan) units, **as directed**.
 - a. Pattern: Pattern A (perforated, regularly spaced large holes), arranged in diagonal **OR** parallel, **as directed**, alignment to pan edge with uniform perforations of dimension, holes per square foot or inch, and percent open area as indicated by product designation **OR** selected from manufacturer's full range, **as directed**.
OR

Pattern: Pattern C (perforated, small holes) regularly spaced, with uniform perforations of dimension, holes per square foot or inch, and percent open area as specified by product designation **OR** selected from manufacturer's full range, **as directed**.

2. Pan Fabrication: Manufacturer's standard units of size, profile, and edge treatment indicated, formed from metal indicated and finished to comply with requirements indicated.
 - a. Lay-in Pans: Formed to set in exposed suspension grid.
 - b. Clip-in Pans: Designed to clip-in and be securely retained in exposed suspension grid by formed edges or accessory clips.
 - c. Snap-in Pans: Designed with dimples or continuous beads on flanges for snap-in, secure engagement with concealed suspension system.
 - d. Torsion-Spring-Hinged Pans: Designed to be securely retained in preslotted exposed suspension grid by torsion springs.
3. Pan Thickness: Not less than **0.020 inch (0.5 mm)** **OR** **0.025 inch (0.6 mm)** **OR** **0.032 inch (0.8 mm)** **OR** **0.040 inch (1.0 mm)**, **as directed**.
4. Pan Edge Detail: Square **OR** Beveled **OR** Reveal **OR** Manufacturer's standard edge detail, **as directed**.
OR
Pan Joint Detail: Butt **OR** Wide reveal, not less than **15/16 inch (24 mm)** wide **OR** Narrow reveal, not greater than **9/16 inch (15 mm)** wide **OR** Flush narrow reveal, not greater than **9/16 inch (15 mm)** wide, **as directed**.
5. Pan Size: **12 by 12 inches (305 by 305 mm)** **OR** **12 by 24 inches (305 by 610 mm)** **OR** **12 by 36 inches (305 by 915 mm)** **OR** **24 by 24 inches (610 by 610 mm)** **OR** **24 by 48 inches (610 by 1220 mm)** **OR** **24 by 60 inches (610 by 1525 mm)** **OR** **30 by 30 inches (760 by 760 mm)** **OR** **30 by 60 inches (760 by 1525 mm)** **OR** As indicated on Drawings, **as directed**.
6. Scoring: Score pans at intervals to appear as **12-by-12-inch (305-by-305-mm)** ceiling units.
7. Pan Face Finish: Mill **OR** Lacquered mill **OR** Clear anodized **OR** Clear mirror-anodized **OR** Painted white **OR** Painted to match color indicated by product designation **OR** Painted to match sample **OR** Painted in color selected from manufacturer's full range **OR** Bright-reflective metallic finish selected from manufacturer's full range, **as directed**.
8. LR: Not less than 0.70 **OR** 0.75, **as directed**.
9. NRC: Not less than 0.60 **OR** 0.65 **OR** 0.70 **OR** 0.75 **OR** 0.80 **OR** 0.85 **OR** 0.90 **OR** 0.95, **as directed**.
10. CAC: Not less than 35 **OR** 40 **OR** 45, **as directed**.

C. Steel Pans For Acoustical Metal Pan Ceiling

1. Classification: Units complying with ASTM E 1264 for Type V, perforated steel facing (pan) with mineral- or glass-fiber-base backing **OR** Type XX, other types described as perforated steel facing (pan) units with sound-absorbent fabric backing **OR** Type XX, other types described as unperforated steel facing (pan) units, **as directed**.
 - a. Pattern: Pattern A (perforated, regularly spaced large holes), arranged in diagonal **OR** parallel, **as directed**, alignment to pan edge with uniform perforations of dimension, holes per square foot or inch, and percent open area as indicated by product designation **OR** selected from manufacturer's full range, **as directed**.
OR
Pattern: Pattern C (perforated, small holes) regularly spaced, with uniform perforations of dimension, holes per square foot or inch, and percent open area as specified by product designation **OR** selected from manufacturer's full range, **as directed**.
2. Pan Fabrication: Manufacturer's standard units of size, profile, and edge treatment indicated, formed from metal indicated and finished to comply with requirements indicated.
 - a. Lay-in Pans: Formed to set in exposed suspension grid.
 - b. Clip-in Pans: Designed to clip-in and be securely retained in exposed suspension grid by formed edges or accessory clips.
 - c. Snap-in Pans: Designed with dimples or continuous beads on flanges for snap-in, secure engagement with concealed suspension system.

- d. Torsion-Spring-Hinged Pans: Designed to be securely retained in preslotted exposed suspension grid by torsion springs.
 3. Pan Thickness: Not less than 0.010-inch (0.25-mm) OR 0.020-inch (0.5-mm) OR 0.024-inch (0.6-mm) OR 0.030-inch (0.75-mm) OR 0.036-inch (0.9-mm), as directed, nominal thickness.
 4. Pan Edge Detail: Square OR Beveled OR Reveal OR Manufacturer's standard edge detail, as directed.
OR
Pan Joint Detail: Butt OR Wide reveal, not less than 15/16 inch (24 mm) wide OR Narrow reveal, not greater than 9/16 inch (15 mm) wide OR Flush narrow reveal, not greater than 9/16 inch (15 mm) wide, as directed.
 5. Pan Size: 12 by 12 inches (305 by 305 mm) OR 12 by 24 inches (305 by 610 mm) OR 12 by 36 inches (305 by 915 mm) OR 24 by 24 inches (610 by 610 mm) OR 24 by 48 inches (610 by 1220 mm) OR 24 by 60 inches (610 by 1525 mm) OR 30 by 30 inches (760 by 760 mm) OR 30 by 60 inches (760 by 1525 mm) OR As indicated on Drawings, as directed.
 6. Scoring: Score pans at intervals to appear as 12-by-12-inch (305-by-305-mm) ceiling units.
 7. Pan Face Finish: Painted white OR Painted to match color indicated by product designation OR Painted to match sample OR Painted in color selected from manufacturer's full range OR Plated with metallic finish, as selected from manufacturer's full range OR Bright-reflective metallic finish selected from manufacturer's full range, as directed.
 8. LR: Not less than 0.70 OR 0.75, as directed.
 9. NRC: Not less than 0.60 OR 0.65 OR 0.70 OR 0.75 OR 0.80 OR 0.85 OR 0.90 OR 0.95, as directed.
 10. CAC: Not less than 35 OR 40 OR 45, as directed.
- D. Stainless-Steel Pans For Acoustical Metal Pan Ceiling
1. Classification: Units complying with ASTM E 1264 for Type VI, perforated stainless-steel facing (pan) with mineral- or glass-fiber-base backing OR Type XX, other types described as perforated stainless-steel facing (pan) units with sound-absorbent fabric backing OR Type XX, other types described as unperforated stainless-steel facing (pan) units, as directed.
 - a. Pattern: Pattern A (perforated, regularly spaced large holes), arranged in parallel alignment to pan edge with uniform perforations of 0.109-inch (2.8-mm) diameter, 1800 holes/sq. ft. or inch, and 11.8 percent open area.
 2. Pan Fabrication: Manufacturer's standard units of size, profile, and edge treatment indicated, formed from metal indicated and finished to comply with requirements indicated.
 - a. Lay-in Pans: Formed to set in exposed suspension grid.
 - b. Clip-in Pans: Designed to clip-in and be securely retained in exposed suspension grid by formed edges or accessory clips.
 - c. Snap-in Pans: Designed with dimples or continuous beads on flanges for snap-in, secure engagement with concealed suspension system.
 - d. Torsion-Spring-Hinged Pans: Designed to be securely retained in preslotted exposed suspension grid by torsion springs.
 3. Pan Thickness: Not less than 0.019 inch (0.5 mm) OR 0.025 inch (0.65 mm) OR 0.030 inch (0.76 mm), as directed.
 4. Pan Edge Detail: Square OR Beveled OR Reveal OR Manufacturer's standard edge detail, as directed.
OR
Pan Joint Detail: Butt OR Wide reveal, not less than 15/16 inch (24 mm) wide OR Narrow reveal, not greater than 9/16 inch (15 mm) wide OR Flush narrow reveal, not greater than 9/16 inch (15 mm) wide, as directed.
 5. Pan Size: 12 by 12 inches (305 by 305 mm) OR 12 by 24 inches (305 by 610 mm) OR 12 by 36 inches (305 by 915 mm) OR 24 by 24 inches (610 by 610 mm) OR 24 by 48 inches (610 by 1220 mm) OR 30 by 30 inches (760 by 760 mm) OR As indicated on Drawings, as directed.
 6. Scoring: Score pans at intervals to appear as 12-by-12-inch (305-by-305-mm) ceiling units.
 7. Pan Face Finish: Brushed, directional polish OR Satin, directional polish OR Mirrorlike reflective, nondirectional polish, as directed.

8. NRC: Not less than 0.60 **OR** 0.65 **OR** 0.70 **OR** 0.75 **OR** 0.80 **OR** 0.85 **OR** 0.90 **OR** 0.95, **as directed**.
9. CAC: Not less than 35 **OR** 40 **OR** 45, **as directed**.

E. Metal Suspension Systems

1. Recycled Content: Provide products made from steel sheet with average recycled content such that postconsumer recycled content plus one-half of preconsumer recycled content is not less than 25 percent.
2. Metal Suspension System Standard: Provide manufacturer's standard metal suspension systems of types, structural classifications, and finishes indicated that comply with applicable ASTM C 635 requirements.
3. Suspension Systems: Provide systems complete with carriers, runners, splice sections, connector clips, alignment clips, leveling clips, hangers, molding, trim, retention clips, load-resisting struts, and other suspension components required to support ceiling units and other ceiling-supported construction.
4. Attachment Devices: Size for five times the design load indicated in ASTM C 635, Table 1, "Direct Hung," unless otherwise indicated. Comply with seismic design requirements.
 - a. Anchors in Concrete: Anchors of type and material indicated below, with holes or loops for attaching hangers of type indicated and with capability to sustain, without failure, a load equal to five times that imposed by ceiling construction, as determined by testing per ASTM E 488 or ASTM E 1512 as applicable, conducted by a qualified testing and inspecting agency.
 - 1) Type: Cast-in-place **OR** Postinstalled expansion **OR** Postinstalled bonded, **as directed**, anchors.
 - 2) Corrosion Protection: Carbon-steel components zinc plated to comply with ASTM B 633, Class Fe/Zn 5 (0.005 mm) for Class SC 1 service condition.
 - 3) Corrosion Protection: Stainless-steel components complying with ASTM F 593 and ASTM F 594, Group 1 Alloy 304 or 316 for bolts; Alloy 304 or 316 for anchor.
 - 4) Corrosion Protection: Components fabricated from nickel-copper-alloy rods complying with ASTM B 164 for UNS No. N04400 alloy.
 - b. Power-Actuated Fasteners in Concrete: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with clips or other accessory devices for attaching hangers of type indicated, and with capability to sustain, without failure, a load equal to 10 times that imposed by ceiling construction, as determined by testing per ASTM E 1190, conducted by a qualified testing and inspecting agency.
5. Wire Hangers, Braces, and Ties: Provide wires complying with the following requirements:
 - a. Zinc-Coated, Carbon-Steel Wire: ASTM A 641/A 641M, Class 1 zinc coating, soft temper.
 - b. Stainless-Steel Wire: ASTM A 580/A 580M, Type 304, nonmagnetic.
 - c. Nickel-Copper-Alloy Wire: ASTM B 164, nickel-copper-alloy UNS No. N04400.
 - d. Size: Select wire diameter so its stress at 3 times the hanger design load indicated in ASTM C 635, Table 1, Direct Hung will be less than yield stress of wire, but provide not less than **0.106-inch- (2.69-mm-)** **OR** **0.135-inch- (3.5-mm-)**, **as directed**, diameter wire.
6. Hanger Rods **OR** Flat Hangers, **as directed**: Mild steel, zinc coated or protected with rust-inhibitive paint.
7. Angle Hangers: Angles with legs not less than **7/8 inch (22 mm)** wide; formed with **0.04-inch- (1.0-mm-)** thick, galvanized-steel sheet complying with ASTM A 653/A 653M, **G90 (Z275)** coating designation; with bolted connections and **5/16-inch- (8-mm-)** diameter bolts.
8. Seismic Stabilizer Bars: Manufacturer's standard perimeter stabilizers designed to accommodate seismic forces.
9. Seismic Struts: Manufacturer's standard compression struts designed to accommodate seismic forces.
10. Seismic Clips: Manufacturer's standard seismic clips designed and spaced to secure acoustical metal pans in place.
11. Hold-Down Clips: Manufacturer's standard hold-down clips spaced to secure acoustical metal pans in place to molding and trim at perimeter **OR** at each pan, **as directed**.

12. Exposed Metal Edge Moldings and Trim: Provide exposed members as indicated or as required to comply with seismic requirements of authorities having jurisdiction, to conceal edges of and penetrations through ceiling, to conceal edges of pans and runners, for fixture trim and adapters, for fasciae at changes in ceiling height, and for other conditions; of metal and finish matching acoustical metal pan ceiling units, unless otherwise indicated.
 - a. For Circular Penetrations of Ceiling: Fabricate edge moldings to diameter required to fit penetration exactly.
- F. Direct-Hung, Standard-Grid, Metal Suspension System For Acoustical Metal Pan Ceiling
 1. Suspension System: For clip-in **OR** lay-in **OR** torsion-spring, **as directed**, pans.
 2. Wide-Face, Capped, Double-Web, Steel Suspension System: Main and cross runners roll formed from cold-rolled steel sheet, prepainted, electrolytic zinc-coated or hot-dip galvanized according to ASTM A 653/A 653M, **G30 (Z90)** coating designation, with prefinished, cold-rolled, **15/16-inch- (24-mm-)** wide sheet metal caps on flanges.
 - a. Structural Classification: Intermediate-duty **OR** Heavy-duty, **as directed**, system.
 - b. End Condition of Cross Runners: Override (stepped) **OR** Butt-edge, **as directed**, type.
 - c. Face Design: Flat, flush.
 - d. Cap Material: Steel **OR** Aluminum, **as directed**, cold-rolled sheet.
 - e. Cap Finish: Painted white **OR** Painted in color as selected from manufacturer's full range **OR** Painted to match color indicated by manufacturer's designation **OR** Painted to match color of metal pan **OR** Plated with metallic finish, as selected from manufacturer's full range **OR** Plated with metallic finish indicated by manufacturer's designation **OR** Natural finish for aluminum, **as directed**.
 3. Narrow-Face, Capped, Double-Web, Steel Suspension System: Main and cross runners roll formed from cold-rolled steel sheet, prepainted, electrolytic zinc-coated or hot-dip galvanized according to ASTM A 653/A 653M, **G30 (Z90)** coating designation, with prefinished, cold-rolled, **9/16-inch- (15-mm-)** wide sheet metal caps on flanges.
 - a. Structural Classification: Intermediate-duty **OR** Heavy-duty, **as directed**, system.
 - b. End Condition of Cross Runners: Override (stepped) **OR** Butt-edge, **as directed**, type.
 - c. Face Design: Flat, flush **OR** Flanges formed with an integral center reveal, **as directed**.
 - d. Cap Material: Steel **OR** Aluminum, **as directed**, cold-rolled sheet.
 - e. Cap Finish: Painted white **OR** Painted in color as selected from manufacturer's full range **OR** Painted to match color indicated by manufacturer's designation **OR** Painted to match color of metal pan **OR** Plated with metallic finish, as selected from manufacturer's full range **OR** Plated with metallic finish indicated by manufacturer's designation **OR** Natural finish for aluminum, **as directed**.
 4. Narrow-Face, Uncapped, Double-Web, Steel Suspension System: Main and cross runners roll formed from cold-rolled steel sheet, prepainted, electrolytic zinc-coated or hot-dip galvanized, to produce structural members with **9/16-inch- (15-mm-)** wide faces.
 - a. Structural Classification: Intermediate-duty **OR** Heavy-duty, **as directed**, system.
 - b. Face Design: With **1/8-inch- (3.2-mm-)** wide, slotted, box-shaped flange **OR** With **1/4-inch- (6.35-mm-)** wide, slotted, box-shaped flange, **as directed**.
 - c. Face Finish: Painted white **OR** in color as selected from manufacturer's full range **OR** to match color indicated by manufacturer's designation **OR** to match color of metal pan, **as directed**.
 5. Wide-Face, Capped, Double-Web, Steel Suspension System: Main and cross runners roll formed from cold-rolled steel sheet, hot-dip galvanized according to ASTM A 653/A 653M, **G60 (Z180)** coating designation, with prefinished, cold-rolled, **15/16-inch- (24-mm-)** wide aluminum caps on flanges.
 - a. Structural Classification: Intermediate-duty **OR** Heavy-duty, **as directed**, system.
 - b. Face Design: Flat, flush.
 - c. Face Finish: Painted white **OR** Painted to match color indicated by manufacturer's designation **OR** Painted to match color of acoustical unit **OR** Natural finish, **as directed**.
 6. Wide-Face, Capped, Double-Web, Stainless-Steel Suspension System: Main and cross runners roll formed from and capped with Type 304 or 316 stainless-steel sheet, with prefinished, cold-rolled, **15/16-inch- (24-mm-)** wide stainless-steel caps on flanges.

- a. Structural Classification: Intermediate-duty system.
 - b. Face Design: Flat, flush.
 7. Suspension System for Torsion-Spring Metal Pans: Provide runners with factory-cut slots fabricated to accept torsion-spring attachment.
- G. Metal Suspension System For Acoustical Snap-In Metal Pan Ceiling
 1. Indirect-Hung, Snap-Tee **OR** Bar, **as directed**, System: Designed to support metal pans that snap into main runners, consisting of main runners connected to carrying channels that are attached by hangers to building structure, and complying with the following requirements:
 - a. Main Runners: Formed from the following metal:
 - 1) Aluminum Sheet: Alloy and temper recommended by aluminum producer and finisher for type of use indicated and manufacturer's standard finish, complying with **ASTM B 209 (ASTM B 209M)**.
 - 2) Electrolytic Zinc-Coated Steel Sheet: ASTM A 591/A 591M, with not less than **80Z (24G)** zinc coating.
 - 3) Hot-Dip Galvanized Steel: ASTM A 653/A 653M, not less than **G60 (Z180)** zinc coating.
 - 4) Stainless-Steel Sheet: ASTM A 666, Type 302 or 304, stretcher leveled, with cold-rolled mill finish.
 - 5) Metal Sheet: Metal as standard with ceiling system manufacturer with factory-applied protective finish complying with ASTM C 635.
 - b. Carrying Channels: Same member and metal as indicated for main runners.
OR
Carrying Channels: Cold-rolled steel, not less than **0.060-inch (1.5-mm)** nominal thickness of base (uncoated) metal and **7/16-inch- (11-mm-)** wide flanges, protected with rust-inhibitive paint **OR** hot-dip galvanized according to ASTM A 653/A 653M, **G60 (Z180)** coating designation, **as directed**, and as follows:
 - 1) Depth and Weight: **1-1/2 inches and 475 lb/1000 feet (38 mm and 215 kg/305 m) OR 2 inches and 590 lb/1000 feet (51 mm and 268 kg/305 m), as directed.**
 - c. Exterior Bracing Channels and Angles: Cold-rolled steel, hot-dip galvanized to comply with ASTM A 653/A 653M, **G60 (Z180)** coating designation; size and profile as required to withstand wind load.
 2. Direct-Hung, Snap-Tee **OR** Bar, **as directed**, System: Designed to support metal pans that snap into main runners, consisting of main runners supported by hangers attached directly to building structure, and complying with the following requirements:
 - a. Hangers: Angles or channels, as standard with ceiling system manufacturer, formed from same metal as main runners.
 - b. Main Runners: Rolled aluminum sheet; alloy and temper recommended by aluminum producer and finisher for type of use indicated and manufacturer's standard finish, complying with **ASTM B 209 (ASTM B 209M)**.
 3. Access Panels: For access at locations indicated, provide acoustical snap-in metal pan ceiling units, accessible by key or tool **OR** two access knobs; place one access knob at each end of panel near corners, **as directed**.
 - a. Access Key or Tool: Provide manufacturer' standard key or tool for opening access panels; one **OR** two, **as directed**.
- H. Acoustical Sealant
 1. Acoustical Sealant for Exposed and Concealed Joints: Manufacturer's standard nonsag, paintable, nonstaining latex sealant, with a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24), complying with ASTM C 834 and effective in reducing airborne sound transmission through perimeter joints and openings in building construction as demonstrated by testing representative assemblies according to ASTM E 90.
 2. Acoustical Sealant for Concealed Joints: Manufacturer's standard nondrying, nonhardening, nonskinning, nonstaining, gunnable, synthetic-rubber sealant, with a VOC content of 250 g/L or

less when calculated according to 40 CFR 59, Subpart D (EPA Method 24), recommended for sealing interior concealed joints to reduce airborne sound transmission.

I. General Finish Requirements

1. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
 - a. High-Humidity Finish: Comply with ASTM C 635 requirements for "Coating Classification for Severe Environment Performance" where high-humidity finishes are indicated.
2. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
3. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

J. Aluminum Finishes

1. Mill Finish: AA-M10C10 (Mechanical Finish: as fabricated, unspecified; Chemical Finish: chemically cleaned).
2. Lacquered Mill Finish: AA-M10C10R1x (Mechanical Finish: as fabricated, unspecified; Chemical Finish: chemically cleaned; Organic Coating: as specified below).
 - a. Organic Coating: Manufacturer's standard clear organic coating.
3. Clear Anodic Finish: AAMA 611, AA-M12C22A31, Class II, 0.010 mm or thicker.
4. Clear Mirror Anodic Finish: AA-M21C12A212, 0.005 mm or thicker.
5. Color-Coated Finish: Manufacturer's standard powder-coat, **as directed**, baked paint complying with coating manufacturer's written instructions for surface preparation, pretreatment, application, baking, and minimum dry film thickness.
6. Bright-Reflective Finish: Manufacturer's standard chemical/mechanical bright-reflective metallic finish complying with finish manufacturer's written instructions for surface preparation, pretreatment, process, protective coating, and minimum thickness to produce a finish uniform in appearance and free of blisters, pits, roughness, nodules, burning, cracks, unfinished areas, and other visible defects.

K. Galvanized-Steel Sheet Finishes

1. Color-Coated Finish: Manufacturer's standard powder-coat, **as directed**, baked paint complying with coating manufacturer's written instructions for surface preparation, pretreatment, application, baking, and minimum dry film thickness.

L. Steel Sheet Finishes

1. Electroplated Finish: Electroplating process complying with finish manufacturer's written instructions for surface preparation, pretreatment, process, and minimum thickness to produce a coating uniform in appearance and free of blisters, pits, roughness, nodules, burning, cracks, unplated areas, and other visible defects.
2. Bright-Reflective Finish: Manufacturer's standard chemical/mechanical bright-reflective metallic finish complying with finish manufacturer's written instructions for surface preparation, pretreatment, process, protective coating, and minimum thickness to produce a finish uniform in appearance and free of blisters, pits, roughness, nodules, burning, cracks, unfinished areas, and other visible defects.

M. Stainless-Steel Finishes

1. Surface Preparation: Remove tool and die marks and stretch lines, or blend into finish.
2. Polished Finishes: Grind and polish surfaces to produce uniform finish, free of cross scratches.
 - a. Run grain of directional finishes with long dimension of each piece.
 - b. When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.

1.3 EXECUTION

A. Preparation

1. Measure each ceiling area and establish layout of acoustical metal pans to balance border widths at opposite edges of each ceiling. Avoid using less-than-half-width pans at borders, and comply with layout shown on reflected ceiling plans and Coordination Drawings.

B. Installation

1. Install acoustical metal pan ceilings to comply with ASTM C 636 **OR** IBC Standard, **as directed**, and seismic requirements indicated, per manufacturer's written instructions and CISCAs "Ceiling Systems Handbook."
2. Suspend ceiling hangers from building's structural members and as follows:
 - a. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structure or of ceiling suspension system.
 - b. Splay hangers only where required to miss obstructions; offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.
 - c. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with location of hangers at spacings required to support standard suspension system members, install supplemental suspension members and hangers in form of trapezes or equivalent devices.
 - d. Secure wire hangers to ceiling suspension members and to supports above with a minimum of three tight turns. Connect hangers directly either to structures or to inserts, eye screws, or other devices that are secure and appropriate for substrate and that will not deteriorate or otherwise fail due to age, corrosion, or elevated temperatures.
OR
Secure flat, angle, channel, and rod hangers to structure, including intermediate framing members, by attaching to inserts, eye screws, or other devices that are secure and appropriate for both structure to which hangers are attached and type of hanger involved.
 - e. Do not support ceilings directly from permanent metal forms or floor deck. Fasten hangers to cast-in-place hanger inserts, postinstalled mechanical or adhesive anchors, or power-actuated fasteners that extend through forms into concrete.
 - f. When steel framing does not permit installation of hanger wires at spacing required, install carrying channels or other supplemental support for attachment of hanger wires.
 - g. Do not attach hangers to steel deck tabs.
 - h. Do not attach hangers to steel roof deck. Attach hangers to structural members.
 - i. Space hangers not more than **48 inches (1200 mm)** o.c. along each member supported directly from hangers unless otherwise indicated; provide hangers not more than **8 inches (200 mm)** from ends of each member.
 - j. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced standards and publications.
3. Secure bracing wires to ceiling suspension members and to supports with a minimum of four tight turns. Suspend bracing from building's structural members as required for hangers, without attaching to permanent metal forms, steel deck, or steel deck tabs. Fasten bracing wires into concrete with cast-in-place or postinstalled anchors.
4. Install edge moldings and trim of type indicated at perimeter of acoustical ceiling area and where necessary to conceal edges of acoustical metal pans.
 - a. Apply acoustical sealant in a continuous ribbon concealed on back of vertical legs of moldings before they are installed.
 - b. Screw attach moldings to substrate at intervals not more than **16 inches (400 mm)** o.c. and not more than **3 inches (75 mm)** from ends, leveling with ceiling suspension system to a tolerance of **1/8 inch in 12 feet (3.2 mm in 3.6 m)**. Miter corners accurately and connect securely.
 - c. Do not use exposed fasteners, including pop rivets, on moldings and trim.
5. Install suspension system runners so they are square and securely interlocked with one another. Remove and replace dented, bent, or kinked members.

6. Cut acoustical metal pan units for accurate fit at borders and at interruptions and penetrations by other work through ceilings. Stiffen edges of cut units as required to eliminate evidence of buckling or variations in flatness exceeding referenced standards for stretcher-leveled metal sheet.
 7. Install acoustical metal pans in coordination with suspension system and exposed moldings and trim.
 - a. For lay-in square-edge pans, install pans with edges fully hidden from view by flanges of suspension system runners and moldings.
 - b. For lay-in reveal-edge pans on suspension system runners, install pans with bottom of reveal in firm contact with top surface of runner flanges.
 - c. For lay-in reveal-edge pans on suspension system members with box-shaped flanges, install pans with reveal surfaces in firm contact with suspension system surfaces and panel faces flush with bottom face of runners.
 - d. For clip-in **OR** torsion-spring-hinged, **as directed**, pans, position pans according to manufacturer's written instructions.
 - e. For snap-in pans, fit adjoining units to form flush, tight joints.
 - f. Align joints in adjacent courses to form uniform, straight joints parallel to room axis in both directions unless otherwise indicated.
 - g. Fit adjoining units to form flush, tight joints.
 - h. Install directionally patterned or textured metal pans in directions indicated.
 - i. Install sound-absorbent fabric layers in perforated metal pans.
 - j. Install sound-absorbent pads in perforated metal pans over metal spacer grids, **as directed**.
 8. Install sound attenuation panels in areas indicated by reflected ceiling plans or room finish schedules. Lay panels directly on ceiling system and close major openings to form complete coverage in required areas. Lay second sound-absorbent pads on sound attenuation panels.
 9. Install hold-down clips where indicated.
- C. Field Quality Control
1. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
 2. Tests and Inspections: Testing and inspecting of completed installations of acoustical panel ceiling hangers and anchors and fasteners shall take place in successive stages, in areas of extent and using methods as follows. Do not proceed with installations of acoustical panel ceiling hangers for the next area until test results for previously completed installations of acoustical panel ceiling hangers show compliance with requirements.
 - a. Extent of Each Test Area: When installation of ceiling suspension systems on each floor has reached 20 percent completion but no panels have been installed.
 - 1) Within each test area, testing agency will select 1 of every 10 power-actuated fasteners and postinstalled anchors used to attach hangers to concrete and will test them for **200 lbf (890 N)** of tension; it will also select one of every 2 postinstalled anchors used to attach bracing wires to concrete and will test them for **440 lbf (1957 N)** of tension.
 - 2) When testing discovers fasteners and anchors that do not comply with requirements, testing agency will test those anchors not previously tested until 20 pass consecutively and then will resume initial testing frequency.
 3. Acoustical panel ceiling hangers and anchors and fasteners will be considered defective if they do not pass tests and inspections.
 4. Prepare test and inspection reports.
- D. Cleaning
1. Clean exposed surfaces of acoustical metal pan ceilings, including trim and edge moldings after removing strippable, temporary protective covering, if any. Comply with manufacturer's written instructions for stripping of temporary protective covering, cleaning, and touchup of minor finish damage. Remove and replace ceiling components that cannot be successfully cleaned and repaired to permanently eliminate evidence of damage, including dented and bent units.

END OF SECTION 09 54 23 00

NOT FOR BID

SECTION 09 54 23 00a - LINEAR METAL CEILINGS

1.1 GENERAL

A. Description Of Work

1. This specification covers the furnishing and installation of materials for linear metal ceilings. Products shall be as follows or as directed by the Owner. Installation procedures shall be in accordance with the product manufacturer's recommendations. Demolition and removal of materials shall be as required to support the work.

B. Summary

1. Section includes strip linear metal pans and suspension systems for ceilings.

C. Definitions

1. LR: Light Reflectance coefficient.
2. NRC: Noise Reduction Coefficient.

D. Performance Requirements

1. Structural Performance: Exterior linear metal ceilings shall withstand exterior exposure and the effects of gravity loads and the following loads and stresses without showing permanent deformation of ceiling system components including pans and suspension system; noise or metal fatigue caused by vibration, deflection, and displacement of ceiling units; or permanent damage to fasteners and anchors.
 - a. Wind Load: Uniform pressure of 20 lbf/sq. ft. (960 Pa) OR of 30 lbf/sq. ft. (1436 Pa) OR as indicated on Drawings, **as directed**, acting inward or outward.
2. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes. Base calculations on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.
 - a. Temperature Change (Range): 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), **as directed**, material surfaces.

E. Submittals

1. Product Data: For each type of product indicated.
2. Performance Data: For installed products indicated to comply with design loads and other criteria, include structural analysis and other analytical data signed and sealed by the qualified professional engineer responsible for their preparation.
3. Samples: For each exposed finish.
4. Coordination Drawings: Drawn to scale and coordinating and showing the following:
 - a. Linear pattern.
 - b. Joint pattern.
 - c. Ceiling suspension members.
 - d. Method of attaching hangers to building structure.
 - e. Ceiling-mounted items.
 - f. Ceiling perimeter and penetrations through ceiling; trim and moldings.
5. Product test reports.
6. Evaluation reports.
7. Maintenance data.

F. Quality Assurance

1. Acoustical Testing Agency Qualifications: An independent testing laboratory or an NVLAP-accredited laboratory.
2. Surface-Burning Characteristics: Complying with ASTM E 1264 for Class A materials, as determined by testing identical products according to ASTM E 84 by UL or another testing and inspecting agency acceptable to authorities having jurisdiction.

3. Seismic Standard: Comply with the following:
 - a. Standard for Ceiling Suspension Systems Requiring Seismic Restraint: Comply with ASTM E 580.
 - b. CISCAs Recommendations for Acoustical Ceilings: Comply with CISCAs "Recommendations for Direct-Hung Acoustical Tile and Lay-in Panel Ceilings - Seismic Zones 0-2."
 - c. CISCAs Guidelines for Systems Requiring Seismic Restraint: Comply with CISCAs "Guidelines for Seismic Restraint of Direct-Hung Suspended Ceiling Assemblies - Seismic Zones 3 & 4."
 - d. IBC Standard for Metal Suspension Systems for Acoustical Tile and for Lay-in Panel Ceilings.
 - e. SEI/ASCE 7, "Minimum Design Loads for Buildings and Other Structures": Section 9, "Earthquake Loads."

G. Delivery, Storage, And Handling

1. Deliver linear metal pans, suspension system components, and accessories to Project site in original, unopened packages and store them in a fully enclosed, conditioned space where they will be protected against damage from moisture, humidity, temperature extremes, direct sunlight, surface contamination, and other causes.
2. Handle linear metal pans, suspension system components, and accessories carefully to avoid damaging units and finishes in any way.

1.2 PRODUCTS

A. Linear Metal Ceiling Pans

1. Acoustical Metal Pan Standard: Provide manufacturer's standard linear metal pans of configuration indicated that comply with ASTM E 1264.
 - a. Mounting Method for Measuring NRC: Type E-400.
2. Sheet Metal Characteristics: For metal components exposed to view in the completed Work, provide materials with smooth, flat surfaces without blemishes. Do not use materials with exposed pitting, seam marks, roller marks, roughness, stains, or discolorations.
 - a. Aluminum Sheet: Roll-formed aluminum sheet, complying with **ASTM B 209 (ASTM B 209M)**; alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated.
 - b. Steel Sheet: Commercial-quality, cold-rolled, carbon-steel sheet; stretcher leveled; with protective coating complying with ASTM C 635.
 - c. Steel Sheet: Commercial-quality, cold-rolled, carbon-steel sheet; stretcher leveled and ASTM A 591/A 591M, **40Z (12G)** coating for painted finish **OR** ASTM A 1008/A 1008M for electroplating, **as directed**; with protective coating complying with ASTM C 635 and recommended by finisher for finish indicated.
 - d. Stainless-Steel Sheet: Complying with ASTM A 240/A 240M, Type 304 **OR** Type 430, **as directed**.
3. Pan Fabrication: Manufacturer's standard units of size, profile, and edge treatment indicated, formed from metal indicated to snap on and be securely retained on carriers without separate fasteners, and finished to comply with requirements indicated.
4. Pan Splices: Construction same as pans, in lengths **8 to 12 inches (200 to 300 mm)**; with manufacturer's standard finish.
5. End Caps: Metal matching pans **OR** Plastic **OR** Manufacturer's standard material, **as directed**; fabricated to fit and conceal exposed ends of pans.
6. Filler Strips: Metal matching pans **OR** Plastic **OR** Manufacturer's standard material, **as directed**; fabricated to uninterruptedly close voids between pans.
7. Moldings and Trim: Provide manufacturer's standard moldings and trim for exposed members, and as indicated or required, for edges and penetrations of ceiling, around fixtures, at changes in ceiling height, and for other conditions; of same metal and finish as linear metal ceiling pans.

8. Sound-Absorbent Fabric Layer: Provide fabric layer, sized to fit concealed surface of pan, and consisting of black, nonwoven, nonflammable, sound-absorbent material with surface-burning characteristics for flame-spread index of 25 or less and smoke-developed index of 50 or less, as determined by testing per ASTM E 84.
 - a. Bond fabric layer to pan in the factory with manufacturer's standard nonflammable adhesive.
9. Sound-Absorbent Pads: Provide width and length to completely fill between carriers, joined at center of panel, with surface-burning characteristics for flame-spread index of 25 or less and smoke-developed index of 50 or less, as determined by testing per ASTM E 84, and to comply with the following requirements:
 - a. Plastic Sheet-Wrapped Mineral-Fiber Insulation: Pads consisting of nonrigid, PVC plastic sheet encapsulating unfaced mineral-fiber insulation complying with ASTM C 553, Type I, II, or III, and as follows:
 - 1) Mineral-Fiber Type and Thickness: Glass fiber; **1 inch (25 mm) OR 1-1/2 inches (38 mm) OR 3 inches (76 mm), as directed.**
 - 2) Mineral-Fiber Density: **3/4 lb/cu. ft. (12 kg/cu. m) OR 1 lb/cu. ft. (16 kg/cu. m) OR 1-1/2 lb/cu. ft. (24 kg/cu. m), as directed.**
 - 3) Plastic Sheet Thickness and Color: Not less than **0.003 inch (0.076 mm)**; clear **OR** flat black **OR** white, **as directed.**
 - b. Unwrapped, Glass-Fiber Insulation: Black-coated, unfaced, glass-fiber insulation complying with ASTM C 553, Type I, II, or III, not less than **1-lb/cu. ft. (16-kg/cu. m)** density, treated to be nondusting, and as follows:
 - 1) Thickness: **1 inch (25 mm) OR 1-1/2 inches (38 mm), as directed.**
- B. Metal Suspension Systems
 1. Metal Suspension Systems Standard: Provide ceiling manufacturer's standard metal suspension systems of types and finishes indicated that comply with applicable ASTM C 635 requirements.
 2. Suspension Systems: Provide systems complete with carriers, splice sections, connector clips, alignment clips, leveling clips, hangers, molding, trim, retention clips, load-resisting struts, fixture adapters, and other suspension components required to support ceiling units and other ceiling-supported construction.
 3. Attachment Devices: Size for five times the design load indicated in ASTM C 635, Table 1, Direct Hung, unless otherwise indicated.
 - a. Cast-in-Place and Postinstalled Anchors in Concrete: Anchors of type and material indicated below, with holes or loops for attaching hangers of type indicated and with capability to sustain, without failure, a load equal to five times that imposed by ceiling construction, as determined by testing per ASTM E 488 or ASTM E 1512 as applicable, conducted by a qualified testing and inspecting agency.
 - 1) Type: Cast-in-place **OR** Postinstalled expansion **OR** Postinstalled bonded, **as directed**, anchors.
 - 2) Corrosion Protection: Carbon-steel components zinc plated to comply with ASTM B 633, Class Fe/Zn 5 (0.005 mm) for Class SC service condition (mild).
 - 3) Corrosion Protection: Stainless-steel components complying with ASTM F 593 and ASTM F 594, Group 1 Alloy 304 or 316 for bolts; Alloy 304 or 316 for anchors.
 - 4) Corrosion Protection: Components fabricated from nickel-copper-alloy rods complying with ASTM B 164 for UNS No. N04400 alloy.
 - b. Power-Actuated Fasteners in Concrete: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with clips or other accessory devices for attaching hangers of type indicated, and with capability to sustain, without failure, a load equal to 10 times that imposed by ceiling construction, as determined by testing per ASTM E 1190, conducted by a qualified testing and inspecting agency.
 4. Wire Hangers, Braces, and Ties: Provide wire complying with the following requirements:
 - a. Zinc-Coated, Carbon-Steel Wire: ASTM A 641/A 641M, Class 1 zinc coating, soft temper.
 - b. Stainless-Steel Wire: ASTM A 580/A 580M, Type 304, nonmagnetic.
 - c. Nickel-Copper-Alloy Wire: ASTM B 164, nickel-copper-alloy UNS No. N04400.

- d. Size: Select wire diameter so its stress at 3 times the hanger design load indicated in ASTM C 635, Table 1, Direct Hung will be less than yield stress of wire, but provide not less than **0.106-inch- (2.69-mm-)** OR **0.135-inch- (3.5-mm-)**, **as directed**, diameter wire.
 5. Hanger Rods **OR** Flat Hangers, **as directed**: Mild steel, zinc coated or protected with rust-inhibitive paint.
 6. Angle Hangers: Angles with legs not less than **7/8 inch (22 mm)** wide; formed from **0.04-inch- (1.0-mm-)** thick, galvanized-steel sheet complying with ASTM A 653/A 653M, **G90 (Z275)** coating designation; with bolted connections and **5/16-inch- (8-mm-)** diameter bolts.
 7. Carriers: Factory finished with matte-black baked finish, **as directed**.
 - a. Main Carriers: Aluminum, not less than **0.240-inch (6.0-mm)** rolled sheet, alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated, complying with **ASTM B 209 (ASTM B 209M)**.
 - b. Main Carriers: Steel, not less than **0.0209-inch (0.53-mm)** nominal thickness, cold-rolled sheet, with factory-applied protective coating, complying with ASTM C 635.
 - 1) Electrolytic Zinc-Coated Steel: ASTM A 591/A 591M, not less than **80Z (24G)**, **as directed**, zinc coating.
 - 2) Hot-Dip Galvanized Steel: ASTM A 653/A 653M, not less than **G60 (Z180)**, **as directed**, zinc coating.
 - c. Adaptable Carriers: Manufacturer's standard carriers for direct attachment to existing suspended tees.
 - d. Flexible Radial Carriers: Manufacturer's standard radial carriers.
 - e. Expansion Carriers: Manufacturer's standard carriers allowing for irregularities or other unusual space conditions.
 8. Carrier Splices: Same metal, profile, and finish as indicated for carriers.
 9. Stabilizer Channels, Tees, and Bars: Manufacturer's standard components for stabilizing main carriers at regular intervals and at light fixtures, air-distribution equipment, access doors, and other equipment; spaced as standard with manufacturer for use indicated; and factory finished with matte-black baked finish.
 10. Seismic Struts: Manufacturer's standard compression struts designed to accommodate seismic forces.
 11. Exterior Bracing Channels and Angles: Cold-rolled steel, hot-dip galvanized to comply with ASTM A 653/A 653M, **G60 (Z180)** coating designation; size and profile as required to withstand wind load.
 12. Hold-Down Clips: Manufacturer's standard hold-down clips spaced as standard with manufacturer.
 13. Edge Moldings and Trim: Provide exposed members as indicated or required to comply with seismic requirements of authorities having jurisdiction, to conceal edges of penetrations through ceiling, to conceal ends of pans and carriers, for fixture trim and adapters, for fasciae at changes in ceiling height, and for other conditions; of metal and finish matching linear metal pans or extruded plastic unless otherwise indicated.
 - a. For Circular Penetrations of Ceiling: Fabricate edge moldings to diameter required to fit penetration exactly.
- C. Aluminum Pans And Suspension System For Linear Metal Ceiling
1. Aluminum Pans and Suspension System:
 2. Classification: Units complying with ASTM E 1264 for Type XIII, aluminum strips with mineral- or glass-fiber-base backing; Form 1, perforated **OR** Type XIII, aluminum strips with mineral- or glass-fiber-base backing; Form 2, unperforated **OR** Type XX, other types described as perforated aluminum strips with sound-absorbent fabric backing, **as directed**.
 3. Pan Thickness: Not less than **0.018 inch (0.46 mm)** OR **0.022 inch (0.56 mm)** OR **0.024 inch (0.6 mm)** OR **0.025 inch (0.65 mm)** OR **0.027 inch (0.7 mm)** OR **0.032 inch (0.8 mm)** OR **0.040 inch (1.0 mm)**, **as directed**.
 4. Pan Edge Detail: Beveled **OR** Square **OR** Round **OR** Manufacturer's standard edge detail, **as directed**.

5. Linear Module Width and Pan Face Width: 2-inch (51-mm) module width and 1-1/4-inch (32-mm) face width **OR** 4-inch (102-mm) module width and 3-1/4-inch (83-mm) face width **OR** 6-inch (152-mm) module width and 5-1/4-inch (133-mm) face width **OR** 8-inch (203-mm) module width and 7-1/4-inch (184-mm) face width **OR** 100-mm module width and 80-mm face width **OR** 200-mm module width and 180-mm face width **OR** 300-mm module width and 280-mm face width **OR** As indicated on Drawings, **as directed**.
 6. Pan Depth: 5/8 inch (16 mm) deep **OR** 3/4 inch (19 mm) deep **OR** Not less than 1 to 1-1/2 inches (25 to 38 mm) deep **OR** 15 mm deep **OR** As indicated, **as directed**.
 7. Pan Face Finish: Mill **OR** Lacquered mill **OR** Clear anodized **OR** Clear mirror-anodized **OR** Painted white **OR** Painted to match color indicated by product designation **OR** Painted to match sample **OR** Painted in color selected from manufacturer's full range **OR** High-performance organic coating in color selected from manufacturer's full range **OR** Bright-reflective finish selected from manufacturer's full range, **as directed**.
 8. End Cap, Finish of Exposed Portions: Matte black **OR** To match pan **OR** Manufacturer's standard finish, **as directed**.
 9. Filler Strip Design: Recessed **OR** Flush **OR** An integral extension of pan profile **OR** Expansion, for use with expansion carriers **OR** Slotted, for air diffusion, **as directed**.
 10. Filler Strip, Finish of Exposed Portions: Matte black **OR** To match pan, **as directed**.
 11. LR: Not less than 0.70 **OR** 0.75, **as directed**.
 12. NRC: Not less than 0.65 **OR** 0.75 **OR** 0.95, **as directed**.
 13. Suspension-System Main-Carrier Material: Aluminum **OR** Electrolytic zinc-coated steel **OR** Hot-dip galvanized steel **OR** Manufacturer's standard material and protective finish, **as directed**.
- D. Steel Pans And Suspension System For Linear Metal Ceiling
1. Steel Pans and Suspension System:
 2. Classification: Units complying with ASTM E 1264 for Type XIII, steel strips with mineral- or glass-fiber-base backing; Form 1, perforated **OR** Type XIII, steel strips with mineral- or glass-fiber-base backing; Form 2, unperforated **OR** Type XX, other types described as perforated steel strips with sound-absorbent fabric backing, **as directed**.
 3. Pan Thickness: Not less than 0.015 inch (0.4 mm) **OR** 0.020 inch (0.5 mm) **OR** 0.024 inch (0.6 mm) **OR** 0.030 inch (0.75 mm), **as directed**.
 4. Pan Edge Detail: Beveled **OR** Square **OR** Round **OR** Manufacturer's standard edge detail, **as directed**.
 5. Linear Module Width and Pan Face Width: 2-inch (51-mm) module width and 1-1/4-inch (32-mm) face width **OR** 4-inch (102-mm) module width and 3-1/4-inch (83-mm) face width **OR** 6-inch (152-mm) module width and 5-1/4-inch (133-mm) face width **OR** 8-inch (203-mm) module width and 7-1/4-inch (184-mm) face width **OR** As indicated on Drawings, **as directed**.
 6. Pan Depth: 5/8 inch (16 mm) deep **OR** 3/4 inch (19 mm) deep **OR** Not less than 1 to 1-1/2 inches (25 to 38 mm) deep **OR** 15 mm deep **OR** As indicated, **as directed**.
 7. Pan Face Finish: Painted white **OR** Painted to match color indicated by product designation **OR** Painted to match sample **OR** Painted in color selected from manufacturer's full range **OR** Electroplated finish selected from manufacturer's full range, **as directed**.
 8. End Cap, Finish of Exposed Portions: Matte black **OR** To match pan **OR** Manufacturer's standard finish, **as directed**.
 9. Filler Strip Design: Recessed **OR** Flush **OR** An integral extension of pan profile **OR** Expansion, for use with expansion carriers **OR** Slotted, for air diffusion, **as directed**.
 10. Filler Strip, Finish of Exposed Portions: Matte black **OR** To match pan, **as directed**.
 11. LR: Not less than 0.70 **OR** 0.75, **as directed**.
 12. NRC: Not less than 0.65 **OR** 0.75 **OR** 0.95, **as directed**.
 13. Suspension-System Main-Carrier Material: Aluminum **OR** Electrolytic zinc-coated steel **OR** Hot-dip galvanized steel **OR** Manufacturer's standard material and protective finish, **as directed**.
- E. Stainless-Steel Pans And Suspension System For Linear Metal Ceiling
1. Stainless-Steel Pans and Suspension System:
 2. Classification: Units complying with ASTM E 1264 for Type XIII, stainless-steel strips with mineral- or glass-fiber-base backing; Form 1, perforated **OR** Type XIII, stainless-steel strips with

mineral- or glass-fiber-base backing; Form 2, unperforated **OR** Type XX, other types described as perforated stainless-steel strips with sound-absorbent fabric backing, **as directed**.

3. Pan Thickness: Not less than **0.016 inch (0.396 mm)** **OR** **0.019 inch (0.475 mm)**, **as directed**.
4. Pan Edge Detail: Manufacturer's standard edge detail, **as directed**.
5. Linear Module Width and Pan Face Width: **2-inch (51-mm)** module width and **1-1/4-inch (32-mm)** face width **OR** **4-inch (102-mm)** module width and **3-1/4-inch (83-mm)** face width **OR** **6-inch (152-mm)** module width and **5-1/4-inch (133-mm)** face width **OR** **8-inch (203-mm)** module width and **7-1/4-inch (184-mm)** face width **OR** As indicated on Drawings, **as directed**.
6. Pan Depth: **5/8 inch (16 mm)** deep **OR** As indicated, **as directed**.
7. Pan Face Finish: Brushed, directional polish **OR** Satin, directional polish **OR** Mirrorlike reflective, nondirectional polish, **as directed**.
8. End Cap, Finish of Exposed Portions: Matte black **OR** To match pan **OR** Manufacturer's standard finish, **as directed**.
9. Filler Strip Design: Recessed **OR** Flush **OR** An integral extension of pan profile **OR** Expansion, for use with expansion carriers **OR** Slotted, for air diffusion, **as directed**.
10. Filler Strip, Finish of Exposed Portions: Matte black **OR** To match pan, **as directed**.
11. NRC: Not less than 0.65 **OR** 0.75 **OR** 0.95, **as directed**.
12. Suspension-System Main-Carrier Material: Aluminum **OR** Electrolytic zinc-coated steel **OR** Hot-dip galvanized steel **OR** Manufacturer's standard material and protective finish, **as directed**.

F. Accessories

1. Access Panels: For access at locations indicated, provide door hinge assembly, retainer clip, and retainer bar, assembled with ceiling panels and carrier sections into access doors of required size, permitting upward or downward opening.

G. General Finish Requirements

1. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
2. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
3. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

H. Aluminum Finishes

1. Mill Finish: AA-M10C10.
2. Lacquered Mill Finish: AA-M10C10R1x with manufacturer's standard clear, organic coating.
3. Clear Anodic Finish: AAMA 611, AA-M12C22A31, Class II, 0.010 mm or thicker.
4. Clear Mirror Anodic Finish: AA-M21C12A212, 0.005 mm or thicker.
5. Color-Coated Finish: Manufacturer's standard powder-coat baked paint finish complying with coating manufacturer's written instructions for surface preparation, pretreatment, application, baking, and minimum dry film thickness.
6. High-Performance Organic Finish: 2-coat fluoropolymer finish complying with AAMA 2604 **OR** AAMA 2605, **as directed**, and containing not less than 50 **OR** 70, **as directed**, percent PVDF resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
7. Bright-Reflective Finish: Manufacturer's standard chemical/mechanical bright-reflective metallic finish complying with finish manufacturer's written instructions for surface preparation, pretreatment, process, protective coating, and minimum thickness to produce a finish uniform in appearance and free of blisters, pits, roughness, nodules, burning, cracks, unfinished areas, and other visible defects.

I. Galvanized-Steel Sheet Finishes

1. Color-Coated Finish: Manufacturer's standard powder-coat baked paint finish complying with coating manufacturer's written instructions for surface preparation, pretreatment, application, baking, and minimum dry film thickness.

J. Steel Sheet Finishes

1. Electroplated Finish: Electroplating process complying with finish manufacturer's written instructions for surface preparation, pretreatment, process, and minimum thickness to produce a coating uniform in appearance and free of blisters, pits, roughness, nodules, burning, cracks, unplated areas, and other visible defects.
2. Bright-Reflective Finish: Manufacturer's standard chemical/mechanical bright-reflective metallic finish complying with finish manufacturer's written instructions for surface preparation, pretreatment, process, protective coating, and minimum thickness to produce a finish uniform in appearance and free of blisters, pits, roughness, nodules, burning, cracks, unfinished areas, and other visible defects.

K. Stainless-Steel Finishes

1. Surface Preparation: Remove tool and die marks and stretch lines, or blend into finish.
2. Polished Finishes: Grind and polish surfaces to produce uniform finish, free of cross scratches.
 - a. Run grain of directional finishes with long dimension of each piece.
 - b. When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.

1.3 EXECUTION

A. Installation

1. Comply with ASTM C 636 **OR** IBC Standard, **as directed**, and seismic requirement indicated, per manufacturer's written instructions and CISC's "Ceiling Systems Handbook."
2. Suspend ceiling hangers from building's structural members and as follows:
 - a. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structure or of ceiling suspension system.
 - b. Splay hangers only where required to miss obstructions; offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.
 - c. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with location of hangers at spacings required to support standard suspension system members, install supplemental suspension members and hangers in form of trapezes or equivalent devices.
 - d. Secure wire hangers to ceiling suspension members and to supports above with a minimum of three tight turns. Connect hangers directly either to structures or to inserts, eye screws, or other devices that are secure and appropriate for substrate to which hangers are attached and for type of hanger involved.
 - e. Secure flat, angle, channel, and rod hangers to structure, including intermediate framing members, by attaching to inserts, eye screws, or other devices that are secure and appropriate for both structure to which hangers are attached and type of hanger involved. Install hangers in a manner that will not cause them to deteriorate or fail due to age, corrosion, or elevated temperatures.
 - f. Do not support ceilings directly from permanent metal forms or floor deck. Fasten hangers to cast-in-place hanger inserts, postinstalled mechanical or adhesive anchors, or power-actuated fasteners that extend through forms into concrete.
 - g. When steel framing does not permit installation of hanger wires at spacing required, install carrying channels or other supplemental support for attachment of hanger wires.
 - h. Do not attach hangers to steel deck tabs.
 - i. Do not attach hangers to steel roof deck. Attach hangers to structural members.
 - j. Space hangers not more than **48 inches (1200 mm)** o.c. along each member supported directly from hangers unless otherwise indicated; provide hangers not more than **8 inches (200 mm)** from ends of each member.

- k. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced standards and publications.
- 3. Secure bracing wires to ceiling suspension members and to supports with a minimum of four tight turns. Suspend bracing from building's structural members as required for hangers but without attaching to permanent metal forms, steel deck, or steel deck tabs. Fasten bracing wires into concrete with cast-in-place or postinstalled anchors.
- 4. Install edge moldings and trim of type indicated at perimeter of linear metal ceiling area and where necessary to conceal edges and ends of linear metal pans.
 - a. Screw attach moldings to substrate at intervals not more than **16 inches (400 mm)** o.c. and not more than **3 inches (75 mm)** from ends, leveling with ceiling suspension system to a tolerance of **1/8 inch in 12 feet (3.2 mm in 3.6 m)**. Miter corners accurately and connect securely.
 - b. Do not use exposed fasteners, including pop rivets, on moldings and trim.
- 5. Install suspension system carriers so they are aligned and securely interlocked with one another. Remove and replace dented, bent, or kinked members.
- 6. Cut linear metal pans for accurate fit at borders and at interruptions and penetrations by other work through ceilings. Stiffen edges of cut units as required to eliminate evidence of buckling or variations in flatness exceeding referenced standards for stretcher-leveled metal sheet.
- 7. Install linear metal pans in coordination with suspension system and exposed moldings and trim.
 - a. Align joints in adjacent courses to form uniform, straight joints parallel to room axis in both directions unless otherwise indicated.
 - b. Fit adjoining units to form flush, tight joints. Scribe and cut units for accurate fit at borders and around construction penetrating ceiling.
 - c. Install pans with butt joints using internal pan splices.
 - 1) Joint Configuration: Aligned **OR** Aligned, every other panel length **OR** Staggered a minimum of **12 inches (300 mm)** **OR** Random **OR** As indicated, **as directed**.
 - d. Install directionally textured metal pans in directions indicated.
 - e. Where metal pan ends are visible, install end caps unless trim is indicated.
 - f. Install filler strips where indicated.
 - g. Install sound-absorbent fabric layers in perforated metal pans.
 - h. Install sound-absorbent pads at right angle to perforated metal pans so pads do not hang unsupported.
- 8. Install hold-down clips where indicated.

B. Cleaning

- 1. Clean exposed surfaces of linear metal ceilings, including trim and edge moldings after removing strippable, temporary protective covering if any. Comply with manufacturer's written instructions for stripping of temporary protective covering, cleaning, and touchup of minor finish damage. Remove and replace ceiling components that cannot be successfully cleaned and repaired to permanently eliminate evidence of damage, including dented and bent units.

END OF SECTION 09 54 23 00a

SECTION 09 63 13 00 - BRICK FLOORING

1.1 GENERAL

A. Description Of Work

1. This specification covers the furnishing and installation of materials for brick flooring. Products shall be as follows or as directed by the Owner. Installation procedures shall be in accordance with the product manufacturer's recommendations. Demolition and removal of materials shall be as required to support the work.

B. Summary

1. This Section includes the following:
 - a. Brick flooring set on thickset mortar bed.
 - b. Brick flooring set in thin-set mortar directly on concrete.

C. PRECONSTRUCTION TESTING

1. Preconstruction Adhesion and Compatibility Testing: Submit to latex-additive manufacturer, for testing as indicated below, samples of flooring materials that will contact or affect mortar and grout that contain latex additives.
 - a. Use manufacturer's standard test methods to determine whether mortar and grout materials will obtain optimum adhesion with, and will be nonstaining to, installed brick and other materials constituting brick flooring installation.

D. Submittals

1. Product Data: For each material indicated, except water and aggregates.
2. Samples: For each type of brick and grout indicated.

E. Delivery, Storage, And Handling

1. Store brick on elevated platforms in a dry location. If units are not stored in an enclosed location, cover tops and sides of stacks with waterproof sheeting, securely tied.
2. Store cementitious materials on elevated platforms, under cover, and in a dry location. Do not use cementitious materials that have become damp.
3. Store aggregates where grading and other required characteristics can be maintained and contamination avoided.
4. Store liquids in tightly closed containers protected from freezing.

F. Project Conditions

1. Environmental Limitations: Do not use mortar and grout containing portland cement when temperature of brick, substrates, or materials is below 40 deg F (4.4 deg C).

1.2 PRODUCTS

A. Brick Pavers

1. Brick Pavers: Light-traffic paving brick; ASTM C 902, without frogs or cores in surfaces exposed to view in the completed Work.
 - a. Class SX for exposure to freezing weather, and Class MX for exterior uses that do not expose brick to freezing. Class NX for interior locations.
 - b. Type I for driveways and entrances to public and commercial buildings exposed to extensive abrasion; Type II, exterior walkways and floors in restaurants and stores exposed to intermediate traffic; Type III, floors and patios exposed to low traffic, as in single-family homes.
 - c. Application PS is normal tolerance for mortared joint installation; Application PX is close tolerance for ungrouted joints; Application PA is nonuniform sized for decorative effect.

2. Colors and Textures: As selected from manufacturer's full range.
3. Slip Resistance: Static coefficient of friction of at least 0.6 where used on level surfaces and 0.8 where used on ramps when tested according to ASTM C 1028.
4. Temporary Protective Coating: Precoat exposed surfaces of brick pavers at factory with a temporary protective coating that is compatible with brick, mortar, and grout products.

B. Mortar Setting-Bed Materials

1. Portland Cement: ASTM C 150, Type I or II.
2. Hydrated Lime: ASTM C 207, Type S.
3. Aggregate: ASTM C 144.
4. Latex Additive: Acrylic resin or styrene-butadiene-rubber, as recommended by manufacturer water emulsion, serving as replacement for part or all of gaging water, of type specifically recommended by latex-additive manufacturer for use with field-mixed portland cement and aggregate mortar bed, and not containing a retarder.
5. Cleavage Membrane: Asphalt felt, ASTM D 226, Type I (No. 15); or polyethylene sheeting, ASTM D 4397, **4.0 mils (0.1 mm)** thick, for work over wood subfloor or for isolation of portland cement setting bed from concrete subfloor.
6. Reinforcing Wire Fabric: Galvanized, welded wire fabric, **2 by 2 inches (50.8 by 50.8 mm)** by **0.062-inch (1.57-mm)** diameter; ASTM A 1064, for portland cement setting beds over cleavage membrane.
7. Thin-Set Mortar: Latex-portland cement mortar complying with ANSI A118.4.
 - a. Provide prepackaged, dry-mortar mix containing dry, redispersible, vinyl acetate or acrylic additive to which only water must be added at Project site.
 - b. Provide prepackaged, dry-mortar mix combined with acrylic resin or styrene-butadiene-rubber liquid-latex additive at Project site.
 - c. Provide product that is approved by manufacturer for application thickness of **5/8 inch (16 mm)**.

C. Grout Materials

1. Sand-Portland Cement Grout: ANSI A108.10, composed of white or gray cement and white or colored aggregate as required to produce color indicated.
 - a. Colored Mortar Pigments for Grout: Natural and synthetic iron and chromium oxides, compounded for use in mortar and grout mixes. Use only pigments that have proved, through testing and experience, to be satisfactory for use in portland cement grout.
2. Standard Cement Grout: ANSI A118.6, sanded.
3. Polymer-Modified Tile Grout: ANSI A118.7, sanded.
4. Polymer Type: Ethylene vinyl acetate or acrylic additive; in dry, redispersible form; prepackaged with other dry ingredients.
5. Polymer Type: Acrylic resin or styrene-butadiene rubber in liquid-latex form for addition to prepackaged dry-grout mix.
6. Colors: As selected from manufacturer's full range.
7. Water: Potable.

D. Miscellaneous Materials

1. Expansion- and Control-Joint-Filler Strips: ASTM D 1752, cork or self-expanding cork.
2. Sealer: Acrylic-based, slip-resistant, water-emulsion floor finish complying with ASTM D 4078 and specifically recommended by sealer manufacturer for use indicated.
3. Floor Wax: Formulated for use over sealer indicated, acceptable to sealer manufacturer, and specifically recommended by floor-wax manufacturer for use intended.
 - a. Slip Resistance: Static coefficient of friction of at least 0.5 when tested according to ASTM D 2047.

E. Mixes

1. General: Comply with referenced standards and with manufacturers' written instructions. Discard mortars and grout when they have reached their initial set.

2. Portland Cement-Lime Setting-Bed Mortar: Type S **OR** N, **as directed**, complying with ASTM C 270, Proportion Specification, .
3. Latex-Portland Cement Mortar: Comply with written instructions of latex-additive manufacturer to produce stiff mixture with a moist surface when bed is ready to receive brick.
4. Mortar Bed Bond Coat: Mix neat cement and latex additive **OR** water, **as directed**, to a creamy consistency.
5. Latex-Portland Cement Slurry Bond Coat: Mix portland cement, aggregate, and latex additive to comply with written instructions of latex-additive manufacturer.
6. Thin-Set Mortar: Proportion and mix per written instructions of manufacturer.
7. Job-Mixed Portland Cement Grout: Proportion and mix to match setting-bed mortar, except omit hydrated lime and use enough water to produce a pourable mixture.
8. Job-Mixed Polymer-Modified Portland Cement Grout: Add liquid-latex additive to dry grout mix in proportion and concentration recommended by liquid-latex manufacturer. Proportion cement and aggregate to comply with directions of latex-additive manufacturer.
9. Packaged Grout Mix: Proportion and mix ingredients according to manufacturer's written instructions.

1.3 EXECUTION

A. Installation, General

1. Remove substances, from subfloor, that could impair mortar bond, including curing and sealing compounds, form oil, and laitance.
2. Mix bricks from several pallets or cubes, as they are placed, to produce uniform blend of colors and textures.
3. Cut bricks with motor-driven masonry saw to provide pattern indicated and to fit adjoining work neatly. Use full units without cutting where possible.
4. Joint Pattern: Running bond **OR** Herringbone **OR** Basket weave **OR** As indicated **OR** Match existing brick flooring joint pattern, **as directed**.
 - a. Spaced Joint Widths: Provide nominal **3/8-inch (10-mm) OR 1/2-inch (13-mm), as directed**, joint width with variations not exceeding plus or minus **1/16 inch (1.6 mm) OR 1/8 inch (3 mm), as directed**.
5. Tolerances: Do not exceed **1/16-inch (1.6-mm)** unit-to-unit offset from flush nor **1/8 inch in 24 inches (3 mm in 600 mm)** and **1/4 inch in 10 feet (6 mm in 3 m)** from level, or indicated slope.
6. Expansion and Control Joints: Provide joint filler as backing for sealant-filled joints where indicated. Install joint filler before setting brick flooring.

B. Thickset Mortared Brick Flooring

1. Apply mortar bed to concrete subfloors as follows:
 - a. Saturate concrete subfloor with clean water several hours before placing setting bed. Remove surface water about one hour before placing setting bed.
 - b. Apply mortar bed bond coat over surface of concrete subfloor before placing mortar bed. Limit area of bond coat to avoid its drying out before placing setting bed. Do not exceed **1/16-inch (1.6-mm)** thickness for bond coat.
 - c. Apply mortar bed over bond coat immediately after applying bond coat. Spread and screed to elevations required for accurate setting of brick to finished elevations indicated.
 - d. Brick Wet Set on Workable Mortar Bed: Mix and place only that amount of mortar bed that can be covered with brick before initial set. Cut back, bevel edge, and discard material that has reached initial set before placing brick.
 - e. Brick Set on Cured Mortar Bed: Cure mortar bed for not less than 20 hours at **70 deg F (21 deg C)**.
2. Apply mortar bed over cleavage membrane as follows:
 - a. Place cleavage membrane over subfloor, lapped at least **4 inches (100 mm)** at joints.
 - b. Place reinforcing wire fabric over membrane, lapped at joints by at least one full mesh and supported so mesh becomes embedded in the middle of setting bed. Hold edges back from vertical surfaces approximately **1/2 inch (13 mm)**.

- c. Place mortar bed over cleavage membrane with reinforcing wire fabric fully embedded in middle of setting bed. Spread and screed to uniform thickness at elevations required for accurate setting of brick to finished elevations indicated.
- d. Brick Wet Set on Workable Mortar Bed: Mix and place only that amount of mortar bed that can be covered with brick before initial set. Cut back, bevel edge, and discard material that has reached initial set before placing brick.
- e. Brick Set on Cured Mortar Bed: Cure mortar bed for not less than 20 hours at 70 deg F (21 deg C).
- 3. Install brick either in workable mortar bed or in thin-set mortar bond coat over cured mortar bed at Contractor's option.
- 4. Install brick in workable mortar bed as follows:
 - a. Wet brick before laying if the initial rate of absorption exceeds 30 g/30 sq. in. (30 g/194 sq. cm) per minute when tested per ASTM C 67. Allow brick to absorb the water so it is damp but not wet at the time of laying.
 - b. Place brick before initial set of cement occurs. Immediately before placing brick, apply uniform 1/16-inch- (1.6-mm-) thick, slurry bond coat to bed or to back of each brick.
 - c. Tamp or beat brick with a wooden block or rubber mallet to obtain full contact with setting bed and to bring finished surfaces within indicated tolerances. Set each brick in a single operation before initial set of mortar; do not return to areas already set and disturb bricks for purposes of realigning finished surfaces or adjusting joints.
- 5. Install brick in thin-set mortar bond coat over cured mortar bed as follows:
 - a. Wet brick before laying if the initial rate of absorption exceeds 30 g/30 sq. in. (30 g/194 sq. cm) per minute when tested per ASTM C 67. Allow brick to absorb the water so it is damp but not wet at the time of laying.
 - b. Apply thin-set mortar bond coat to setting bed with notched trowel complying with admixture manufacturer's specifications. Key the mortar into setting bed with flat side of trowel and comb with notched side of trowel in one direction. Apply only as much mortar as can be covered with brick before initial set (15 to 30 minutes).
 - c. Place brick while bond coat is still tacky and before initial set takes place. Immediately before placing on setting bed, apply skim coat of thin-set mortar to back of brick. Place brick by sliding in a direction perpendicular to combed ridges and tamp or beat brick to obtain full contact with setting bed and to bring finished surfaces within indicated tolerances.

C. Thin-Set Mortared Brick Flooring

- 1. Install brick flooring with thin-set mortar on concrete subfloor to comply with the following:
 - a. Wet brick before laying if the initial rate of absorption exceeds 30 g/30 sq. in. (30 g/194 sq. cm) per minute when tested per ASTM C 67. Allow brick to absorb the water so it is damp but not wet at the time of laying.
 - b. Apply thin-set mortar to substrate with notched trowel complying with admixture manufacturer's specifications for notch depth and configuration and in heavy enough layer to provide a minimum mortar-bed thickness of 3/32 to 1/8 inch (2.5 to 3 mm) after bricks are fully embedded. Key the mortar into substrate with flat side of trowel and comb with notched side of trowel in one direction. Apply only as much mortar as can be covered with brick before initial set (15 to 30 minutes).
 - c. Place brick while mortar is still tacky and before initial set takes place. Immediately before placing brick, apply skim coat of thin-set mortar to back of brick. Place brick by sliding in a direction perpendicular to combed ridges and tamp or beat brick with a small beating block to obtain full contact with mortar and to bring finished surfaces within indicated tolerances; do not return to areas already set and disturb bricks for purposes of realigning finished surfaces or adjusting joints.

D. Joint Treatment

- 1. Hand-Tight Joints: Sweep dry mixture of portland cement and sand into joints and then fog surface with water to set mixture.

2. Grouted Joints: Grout brick joints complying with ANSI A108.10.
 - a. Grout joints as soon as possible after initial set of setting bed. After initial set of grout, finish joints by tooling to produce a slightly concave polished joint, free from drying cracks.
 - b. Damp cure grout for seven days, unless otherwise recommended by grout or latex-additive manufacturer.
- E. Repair, Pointing, Cleaning, And Protection
 1. Remove and replace brick that is loose, chipped, broken, stained, or otherwise damaged or that does not match adjoining brick as intended. Provide new brick to match adjoining brick and install in same manner as original brick, with same joint treatment and with no evidence of replacement.
 2. Pointing: During tooling of joints, enlarge voids or holes and completely fill with mortar or grout. Point up joints at sealant joints to provide a neat, uniform appearance, properly prepared for sealant application.
 3. Remove protective coating as recommended by protective coating manufacturer and acceptable to brick and grout manufacturers. Trap and remove coating to prevent it from clogging drains.
 4. Sealing and Waxing: After floor has been cleaned and is thoroughly dry, seal and wax. Apply sealer and wax to comply with written directions of manufacturer of each product.

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Task	Specification	Specification Description
09 63 43 00	09 67 16 00	Resinous Flooring

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SECTION 09 64 00 00 - WOOD FLOORING

1.1 GENERAL

A. Description Of Work

1. This specification covers the furnishing and installation of materials for wood flooring. Products shall be as follows or as directed by the Owner. Installation procedures shall be in accordance with the product manufacturer's recommendations. Demolition and removal of materials shall be as required to support the work.

B. Summary

1. This Section includes:
 - a. Factory-finished wood flooring.
 - b. Field-finished wood flooring.
 - c. Sound control underlayment

C. Action Submittals

1. Product Data: For each type of product indicated.
2. LEED Submittals:
 - a. Product Data for Credit MR 4: For recycled-rubber underlayment, documentation indicating percentages by weight of postconsumer and preconsumer recycled content. Include statement indicating cost for each product having recycled content.
 - b. Certificates for Credit MR 6 OR Credit MR 7: Chain-of-custody certificates certifying that products specified to be made from certified wood comply with forest certification requirements. Include evidence that mill is certified for chain of custody by an FSC-accredited certification body. Include statement indicating cost for each certified wood product.
 - c. Product Data for Credit IEQ 4.1: For wood flooring installation adhesives, documentation including printed statement of VOC content.
 - d. Product Data for Credit IEQ 4.2: For field-applied finishes for wood flooring, documentation including printed statement of VOC content.
 - e. Product Data for Credit IEQ 4.3: For wood flooring installation adhesives and field-applied finishes for wood flooring, documentation including printed statement of VOC content.
 - f. Product Data for Credit IEQ 4.3: For wood flooring, documentation from an independent testing agency indicating compliance with the FloorScore Standard.
 - g. Product Data for Credit IEQ 4.4: For composite wood products, documentation indicating that the bonding agent contains no urea formaldehyde.
 - h. Laboratory Test Reports for Credit IEQ 4: For adhesives, field-applied finishes, flooring system elements, composite wood products and wood flooring systems.
3. Shop Drawings: For each type of floor assembly and accessory. Include plans, elevations, sections, details, and attachments to other work. Include expansion provisions and trim details.
4. Samples for Initial Selection: Manufacturer's color charts showing the full range of colors and finishes available for wood flooring.
5. Samples for Verification: For each type of wood flooring and accessory, with stain color and finish required, approximately 12 inches (300 mm) long and of same thickness and material indicated for the Work and showing the full range of normal color and texture variations expected.

D. Maintenance Material Submittals

1. Furnish extra materials described below, before installation begins, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - a. Wood Flooring: Equal to 1 percent of amount installed for each type of wood flooring indicated.

E. Quality Assurance

1. Manufacturer Qualifications: A qualified manufacturer that is certified for chain of custody by an FSC-accredited certification body.
2. Hardwood Flooring: Comply with NOFMA's "Official Flooring Grading Rules" for species, grade, and cut.
 - a. Certification: Provide flooring that carries NOFMA grade stamp on each bundle or piece.
3. Maple Flooring: Comply with applicable MFMA grading rules for species, grade, and cut.
 - a. Certification: Provide flooring that carries MFMA mark on each bundle or piece.
4. Softwood Flooring: Comply with WCLIB No. 17 grading rules for species, grade, and cut.

F. Delivery, Storage, And Handling

1. Deliver wood flooring materials in unopened cartons or bundles.
2. Protect wood flooring from exposure to moisture. Do not deliver wood flooring until after concrete, masonry, plaster, ceramic tile, and similar wet work is complete and dry.
3. Store wood flooring materials in a dry, warm, ventilated, weathertight location.

G. Project Conditions

1. Conditioning period begins not less than seven days before wood flooring installation, is continuous through installation, and continues not less than seven days after wood flooring installation.
 - a. Environmental Conditioning: Maintain an ambient temperature between **65 and 75 deg F (18 and 24 deg C)** and relative humidity planned for building occupants in spaces to receive wood flooring during the conditioning period.
 - b. Wood Flooring Conditioning: Move wood flooring into spaces where it will be installed, no later than the beginning of the conditioning period.
 - 1) Do not install flooring until it adjusts to relative humidity of, and is at same temperature as, space where it is to be installed.
 - 2) Open sealed packages to allow wood flooring to acclimatize immediately on moving flooring into spaces in which it will be installed.
2. After conditioning period, maintain relative humidity and ambient temperature planned for building occupants.
3. Install factory-finished wood flooring after other finishing operations, including painting, have been completed.

1.2 PRODUCTS

A. Field-Finished Wood Flooring

1. Certified Wood: Provide wood flooring produced from wood obtained from forests certified by an FSC-accredited certification body to comply with FSC STD-01-001, "FSC Principles and Criteria for Forest Stewardship."
2. Solid-Wood Plank Flooring: Kiln dried to 6 to 9 percent maximum moisture content, tongue and groove and end matched, and with backs channeled (kerfed) for stress relief.
 - a. Species and Grade: Select red oak **OR** No. 1 Common red oak **OR** No. 2 Common red oak **OR** MFMA-RL First Grade hard maple **OR** MFMA-RL Second and Better Grade hard maple **OR** C & BTR - Flooring Douglas fir **OR** D - Flooring Douglas fir, **as directed**.
 - b. Cut: Plain sawn **OR** Quarter/rift sawn **OR** Edge grain **OR** Vertical grain, **as directed**.
 - c. Thickness: **3/4 inch (19 mm) OR 25/32 inch (20 mm), as directed.**
 - d. Face Width: **2-1/4 inches (57 mm) OR 3-1/8 inches (79 mm) OR 5-1/8 inches (130 mm), as directed.**
 - e. Lengths: Manufacturer's Standard **OR** Random-length strips complying with applicable grading rules **OR** Lengths required to form pattern indicated, **as directed**.
 - f. Preservative Treatment: Clear, penetrating, water-repellent wood preservative that protects against mold, mildew, staining, and decay fungi; complying with MFMA's written recommendations and applied by immersion.

- g. Simulated Wood Pegs: Contrasting wood pegs at ends of plank flooring pieces.
 3. Solid-Wood Parquet Flooring: Kiln dried to 6 to 9 percent maximum moisture content.
 - a. Species: Red oak **OR** White oak **OR** Ash **OR** Maple **OR** Black cherry, **as directed**.
 - b. Thickness: **5/16 inch (8 mm)** **OR** **11/16 inch (17 mm)** **OR** **1/4 inch (6 mm)**, **as directed**.
 4. Engineered-Wood Flooring: HPVA EF, except bonding agent contains no urea formaldehyde.
 - a. Species: Red oak **OR** White oak **OR** Ash **OR** Beech **OR** Maple **OR** Black cherry, **as directed**.
 - b. Thickness: **1/2 inch (13 mm)** **OR** **3/8 inch (9.5 mm)**, **as directed**.
 - c. Construction: Five **OR** Three, **as directed**, ply.
 - d. Width: **2-1/4 inches (57 mm)** **OR** **3 inches (76 mm)**, **as directed**.
 - e. Length: Manufacturer's standard.
 5. Urethane Finish System: Complete solvent-based, oil-modified **OR** water-based, **as directed**, system of compatible components that is recommended by finish manufacturer for application indicated.
 - a. VOC Content: When calculated according to 40 CFR 59, Subpart D (EPA Method 24), as follows:
 - 1) Finish Coats and Floor Sealers: Not more than 350 g/L.
 - 2) Stains: Not more than 250 g/L.
 - b. Finish Coats: Formulated for multicoat application on wood flooring.
 - c. Stain: Penetrating and nonfading type.
 - 1) Color: Match sample **OR** As selected from manufacturer's full range, **as directed**.
 - d. Floor Sealer: Pliable, penetrating type.
 - e. Finish Coats: Formulated for multicoat application on wood flooring.
 6. Wood Filler: Compatible with finish system components and recommended by filler and finish manufacturers for use indicated. If required to match approved Samples, provide pigmented filler.
- B. Factory-Finished Wood Flooring
1. Certified Wood: Provide wood flooring produced from wood obtained from forests certified by an FSC-accredited certification body to comply with FSC STD-01-001, "FSC Principles and Criteria for Forest Stewardship."
 2. Solid-Wood Flooring: Kiln dried to 6 to 9 percent maximum moisture content; tongue and groove and end matched; and with backs channeled (kerfed) for stress relief.
 - a. Species: Red oak **OR** White oak **OR** Ash **OR** Birch **OR** Maple **OR** Black cherry **OR** Hickory **OR** Walnut, **as directed**.
 - b. Cut: Plain sawn **OR** Quarter/rift sawn **OR** Edge grain **OR** Vertical grain, **as directed**.
 - c. Thickness: **3/4 inch (19 mm)** **OR** **25/32 inch (20 mm)**, **as directed**.
 - d. Face Width: **2-1/4 inches (57 mm)** **OR** **3-1/8 inches (79 mm)** **OR** **5-1/8 inches (130 mm)**, **as directed**.
 - e. Lengths: Random-length strips complying with applicable grading rules **OR** Lengths required to form pattern indicated, **as directed**.
 - f. Edge Style: Square **OR** Beveled (eased), **as directed**.
 - g. Finish: UV urethane system.
 - 1) Color: As selected from manufacturer's full range, **as directed**.
 3. Solid-Wood Parquet Flooring: Kiln dried to 6 to 9 percent maximum moisture content.
 - a. Species: Red oak.
 - b. Thickness: **5/16 inch (8 mm)** **OR** **11/16 inch (17 mm)** **OR** **1/4 inch (6 mm)**, **as directed**.
 - c. Finish: UV urethane **OR** Acrylic impregnated, **as directed**.
 - 1) Color: As selected from manufacturer's full range.
 4. Engineered-Wood Flooring: HPVA EF, except bonding agent contains no urea formaldehyde.
 - a. Species: Red oak **OR** White oak **OR** Ash **OR** Beech **OR** Birch **OR** Maple **OR** Black cherry **OR** Hickory **OR** Walnut, **as directed**.
 - b. Thickness: **1/2 inch (13 mm)** **OR** **3/8 inch (9.5 mm)**, **as directed**.
 - c. Construction: Five **OR** Three ply, **as directed**.
 - d. Width: **2-1/4 inches (57 mm)** **OR** **3 inches (76 mm)**, **as directed**.
 - e. Length: Manufacturer's standard.

- f. Edge Style: Square **OR** Beveled (eased), **as directed**.
- g. Finish: UV urethane **OR** Acrylic impregnated, **as directed**.
 - 1) Color: As selected in manufacturer's full range.
- 5. Engineered-Wood Parquet Flooring: HPVA EF, except bonding agent contains no urea formaldehyde.
 - a. Species: Red oak **OR** Ash **OR** Beech **OR** Maple **OR** Walnut, **as directed**.
 - b. Thickness: **3/8 inch (9.5 mm) OR 1/2 inch (13 mm), as directed**.
 - c. Construction: Five **OR** Three, **as directed**, ply.
 - d. Finish: UV urethane.
 - 1) Color: As selected from manufacturer's full range.

C. Sound Control Underlayment

- 1. Sound Control Underlayment: Sound reducing underlayment consisting of impact-absorbing materials. Minimum Impact Insulation Class (IIC) of 50 **OR** 55, as directed when tested according to ASTM E 492.
- 2. Material: Recycled rubber **OR** Polyurethane foam **OR** Wood fiber **OR** Wood fiber made with binder containing no urea formaldehyde, as directed.
- 3. Thickness: **3/4 inch (19 mm) OR 1/2 inch (13 mm) OR 3/8 inch (9 mm) OR 1/4 inch (6 mm) OR 5/32 inch (4 mm), as directed**.

D. Accessory Materials

- 1. Wood Underlayment: As specified in Division 06 Section "Rough Carpentry".
- 2. Vapor Retarder: ASTM D 4397, polyethylene sheet not less than **6.0 mils (0.15 mm) OR 8.0 mils (0.2 mm)** thick, **as directed**.
- 3. Asphalt-Saturated Felt: ASTM D 4869, Type II.
- 4. Wood Flooring Adhesive: Mastic recommended by flooring and adhesive manufacturers for application indicated.
 - a. Use adhesives that have a VOC content of not more than 100 g/L when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- 5. Trowelable Leveling and Patching Compound: Latex-modified, hydraulic-cement-based formulation approved by wood flooring manufacturer.
- 6. Fasteners: As recommended by manufacturer, but not less than that recommended in NWFA's "Installation Guidelines: Wood Flooring."
- 7. Thresholds and Saddles: To match wood flooring. Tapered on each side.
- 8. Reducer Strips: To match wood flooring. **2 inches (51 mm)** wide, tapered, and in thickness required to match height of flooring.
- 9. Cork Expansion Strip: Composition cork strip.
- 10. Feature Strips: **2-inch- (51-mm-)** wide, square-edged walnut strips furnished in lengths as long as practical and in thickness to match wood flooring.
- 11. Metal Feature Strips: **1/8-by-1/8-inch (3-by-3-mm)** solid-brass strip, designed for inlaying into routed reveal in wood flooring surface.
- 12. Wood air vents and grilles of same species and grade as wood flooring and in sizes indicated on Drawings.

1.3 EXECUTION

A. Examination

- 1. Examine substrates, areas and conditions, with Installer present, for compliance with requirements for maximum moisture content, installation tolerances, and other conditions affecting performance of wood flooring.
- 2. Proceed with installation only after unsatisfactory conditions have been corrected.
- 3. Concrete Slabs: Verify that concrete substrates are dry and moisture-vapor emissions are within acceptable levels according to manufacturer's written instructions.

- a. Moisture Testing: Perform tests so that each test area does not exceed **200 sq. ft. (18.6 sq. m)**, and perform no fewer than two tests in each installation area and with test areas evenly spaced in installation areas.
 - 1) Perform anhydrous calcium chloride test per ASTM F 1869, as follows:
 - a) Proceed with installation only after substrates have maximum moisture-vapor-emission rate of **3 lb of water/1000 sq. ft. (1.36 kg of water/92.9 sq. m) OR 4.5 lb of water/1000 sq. ft. (2.04 kg of water/92.9 sq. m)**, as directed in 24 hours.
 - 2) Perform tests recommended by manufacturer. Proceed with installation only after substrates pass testing.
- B. Preparation
 1. Concrete Slabs: Grind high spots and fill low spots on concrete substrates to produce a maximum **1/8-inch (3-mm)** deviation in any direction when checked with a **10-foot (3-m)** straight edge.
 - a. Use trowelable leveling and patching compounds, according to manufacturer's written instructions, to fill cracks, holes, and depressions in substrates.
 2. Remove coatings, including curing compounds, and other substances on substrates that are incompatible with installation adhesives and that contain soap, wax, oil, or silicone, using mechanical methods recommended by manufacturer. Do not use solvents.
 3. Broom or vacuum clean substrates to be covered immediately before product installation. After cleaning, examine substrates for moisture, alkaline salts, carbonation, or dust. Proceed with installation only after unsatisfactory conditions have been corrected.
- C. Installation
 1. Comply with flooring manufacturer's written installation instructions, but not less than applicable recommendations in NWFA's "Installation Guidelines: Wood Flooring."
 2. Wood Sleepers and Subfloor: Install according to requirements in Division 06 Section "Rough Carpentry".
 3. Wood Underlayment: Install according to requirements in Division 06 Section "Rough Carpentry".
 4. Provide expansion space at walls and other obstructions and terminations of flooring as indicated on Drawings **OR** of not less than **3/4 inch (19 mm)**, **as directed**.
 5. Vapor Retarder: Comply with NOFMA's "Installing Hardwood Flooring" for vapor retarder installation and the following:
 - a. Wood Flooring Nailed to Sleepers over Concrete: Install flooring over a layer of polyethylene sheet with edges overlapped over sleepers and turned up behind baseboards.
 - b. Wood Flooring Nailed to Sleepers over Concrete: Install flooring over a layer of polyethylene sheet with edges overlapped over sleepers and turned up behind baseboards.
 - c. Wood Flooring Installed Directly on Concrete: Install a layer of polyethylene sheet according to flooring manufacturer's written instructions.
 6. Sound Control Underlayment: Install over vapor retarder in accordance with manufacturer's written instructions.
 7. Solid-Wood Flooring: Blind nail or staple flooring to substrate.
 - a. For flooring of face width more than **3 inches (75 mm)**, do the following:
 - 1) Install countersunk screws at each end of each piece in addition to blind nailing. Cover screw heads with wood plugs glued flush with flooring.
 - 2) Install no fewer than 2 countersunk nails at each end of each piece, spaced not more than **16 inches (406 mm)** along length of each piece, in addition to blind nailing. Fill holes with matching wood filler.
 8. Solid-Wood Parquet Flooring: Set in adhesive.
 9. Engineered-Wood Flooring: Set in adhesive **OR** Nail or staple **OR** Install floating floor, **as directed**.
- D. Field Finishing

1. Machine-sand flooring to remove offsets, ridges, cups, and sanding-machine marks that would be noticeable after finishing. Vacuum and tack with a clean cloth immediately before applying finish.
 - a. Comply with applicable recommendations in NWFA's "Installation Guidelines: Wood Flooring."
2. Fill open-grained hardwood.
3. Fill and repair wood flooring seams and defects.
4. Apply floor-finish materials in number of coats recommended by finish manufacturer for application indicated, but not less than one coat of floor sealer and three finish coats.
 - a. Apply stains to achieve an even color distribution matching approved Samples.
 - b. For water-based finishes, use finishing methods recommended by finish manufacturer to minimize grain raise.
5. Cover wood flooring before finishing.
6. Do not cover wood flooring after finishing until finish reaches full cure, and not before seven days after applying last finish coat.

E. Protection

1. Protect installed wood flooring during remainder of construction period with covering of heavy kraft paper or other suitable material. Do not use plastic sheet or film that might cause condensation.
 - a. Do not move heavy and sharp objects directly over kraft-paper-covered wood flooring. Protect flooring with plywood or hardboard panels to prevent damage from storing or moving objects over flooring.

END OF SECTION 09 64 00 00



Task	Specification	Specification Description
09 64 13 00	09 64 00 00	Wood Flooring

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SECTION 09 64 23 00 - WOOD SPORTS-FLOOR ASSEMBLIES

1.1 GENERAL

A. Description Of Work

1. This specification covers the furnishing and installation of materials for wood sports-floor assemblies. Products shall be as follows or as directed by the Owner. Installation procedures shall be in accordance with the product manufacturer's recommendations. Demolition and removal of materials shall be as required to support the work.

B. Summary

1. This Section includes wood sports-floor assemblies.

C. Submittals

1. Product Data: For each type of product indicated.
2. Shop Drawings: Show installation details including location and layout of each type of floor assembly and accessory. Include the following:
 - a. Expansion provisions and trim details.
 - b. Layout, colors, widths, and dimensions of game lines and markers.
 - c. Locations of floor inserts for athletic equipment installed through flooring assembly.
3. Samples: For each exposed finish.
4. LEED Submittals:
 - a. Product Data for Credit EQ 4.1: For wood sports-floor assembly installation adhesives, including printed statement of VOC content.
 - b. Product Data for Credit EQ 4.2: For field-applied finishes and game-line and marker paints, including printed statement of VOC content.
 - c. Certificates for Credit MR 7: Chain-of-custody certificates certifying that wood flooring complies with forest certification requirements. Include evidence that manufacturer is certified for chain of custody by an FSC-accredited certification body.
 - 1) Include statement indicating costs for each certified wood product.
5. Maintenance data.

D. Quality Assurance

1. Manufacturer Qualifications: A qualified manufacturer that is certified for chain of custody by an FSC-accredited certification body.
2. Installer Responsibilities: Include installation and field finishing of sports-floor assembly components and accessories, and application of game lines and markers.
3. Forest Certification: Provide wood components produced from wood obtained from forests certified by an FSC-accredited certification body to comply with FSC STD-01-001, "FSC Principles and Criteria for Forest Stewardship."
4. Maple Flooring: Comply with MFMA grading rules for species, grade, and cut.
 - a. Certification: Provide flooring that carries MFMA mark on each bundle or piece.

E. Delivery, Storage, And Handling

1. Deliver assembly materials in unopened cartons or bundles.
2. Protect wood from exposure to moisture. Do not deliver wood components until after concrete, masonry, plaster, ceramic tile, and similar wet work is complete and dry.
3. Store wood components in a dry, warm, well-ventilated, weathertight location and in a horizontal position.

F. Field Conditions

1. Conditioning period begins not less than seven days before sports-floor assembly installation, is continuous through installation, and continues not less than seven days after sports-floor installation.

- a. Environmental Conditioning: Maintain an ambient temperature between **65 and 75 deg F (18 and 24 deg C)** and relative humidity planned for building occupants, but not less than 35 percent or more than 50 percent, in spaces to receive sports-floor assemblies during the conditioning period.
- b. Wood Conditioning: Move wood components into spaces where they will be installed, no later than beginning of the conditioning period.
 - 1) Do not install sports-floor assemblies until wood components adjust to relative humidity of, and are at same temperature as, spaces where they are to be installed.
 - 2) Open sealed packages to allow wood components to acclimatize immediately on moving wood components into spaces in which they will be installed.
- c. After conditioning period, maintain relative humidity and ambient temperature planned for building occupants.
- d. Install sports-floor assemblies after other finishing operations, including painting, have been completed.

1.2 PRODUCTS

A. Description

1. System Type: Floating **OR** Fixed **OR** Anchored resilient **OR** Portable, as directed.
2. Overall System Height: **2-1/8 inches (54 mm) OR 2-1/4 inches (57 mm) OR 2-1/2 inches (64 mm), as directed.**

B. Performance

1. Provide wood athletic flooring systems tested by a qualified testing agency according to DIN V 18032-2 and shown to meet the following requirements:
 - a. Shock Absorption: Minimum 53 percent.
 - b. Vertical Deflection: Minimum **0.09 inch (2.3 mm).**
 - c. Area of Deflection: Maximum 15 percent.
 - d. Ball Bounce: Minimum **90** percent.
 - e. Surface Friction: Not less than 0.5 or more than 0.7.
 - f. Rolling Loads: No damage when subjected to **337 lbf (1500 N)** applied through a single wheel.

C. Flooring Material

1. Random-Length Strip Flooring: Northern hard maple (*Acer saccharum*), kiln dried, random length, tongue and groove, and end matched.
 - a. Grade: MFMA-RL First **OR** Second and Better **OR** Third and Better, **as directed.**
 - 1) Exception: For areas under stacked portion of telescoping bleachers that are normally concealed from view, provide Third and Better Grade.
 - b. Cut: Edge **OR** Flat, **as directed.**
 - c. Thickness: **25/32 inch (20 mm) OR 33/32 inch (26 mm), as directed.**
 - d. Face Width: **2-1/4 inches (57 mm) OR 1-1/2 inches (38 mm), as directed.**
2. Finger-Jointed Strip Flooring: Northern hard maple (*Acer saccharum*), kiln dried, random length, tongue and groove, and end matched.
 - a. Grade: MFMA-RL First **OR** Second and Better **OR** Third and Better, **as directed.**
 - 1) Exception: For areas under stacked portion of telescoping bleachers that are normally concealed from view, provide Third and Better Grade.
 - b. Cut: Edge **OR** Flat, **as directed.**
 - c. Thickness: **25/32 inch (20 mm) OR 33/32 inch (26 mm), as directed.**
 - d. Face Width: **2-1/4 inches (57 mm) OR 1-1/2 inches (38 mm), as directed.**
3. Parquet Flooring: Northern hard maple (*Acer saccharum*), kiln dried, edge grain, and square edge.
 - a. Grade: MFMA-PQ Second and Better **OR** Third and Better, **as directed.**

- b. Thickness: Not less than **5/16 inch (8 mm) OR 3/8 inch (10 mm) OR 7/16 inch (11 mm) OR 1/2 inch (13 mm) OR 11/16 inch (17 mm), as directed.**
 - c. Picket Dimensions:
 - 1) Width: **7/8 inch (22 mm) or 1-1/8 inches (29 mm) OR 7/8 inch (22 mm) OR 1-1/8 inches (29 mm), as directed.**
 - 2) Length: **6 inches (152 mm) OR 9 inches (229 mm), as directed.**
- D. Subfloor Materials
1. Board Underlayment: Nominal **1-by-6-inch (25-by-150-mm)** graded boards; of SPIB No. 2 Southern pine, WCLIB Construction grade (any species), or WWPA No. 3 (any species), dried to 15 percent moisture content.
 2. Plywood Underlayment: APA rated, C-D Plugged, exterior glue, tongue and groove, **15/32 inch (12 mm) OR 23/32 inch (18 mm), as directed, thick.**
 3. Wood Sleepers: Standard grade; **48 inches (1200 mm)** long; kiln-dried Eastern hemlock, fir, pine, or spruce.
 - a. Size: Nominal **2 by 3 inches (50 by 75 mm) OR 2 by 4 inches (50 by 100 mm), as directed.**
 - b. Sleeper Anchors: Manufacturer's standard, but not less than steel drive pins recommended by anchor manufacturer to achieve minimum **900-lbf (4000-N)** pullout strength.
 - c. Sleeper Shims: In size and type recommended in writing by flooring manufacturer for application indicated.
 - d. Asphalt Primer: ASTM D 41.
 - e. Asphalt Mastic: ASTM D 312, Type I, cold-applied dead-level asphalt or Type III, hot-applied steep asphalt, as recommended in writing by manufacturer.
 4. Channels: Manufacturer's standard as indicated by product designation above.
 - a. Channel Anchors: Manufacturer's standard but not less than modified steel drive pins recommended by anchor manufacturer to achieve minimum **900-lbf (4000-N)** pullout strength.
 - b. Clips: Manufacturer's standard as indicated by product designation above.
 5. Resilient Pads: With air voids for resiliency and installed at manufacturer's standard spacing for product designation indicated above.
 - a. Material: PVC **OR** Rubber **OR** Neoprene, **as directed.**
 - b. Thickness: **3/8 inch (10 mm) OR 7/16 inch (11 mm) OR 5/8 inch (16 mm) OR 3/4 inch (19 mm), as directed.**
 6. Resilient Underlayment: Flexible, multicellular, closed-cell, expanded polyethylene-foam sheet; **1/2 inch (13 mm)** thick; nominal **2-lb/cu. ft. (32-kg/cu. m)** density, **as directed.**
- E. Finishes
1. Floor-Finish System: System of compatible components recommended in writing by flooring manufacturer, and MFMA approved.
 - a. Floor-Sealer Formulation: Pliable, penetrating type. MFMA Group 1, Sealers.
 - b. Finish-Coat Formulation: Formulated for gloss finish indicated and multicoat application.
 - 1) Type: MFMA Group 3, Gymnasium-Type Surface Finishes **OR** MFMA Group 5, Water-Based Finishes, **as directed.**
 - c. Game-Line and Marker Paint: Industrial enamel compatible with finish coats and recommended in writing by manufacturers of finish coats, and paint for this use.
 - d. VOC Content: Provide products that comply with the following limits for VOC content when calculated according to 40 CFR 59, Subpart D (EPA Method 24):
 - 1) Floor Sealers and Finish Coats: VOC content of not more than 350 g/L.
 - 2) Game-Line and Marker Paint: VOC content of not more than 150 g/L.
 - e. VOC Emissions: Provide products that comply with the maximum allowable concentrations of VOCs when tested according to California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

F. Accessories

1. Vapor Retarder: ASTM D 4397, polyethylene sheet not less than **6 mils (0.15 mm)** thick.
2. Resilient Wall Base: Molded, vented, rubber or vinyl cove base; **4 by 3 by 48 inches (100 by 75 by 1200 mm)**; with premolded outside corners.
 - a. Color: Black **OR** Brown, **as directed**.
3. Wood Wall Base: Nominal **1-by-3-inch (25-by-75-mm)** wood base **OR** Built-up wood base as indicated on Drawings, **as directed**, matching species, grade, and cut of wood flooring.
4. Thresholds: As specified in Division 08 Section "Door Hardware".
5. Fasteners: Type and size recommended by manufacturer, but not less than those recommended by MFMA for application indicated.
6. Trowelable Leveling and Patching Compound: Latex-modified, hydraulic-cement-based formulation approved by sports-floor manufacturer.
7. Adhesives: Manufacturer's standard for application indicated.
 - a. Concrete Primers: Manufacturer's standard for application indicated.
 - b. Use adhesive and primer, if any, that have a VOC content of 100 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
8. Floor-Finish System: System of compatible components recommended in writing by flooring manufacturer and MFMA approved.
 - a. Type: MFMA Group 3, Gymnasium Type (Surface) Finishes; urethane-oil type **OR** Group 5, Water Based Finishes; polyurethane, **as directed**.
 - b. Floor-Sealer Formulation: Pliable, penetrating type.
 - c. Finish-Coat Formulation: Formulated for gloss finish and multicoat application.
 - d. Game-Line and Marker Paint: Industrial enamel compatible with finish coats and recommended in writing by manufacturers of finish coats, and paint for this use.
 - e. VOC content: Provide products that comply with the following limits for VOC content when calculated according to 40 CFR 59, Subpart D (EPA Method 24):
 - 1) Floor Sealers and Finish Coats: VOC content of not more than 350 g/L.
 - 2) Game-Line and Marker Paint: VOC content of not more than 150 g/L.

1.3 EXECUTION**A. Preparation**

1. Grind high spots and fill low spots on concrete substrates to produce a maximum **1/8-inch (3-mm)** deviation in any direction when checked with a **10-foot (3-m)** straight edge.
 - a. Use trowelable leveling and patching compounds, according to manufacturer's written instructions, to fill cracks, holes, and depressions in substrates.
2. Remove coatings including curing compounds and other substances on substrates that are incompatible with installation adhesives and that contain soap, wax, oil, or silicone; use mechanical methods recommended by manufacturer. Do not use solvents.
3. Broom and vacuum clean substrates to be covered immediately before product installation. After cleaning, examine substrates for moisture, alkaline salts, carbonation, or dust. Proceed with installation only after unsatisfactory conditions have been corrected.

B. Installation

1. General: Comply with sports-floor assembly manufacturer's written instructions, but not less than written recommendations of MFMA applicable to flooring type indicated.
2. Pattern: Lay flooring parallel with long dimension of space to be floored, unless otherwise indicated.
3. Expansion Spaces: Provide as indicated, but not less than that required by manufacturer's written instructions and MFMA's written recommendations at walls and other obstructions, and at interruptions and terminations of flooring.
 - a. Cover expansion spaces with base molding, trim, and saddles, as indicated on Drawings.
4. Vapor Retarder: Install with joints lapped a minimum of **6 inches (150 mm)** and sealed.

5. Underlayment: Install perpendicular to direction of flooring, staggering end joints in adjacent rows.
6. Sleepers:
 - a. Install perpendicular to direction of flooring, staggering end joints a minimum of **24 inches (610 mm)**.
 - b. Space at spacing recommended by manufacturer for system components indicated **OR 12 inches (305 mm) o.c. OR 9 inches (229 mm) o.c. OR 8 inches (203 mm) o.c., as directed.**
 - c. Shim and level sleepers and install anchors at spacing recommended by manufacturer, but not less than **30 inches (760 mm) o.c.**
 - d. Anchor predrilled sleepers through resilient pads.
7. Channels: Anchor channels to substrate according to manufacturer's written instructions.
 - a. Install wood strip flooring across channels.
 - b. Insert steel clip at each intersection of a flooring strip with a channel.
8. Strip Flooring: Mechanically fasten perpendicular to supports.
9. Parquet Flooring: Adhere to substrates according to manufacturer's written instructions.
10. Installation Tolerances: **1/8 inch in 10 feet (3 mm in 3 m)** of variance from level.

C. Sanding And Finishing

1. Follow applicable recommendations in MFMA's "Industry Recommendations for Sanding, Sealing, Court Lining, Finishing, and Resurfacing of Maple Gym Floors."
2. Allow installed flooring to acclimate to ambient conditions for at least 10 days before sanding.
3. Machine sand with coarse, medium, and fine grades of sandpaper to achieve a level, smooth, uniform surface without ridges or cups. Remove sanding dust by tack or vacuum.
4. Finish: Apply seal and finish coats of finish system according to finish manufacturer's written instructions. Provide not less than four coats total and not less than two finish coats.
 - a. Water-Based Finishes: Use finishing methods recommended by finish manufacturer to reduce grain raise and sidebonding effect.
 - b. Game Lines and Markers: Apply game-line and marker paint between final seal coat and first finish coat according to paint manufacturer's written instructions.
 - 1) Mask flooring at game lines and markers, and apply paint to produce lines and markers with sharp edges.
 - 2) Where game lines cross, break minor game line at intersection; do not overlap lines.
 - 3) Apply game lines and markers in widths and colors according to requirements indicated on Drawings.
 - 4) Apply finish coats after game-line and marker paint is fully cured.

D. Protection

1. Protect sports floors during remainder of construction period to allow finish to cure and to ensure that flooring and finish are without damage or deterioration at time of Final Completion.
 - a. Do not cover sports floors after finishing until finish reaches full cure, and not before seven days after applying last finish coat.
 - b. Do not move heavy and sharp objects directly over sports floors. Protect fully cured floor finishes and surfaces with plywood or hardboard panels to prevent damage from storing or moving objects over sports floors.

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Task	Specification	Specification Description
09 64 23 00	09 64 00 00	Wood Flooring
09 64 29 00	09 64 00 00	Wood Flooring
09 64 29 00	09 64 23 00	Wood Sports-Floor Assemblies
09 64 66 00	09 64 00 00	Wood Flooring
09 64 66 00	09 64 23 00	Wood Sports-Floor Assemblies

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SECTION 09 65 13 13 - CORK FLOORING

1.1 GENERAL

A. Description Of Work

1. This specification covers the furnishing and installation of materials for cork flooring. Products shall be as follows or as directed by the Owner. Installation procedures shall be in accordance with the product manufacturer's recommendations. Demolition and removal of materials shall be as required to support the work.

B. Summary

1. Section Includes:
 - a. Cork floor tile.
 - b. Engineered cork floor tile.
 - c. Cork rubber floor tile.
 - d. Cork floating floor system.

C. Submittals

1. Product Data: For each type of product indicated.
2. LEED Submittals:
 - a. Product Data for Credit MR 6.0: For cork flooring, including printed statement of costs for each rapidly renewable material.
 - b. Product Data for Credit EQ 4.1: For adhesive, including printed statement of VOC content.
 - c. Product Data for Credit EQ 4.2: For field-applied sealer and finish coatings, including printed statement of VOC content.
 - d. Product Data for Credit EQ 4.4: For cork flooring and MDF, including printed statement indicating that the bonding agent and adhesive contain no urea-formaldehyde resins.
3. Shop Drawings: For each type of cork flooring. Include cork flooring layouts, edges, columns, doorways, enclosing partitions, built-in furniture, cabinets, and cutouts.
4. Samples: Full-size units of each shade and finish **OR** shade, pattern, and finish **OR** color and pattern, **as directed**, of cork flooring required.
5. Maintenance Data: For each type of cork flooring to include in maintenance manuals.

D. Quality Assurance

1. Fire-Test-Response Characteristics: As determined by testing identical products according to ASTM E 648 or NFPA 253 by a qualified testing agency.
 - a. Critical Radiant Flux Classification: Class I, not less than 0.45 W/sq. cm **OR** Class II, not less than 0.22 W/sq. cm, **as directed**.
2. Product Certificates: For cork floating floor system, from manufacturer, certifying that MDF core contains no urea-formaldehyde resins.

E. Delivery, Storage, And Handling

1. Store cork flooring and installation materials in dry spaces protected from the weather, with ambient temperatures maintained within range recommended by manufacturer, but not less than **50 deg F (10 deg C)** or more than **90 deg F (32 deg C)**. Store cork flooring on flat surfaces.

F. Project Conditions

1. Maintain ambient temperatures within range recommended by manufacturer, but not less than **65 deg F (18 deg C)** or more than **75 deg F (24 deg C)** where relative humidity is between 45 and 65 percent, in spaces to receive cork flooring during the following time periods:
 - a. 72 hours before installation.
 - b. During installation.
 - c. 72 hours after installation.

2. Until Final Completion, maintain ambient temperatures within range recommended by manufacturer, but not less than **65 deg F (18 deg C)** or more than **75 deg F (24 deg C)**.
3. Close spaces to traffic during cork flooring installation.
4. Close spaces to traffic for 72 hours after cork flooring installation.
5. Install cork flooring after other finishing operations, including painting, have been completed.

1.2 PRODUCTS

A. Cork Floor Tile

1. Cork Floor Tile: Composed of 100 percent natural cork bark and recycled cork granules and set in a natural or synthetic, flexible resin matrix; homogeneous and uniform in composition throughout the tile thickness.
2. Provide cork floor tile made with adhesives and binders that do not contain urea-formaldehyde resins.
3. Minimum Density: **30 lb/cu. ft. (480 kg/cu. m) OR 34 lb/cu. ft. (544 kg/cu. m) OR 37 lb/cu. ft. (592 kg/cu. m), as directed.**
4. Thickness: Nominal **0.180 inch (4.8 mm) OR Nominal 0.312 inch (8.0 mm), as directed.**
5. Size: **12 by 12 inches (305 by 305 mm) OR 12 by 24 inches (305 by 610 mm) OR 24 by 24 inches (610 by 610 mm), as directed.**
6. Shade: Light **OR** Medium **OR** Dark **OR** As indicated by manufacturer's designations **OR** Match sample, **as directed.**
7. Finish: Sanded or unfinished **OR** Waxed **OR** Polyurethane **OR** Polyurethane containing UV inhibitors **OR** Acrylic **OR** As indicated by manufacturer's designations **OR** Match sample, **as directed.**

B. Engineered Cork Floor Tile

1. Engineered Cork Floor Tile: Composed of 100 percent natural cork bark and recycled cork granules with laminated, patterned cork veneers and set in a natural or synthetic, flexible resin matrix; homogeneous and uniform in composition throughout the tile thickness.
2. Provide cork floor tile made with adhesives and binders that do not contain urea-formaldehyde resins.
3. Minimum Density: **30 lb/cu. ft. (480 kg/cu. m) OR 34 lb/cu. ft. (544 kg/cu. m) OR 37 lb/cu. ft. (592 kg/cu. m), as directed.**
4. Thickness: Nominal **0.180 inch (4.8 mm) OR Nominal 0.312 inch (8.0 mm), as directed.**
5. Size: **12 by 12 inches (305 by 305 mm) OR 12 by 24 inches (305 by 610 mm) OR 24 by 24 inches (610 by 610 mm), as directed.**
6. Shade: Light **OR** Medium **OR** Dark **OR** As indicated by manufacturer's designations **OR** Match sample, **as directed.**
7. Pattern: As indicated by manufacturer's designations **OR** Match sample, **as directed.**
8. Finish: Sanded or unfinished **OR** Waxed **OR** Polyurethane **OR** Polyurethane containing UV inhibitors **OR** Acrylic **OR** As indicated by manufacturer's designations **OR** Match sample, **as directed.**

C. Cork Rubber Floor Tile

1. Cork Rubber Floor Tile: Composed of 70 percent natural cork granules and 30 percent rubber granules combined with fade-resistant pigments; homogeneous and uniform in composition throughout the tile thickness.
2. Provide cork rubber floor tile made with adhesives and binders that do not contain urea-formaldehyde resins.
3. Physical Characteristics:
 - a. Minimum Density: **78 lb/cu. ft. (1249 kg/cu. m).**
 - b. Minimum Tensile Strength: **700 psi (4.8 MPa).**
4. Thickness: Nominal **0.125 inch (3.2 mm).**
5. Size: **18 by 18 inches (450 by 450 mm).**

6. Texture: Lightly textured wear surface.
 7. Colors and Patterns: As indicated by manufacturer's designations **OR** Match sample **OR** As selected from full range of industry colors, **as directed**.
- D. Cork Floating Floor System
1. Cork Floating Floor System: Laminated planks made of two cork layers, top and bottom, sandwiched around an MDF core and containing no urea-formaldehyde resins.
 2. Plank Density:
 - a. Cork Top Layer: **28 lb/cu. ft. (448 kg/cu. m)** **OR** Manufacturer's standard density, **as directed**.
 - b. Interlocking MDF Core: **45 lb/cu. ft. (720 kg/cu. m)** **OR** Manufacturer's standard density, **as directed**.
 - c. Cork Underlayment Layer: **13 lb/cu. ft. (208 kg/cu. m)** **OR** Manufacturer's standard density, **as directed**.
 3. Plank Thickness: Nominal **0.450-inch (11.4-mm)** overall thickness made up as follows:
 - a. Cork Top Layer: Nominal **0.125 inch (3.2 mm)** **OR** Manufacturer's standard dimension, **as directed**.
 - b. Interlocking MDF Core: Nominal **0.250 inch (6.3 mm)** **OR** Manufacturer's standard dimension, **as directed**.
 - c. Cork Underlayment Layer: Nominal **0.078 inch (2.0 mm)** **OR** Manufacturer's standard dimension, **as directed**.
 4. Plank Size: **18 by 18 inches (450 by 450 mm)** **OR** **36 by 12 inches (900 by 305 mm)**, **as directed**.
 5. Plank Edge: Tongue-and-groove type **OR** Manufacturer's standard interlock, **as directed**.
 6. Shade: Light **OR** Medium **OR** Dark **OR** As indicated by manufacturer's designations **OR** Match sample, **as directed**.
 7. Pattern: As indicated by manufacturer's designations **OR** Match sample, **as directed**.
 8. Finish: Sanded or unfinished **OR** Waxed **OR** Polyurethane **OR** Polyurethane containing UV inhibitors **OR** Acrylic **OR** As indicated by manufacturer's designations **OR** Match sample, **as directed**.
- E. Installation Materials
1. Trowelable Leveling and Patching Compounds: Latex-modified, portland cement-based or blended hydraulic cement-based formulation provided or approved by cork flooring manufacturer for applications indicated.
 2. Vapor Retarder: ASTM D 4397, polyethylene sheet not less than **6.0 mils (0.15 mm)** **OR** **8.0 mils (0.2 mm)**, **as directed**, thick.
 3. Adhesive: Water-resistant products as recommended by manufacturer to suit cork flooring and substrate conditions indicated.
 - a. Use adhesives that have a VOC content of not more than 50 g/L when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- F. Field-Applied Finishes
1. Cork Sealer: Product as recommended by cork flooring manufacturer.
 - a. Use sealers that have a VOC content of not more than 350 g/L when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 2. Paste Wax: Products as recommended by cork flooring manufacturer.
 3. Finish Coatings: Products containing UV inhibitors as recommended by cork flooring manufacturer.
 - a. Use finish coatings that have a VOC content of not more than 350 g/L when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 4. Cork Rubber Tile Sealer: Product as recommended by cork rubber floor tile manufacturer.
 - a. Use sealers that have a VOC content of not more than 350 g/L when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

1.3 EXECUTION

A. Preparation

1. Prepare substrates according to cork flooring manufacturer's written instructions to ensure adhesion of cork flooring.
2. Concrete Substrates: Prepare according to ASTM F 710.
 - a. Verify that substrates are dry and free of curing compounds, sealers, and hardeners.
 - b. Remove substrate coatings and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, using mechanical methods recommended by manufacturer. Do not use solvents.
 - c. Alkalinity and Adhesion Testing: Perform tests recommended by cork flooring manufacturer. Proceed with installation only after substrates pass testing.
 - d. Moisture Testing: Perform tests recommended by cork flooring manufacturer and as follows. Proceed with installation only after substrates pass testing.
 - 1) Perform anhydrous calcium chloride test according to ASTM F 1869. Proceed with installation only after substrates have maximum moisture-vapor emission rate of **3 lb of water/1000 sq. ft. (1.36 kg of water/92.9 sq. m)** in 24 hours.
 - 2) Perform relative humidity test using in situ probes according to ASTM F 2170. Proceed with installation only after substrates have a maximum 75 percent relative humidity level measurement.
3. Access Flooring Panels: Remove protective film of oil or other coating using method recommended by access flooring manufacturer.
4. Fill cracks, holes, and depressions in substrates with trowelable leveling and patching compound and remove bumps and ridges to produce a uniform and smooth substrate.
5. Do not install cork flooring until materials are same temperature as space where they are to be installed.
 - a. Move cork flooring products and installation materials into spaces where they will be installed at least 72 hours in advance of installation.
6. Immediately before installation, sweep and vacuum clean substrates to be covered by cork flooring products.

B. Floor Tile Installation

1. Comply with cork flooring manufacturer's written instructions for installing cork flooring.
2. Mix floor tiles from each carton together to ensure uniform distribution of shade.
3. Discard broken, cracked, chipped, or deformed floor tiles.
4. Lay out floor tiles from center marks established with principal walls, discounting minor offsets, so tiles at opposite edges of room are of equal width. Adjust as necessary to avoid using cut widths that equal less than one-half tile at perimeter.
5. Lay floor tiles square with room axis **OR** at a 45-degree angle with room axis **OR** in ashlar or staggered joint pattern **OR** in pattern indicated, **as directed**.
6. Apply adhesive to substrate and set floor tiles in adhesive.
7. Scribe, cut, and fit floor tiles to butt neatly and tightly to vertical surfaces and permanent fixtures including built-in furniture, cabinets, pipes, outlets, and door frames.
8. Extend floor tiles into toe spaces, door reveals, closets, and similar openings. Extend floor tiles to center of door openings.
9. Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating on floor tiles as marked on substrates. Use chalk or other nonpermanent, nonstaining marking device.
10. Install floor tiles on covers for telephone and electrical ducts, building expansion-joint covers, and similar items in finished floor areas. Maintain overall continuity of shade and finish **OR** shade, pattern, and finish **OR** color and pattern, **as directed**, between pieces of tile installed on covers and adjoining tiles. Tightly adhere tile edges to substrates that abut covers and to cover perimeters.

C. Cork Floating Floor System Installation

1. Comply with manufacturer's written instructions for installing cork floating floor system.
2. Install continuous vapor retarder over substrate, taping side and end laps.
3. Mix floor planks from several cartons to ensure uniform distribution of shade.
4. Discard broken, cracked, chipped, or deformed floor planks.
5. Do not attach floor planks to substrate.
6. Tightly interlock and adhere plank edges with adhesive. Remove excess adhesive from top surface of planks.
7. Lay floor planks in pattern indicated.
8. Use spacers to keep planks from shifting as subsequent rows are added. Remove spacers after installing cork floating floor system.
9. Maintain expansion space at walls and other obstructions and terminations of flooring as indicated on Drawings **OR** of not less than **3/8 inch (9.5 mm)**, **as directed**.
10. Extend floor planks into toe spaces, door reveals, closets, and similar openings. Extend floor planks to center of door openings.
11. Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating on floor planks as marked on substrates. Use chalk or other nonpermanent, nonstaining marking device.

D. Field-Applied Finishes

1. Apply finishes according to cork flooring manufacturer's written instructions.
2. Cork Sealer: Apply one **OR** two, **as directed**, coat(s).
3. Paste Wax: Apply one **OR** two **OR** three, **as directed**, coat(s).
4. Finish Coatings: Apply two **OR** three, **as directed**, coat(s).
5. Cork Rubber Tile Sealer: Apply one **OR** two, **as directed**, coat(s).

E. Cleaning And Protection

1. Comply with manufacturer's written instructions for cleaning and protecting cork flooring.
2. Remove adhesive and other blemishes from exposed surfaces.
3. Sweep and vacuum surfaces thoroughly.
4. Damp-mop surfaces to remove marks and soil.
5. Protect cork flooring products from mars, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during remainder of construction period.
6. Cover cork flooring until Final Completion.

END OF SECTION 09 65 13 13

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SECTION 09 65 13 13a - RESILIENT WALL BASE AND ACCESSORIES

1.1 GENERAL

A. Description Of Work

1. This specification covers the furnishing and installation of materials for resilient wall base and accessories. Products shall be as follows or as directed by the Owner. Installation procedures shall be in accordance with the product manufacturer's recommendations. Demolition and removal of materials shall be as required to support the work.

B. Summary

1. Section Includes:
 - a. Resilient base.
 - b. Resilient stair accessories.
 - c. Resilient molding accessories.

C. Submittals

1. Product Data: For each type of product indicated.
2. LEED Submittals:
 - a. Product Data for Credit EQ 4.1: For adhesives, including printed statement of VOC content.
3. Samples: For each type of product indicated, in manufacturer's standard-size Samples but not less than **12 inches (300 mm)** long, of each resilient product color, texture, and pattern required.

D. Quality Assurance

1. Fire-Test-Response Characteristics: As determined by testing identical products according to ASTM E 648 or NFPA 253 by a qualified testing agency.
 - a. Critical Radiant Flux Classification: Class I, not less than 0.45 W/sq. cm.

E. Delivery, Storage, And Handling

1. Store resilient products and installation materials in dry spaces protected from the weather, with ambient temperatures maintained within range recommended by manufacturer, but not less than **50 deg F (10 deg C)** or more than **90 deg F (32 deg C)**.

F. Project Conditions

1. Maintain ambient temperatures within range recommended by manufacturer, but not less than **70 deg F (21 deg C)** or more than **95 deg F (35 deg C)**, in spaces to receive resilient products during the following time periods:
 - a. 48 hours before installation.
 - b. During installation.
 - c. 48 hours after installation.
2. Until Final Completion, maintain ambient temperatures within range recommended by manufacturer, but not less than **55 deg F (13 deg C)** or more than **95 deg F (35 deg C)**.
3. Install resilient products after other finishing operations, including painting, have been completed.

1.2 PRODUCTS

A. Resilient Base

1. Resilient Base Standard: ASTM F 1861.
 - a. Material Requirement: Type TV (vinyl, thermoplastic) **OR** Type TS (rubber, vulcanized thermoset) **OR** Type TP (rubber, thermoplastic), **as directed**.
 - b. Manufacturing Method: Group I (solid, homogeneous) **OR** Group II (layered), **as directed**.

- c. Style: Cove (base with toe) **OR** Straight (flat or toeless) **OR** Butt to (fit-to-floor), **as directed**.
2. Minimum Thickness: **0.125 inch (3.2 mm) OR 0.080 inch (2.0 mm), as directed.**
3. Height: **2-1/2 inches (64 mm) OR 4 inches (102 mm) OR 6 inches (152 mm) OR** As indicated on Drawings, **as directed.**
4. Lengths: Cut lengths, **48 inches (1219 mm) long OR** Coils in manufacturer's standard length, **as directed.**
5. Outside Corners: Job formed **OR** Preformed, **as directed.**
6. Inside Corners: Job formed **OR** Preformed, **as directed.**
7. Finish: Satin **OR** Matte **OR** Low luster **OR** As selected from manufacturer's full range, **as directed.**
8. Colors and Patterns: As selected from full range of industry colors.

B. Resilient Stair Accessories

1. Resilient Stair Treads Standard: ASTM F 2169.
 - a. Material Requirement: Type TV (vinyl, thermoplastic) **OR** Type TS (rubber, vulcanized thermoset) **OR** Type TP (rubber, thermoplastic), **as directed.**
 - b. Surface Design:
 - 1) Class 1, Smooth (flat).
 - 2) Class 2, Pattern: Raised-disc design **OR** Raised-square design **OR** Raised-chevron design **OR** Raised-diamond design **OR** Raised-rib design **OR** Raised-rib design with abrasive strips, **as directed.**
 - c. Manufacturing Method: Group 1, tread with embedded abrasive strips **OR** Group 2, tread with contrasting color for the visually impaired, **as directed.**
2. Nosing Style: Square, adjustable to cover angles between 60 and 90 degrees **OR** Square **OR** Round, **as directed.**
3. Nosing Height: **1-1/2 inches (38 mm) OR 2 inches (51 mm) OR 2-3/16 inches (56 mm), as directed.**
4. Thickness: **1/4 inch (6 mm)** and tapered to back edge.
5. Size: Lengths and depths to fit each stair tread in one piece **OR** one piece or, for treads exceeding maximum lengths manufactured, in equal-length units, **as directed.**
6. Risers: Smooth, flat, coved-toe, **7 inches (178 mm)** high by length matching treads **OR** toeless, height and length to cover risers, **as directed**; produced by same manufacturer as treads and recommended by manufacturer for installation with treads.
 - a. Thickness: **0.125 inch (3.2 mm) OR 0.080 inch (2.0 mm), as directed.**
7. Stringers: Of same thickness as risers, height and length after cutting to fit risers and treads and to cover stair stringers; produced by same manufacturer as treads and recommended by manufacturer for installation with treads.
8. Colors and Patterns: As selected from full range of industry colors.

C. Resilient Molding Accessory

1. Description: Cap for cove carpet **OR** Cap for cove resilient floor covering **OR** Carpet bar for tackless installations **OR** Carpet edge for glue-down applications **OR** Nosing for carpet **OR** Nosing for resilient floor covering **OR** Reducer strip for resilient floor covering **OR** Joiner for tile and carpet **OR** Transition strips, **as directed.**
2. Material: Vinyl **OR** Rubber, **as directed.**
3. Profile and Dimensions: As indicated.
4. Colors and Patterns: As selected from full range of industry colors.

D. Installation Materials

1. Trowelable Leveling and Patching Compounds: Latex-modified, portland cement based or blended hydraulic-cement-based formulation provided or approved by manufacturer for applications indicated.
2. Adhesives: Water-resistant type recommended by manufacturer to suit resilient products and substrate conditions indicated.

- a. Use adhesives that comply with the following limits for VOC content when calculated according to 40 CFR 59, Subpart D (EPA Method 24):
 - 1) Cove Base Adhesives: Not more than 50 g/L.
 - 2) Rubber Floor Adhesives: Not more than 60 g/L.
3. Stair-Tread-Nose Filler: Two-part epoxy compound recommended by resilient tread manufacturer to fill nosing substrates that do not conform to tread contours.
4. Metal Edge Strips: Extruded aluminum with mill finish of width shown, of height required to protect exposed edges of tiles, and in maximum available lengths to minimize running joints.
5. Floor Polish: Provide protective liquid floor polish products as recommended by resilient stair tread manufacturer.

1.3 EXECUTION

A. Preparation

1. Prepare substrates according to manufacturer's written instructions to ensure adhesion of resilient products.
2. Concrete Substrates for Resilient Stair Treads and Accessories: Prepare according to ASTM F 710.
 - a. Verify that substrates are dry and free of curing compounds, sealers, and hardeners.
 - b. Remove substrate coatings and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, using mechanical methods recommended by manufacturer. Do not use solvents.
 - c. Alkalinity and Adhesion Testing: Perform tests recommended by manufacturer.
 - d. Moisture Testing: Perform tests recommended by manufacturer and as follows. Proceed with installation only after substrates pass testing.
 - 1) Perform anhydrous calcium chloride test, ASTM F 1869. Proceed with installation only after substrates have maximum moisture-vapor-emission rate of **3 lb of water/1000 sq. ft. (1.36 kg of water/92.9 sq. m)** in 24 hours.
 - 2) Perform relative humidity test using in situ probes, ASTM F 2170. Proceed with installation only after substrates have maximum 75 percent relative humidity level measurement.
3. Fill cracks, holes, and depressions in substrates with trowelable leveling and patching compound and remove bumps and ridges to produce a uniform and smooth substrate.
4. Do not install resilient products until they are same temperature as the space where they are to be installed.
 - a. Move resilient products and installation materials into spaces where they will be installed at least 48 hours in advance of installation.
5. Sweep and vacuum clean substrates to be covered by resilient products immediately before installation.

B. Resilient Base Installation

1. Comply with manufacturer's written instructions for installing resilient base.
2. Apply resilient base to walls, columns, pilasters, casework and cabinets in toe spaces, and other permanent fixtures in rooms and areas where base is required.
3. Install resilient base in lengths as long as practicable without gaps at seams and with tops of adjacent pieces aligned.
4. Tightly adhere resilient base to substrate throughout length of each piece, with base in continuous contact with horizontal and vertical substrates.
5. Do not stretch resilient base during installation.
6. On masonry surfaces or other similar irregular substrates, fill voids along top edge of resilient base with manufacturer's recommended adhesive filler material.
7. Preformed Corners: Install preformed corners before installing straight pieces.
8. Job-Formed Corners:
 - a. Outside Corners: Use straight pieces of maximum lengths possible. Form without producing discoloration (whitening) at bends.

b. Inside Corners: Use straight pieces of maximum lengths possible.

C. Resilient Accessory Installation

1. Comply with manufacturer's written instructions for installing resilient accessories.
2. Resilient Stair Accessories:
 - a. Use stair-tread-nose filler to fill nosing substrates that do not conform to tread contours.
 - b. Tightly adhere to substrates throughout length of each piece.
 - c. For treads installed as separate, equal-length units, install to produce a flush joint between units.
3. Resilient Molding Accessories: Butt to adjacent materials and tightly adhere to substrates throughout length of each piece. Install reducer strips at edges of carpet **OR** resilient floor covering, **as directed**, that would otherwise be exposed.

D. Cleaning And Protection

1. Comply with manufacturer's written instructions for cleaning and protection of resilient products.
2. Perform the following operations immediately after completing resilient product installation:
 - a. Remove adhesive and other blemishes from exposed surfaces.
 - b. Sweep and vacuum surfaces thoroughly.
 - c. Damp-mop surfaces to remove marks and soil.
3. Protect resilient products from marks, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during remainder of construction period.
4. Floor Polish: Remove soil, visible adhesive, and surface blemishes from resilient stair treads before applying liquid floor polish.
 - a. Apply one **OR** two **OR** three, **as directed**, coat(s).
5. Cover resilient products until Final Completion.

END OF SECTION 09 65 13 13a



Task	Specification	Specification Description
09 65 13 23	09 65 13 13	Cork Flooring

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SECTION 09 65 13 33 - RESILIENT FLOOR TILE

1.1 GENERAL

A. Description Of Work

1. This specification covers the furnishing and installation of materials for resilient floor tile. Products shall be as follows or as directed by the Owner. Installation procedures shall be in accordance with the product manufacturer's recommendations. Demolition and removal of materials shall be as required to support the work.

B. Summary

1. Section Includes:
 - a. Solid vinyl floor tile.
 - b. Rubber floor tile.
 - c. Vinyl composition floor tile.
 - d. Resilient terrazzo floor tile.

C. Submittals

1. Product Data: For each type of product indicated.
2. LEED Submittals:
 - a. Product Data for Credit EQ 4.1: For adhesives, sealants and chemical-bonding compounds, including printed statement of VOC content.
3. Shop Drawings: For each type of floor tile. Include floor tile layouts, edges, columns, doorways, enclosing partitions, built-in furniture, cabinets, and cutouts.
 - a. Show details of special patterns.
4. Samples: Full-size units of each color and pattern of floor tile required.
5. Seam Samples: For seamless-installation technique indicated and for each flooring product, color, and pattern required; with seam running lengthwise and in center of **6-by-9-inch (150-by-230-mm)** Sample applied to a rigid backing and prepared by Installer for this Project.
6. Maintenance data.

D. Quality Assurance

1. Fire-Test-Response Characteristics: As determined by testing identical products according to ASTM E 648 or NFPA 253 by a qualified testing agency.
 - a. Critical Radiant Flux Classification: Class I, not less than 0.45 W/sq. cm.
2. Preconstruction Testing: Use manufacturer's standard test methods to determine whether materials will obtain optimum adhesion with installed flooring material.

E. Delivery, Storage, And Handling

1. Store floor tile and installation materials in dry spaces protected from the weather, with ambient temperatures maintained within range recommended by manufacturer, but not less than **50 deg F (10 deg C)** or more than **90 deg F (32 deg C)**. Store floor tiles on flat surfaces.

F. Project Conditions

1. Maintain ambient temperatures within range recommended by manufacturer, but not less than **70 deg F (21 deg C)** or more than **95 deg F (35 deg C)**, in spaces to receive floor tile during the following time periods:
 - a. 48 hours before installation.
 - b. During installation.
 - c. 48 hours after installation.
2. Until Final Completion, maintain ambient temperatures within range recommended by manufacturer, but not less than **55 deg F (13 deg C)** or more than **95 deg F (35 deg C)**.
3. Close spaces to traffic during floor tile installation.
4. Close spaces to traffic for 48 hours after floor tile installation.

5. Install floor tile after other finishing operations, including painting, have been completed.

1.2 PRODUCTS

A. Solid Vinyl Floor Tile

1. Tile Standard: ASTM F 1700.
 - a. Class: As indicated by product designations **OR** Class I, monolithic vinyl tile **OR** Class II, surface-decorated vinyl tile **OR** Class III, printed film vinyl tile, **as directed**.
 - b. Type: Type A, smooth surface **OR** Type B, embossed surface, **as directed**.
2. Thickness: **0.080 inch (2.0 mm) OR 0.100 inch (2.5 mm) OR 0.120 inch (3.0 mm) OR 0.125 inch (3.2 mm), as directed.**
3. Size: **12 by 12 inches (305 by 305 mm) OR 18 by 18 inches (457 by 457 mm) OR 24 by 24 inches (610 by 610 mm) OR 36 by 36 inches (914 by 914 mm) OR 3 by 36 inches (76 by 914 mm), as directed.**
4. Seaming Method: Heat welded **OR** Chemically bonded **OR** Standard, **as directed**.
5. Colors and Patterns: As selected from full range of industry colors.

B. Rubber Floor Tile

1. Tile Standard: ASTM F 1344, Class I-A, homogeneous rubber tile, solid color **OR** Class I-B, homogeneous rubber tile, through mottled **OR** Class II-A, laminated rubber tile, solid-color wear layer **OR** Class II-B, laminated rubber tile, mottled wear layer, **as directed**.
2. Hardness: Not less than 85 as required by ASTM F 1344, measured using Shore, Type A durometer per ASTM D 2240 **OR** Manufacturer's standard hardness, **as directed**.
3. Wearing Surface: Smooth **OR** Textured **OR** Molded pattern, **as directed**.
 - a. Molded-Pattern Figure: Raised discs **OR** Raised squares, **as directed**.
4. Thickness: **0.125 inch (3.2 mm).**
5. Size: **12 by 12 inches (305 by 305 mm) OR 24 by 24 inches (610 by 610 mm), as directed.**
6. Seaming Method: Heat welded **OR** Chemically bonded **OR** Standard, **as directed**.
7. Colors and Patterns: As selected from full range of industry colors.

C. Vinyl Composition Floor Tile

1. Tile Standard: ASTM F 1066, Class 1, solid-color tile **OR** Class 2, through-pattern tile **OR** Class 3, surface-pattern tile, **as directed**.
2. Wearing Surface: Smooth **OR** Embossed, **as directed**.
3. Thickness: **0.125 inch (3.2 mm).**
4. Size: **12 by 12 inches (305 by 305 mm).**
5. Colors and Patterns: As selected from full range of industry colors.

D. Resilient Terrazzo Floor Tile

1. Resilient Terrazzo Floor Tile: Marble or granite chips embedded in flexible, thermoset-polyester-resin matrix; electrically nonconductive and chemical, oil, and corrosion resistive, with smooth wearing surface and manufacturer's standard factory-applied, protective urethane coating.
2. Thickness: **1/8 inch (3.0 mm) OR 3/16 inch (4.8 mm), as directed.**
3. Size: **12 by 12 inches (305 by 305 mm).**
4. Performance Characteristics:
 - a. Compressive Strength: **2900 to 5000 psi (20 to 34.5 MPa)**, ASTM C 109/C 109M or ASTM D 695.
 - b. Abrasion Resistance: Maximum 0.0196 cubic centimeters volume loss, ASTM F 510, Taber abrader, S-39 wheels, at 500 cycles with 1000-gram load.
 - c. Static Load Limit: **0.0007-inch (0.0177-mm)** maximum indentation, ASTM F 970 at **125 lb (57 kg)**.
 - d. Resin Matrix Hardness: Not less than 78, as measured using Shore, Type D durometer per ASTM D 2240.
5. Colors and Patterns: As selected from full range of industry colors.

E. Installation Materials

1. Trowelable Leveling and Patching Compounds: Latex-modified, portland cement based or blended hydraulic-cement-based formulation provided or approved by manufacturer for applications indicated.
2. Adhesives: Water-resistant type recommended by manufacturer to suit floor tile and substrate conditions indicated.
 - a. Use adhesives that comply with the following limits for VOC content when calculated according to 40 CFR 59, Subpart D (EPA Method 24):
 - 1) VCT and Asphalt Tile Adhesives: Not more than 50 g/L.
 - 2) Rubber Floor Adhesives: Not more than 60 g/L.
3. Seamless-Installation Accessories:
 - a. Heat-Welding Bead: Manufacturer's solid-strand product for heat welding seams.
 - 1) Color: As selected from manufacturer's full range to contrast with floor tile **OR** Match floor tile, **as directed**.
 - b. Chemical-Bonding Compound: Manufacturer's product for chemically bonding seams.
 - 1) Use chemical-bonding compound that has a VOC content of 350 **OR** 510, **as directed**, g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
4. Floor Polish: Provide protective liquid floor polish products as recommended by manufacturer.
5. Joint Sealant for Resilient Terrazzo Floor Tile: Silicone sealant of type and grade as recommended in writing by manufacturer to suit resilient terrazzo floor tile.
 - a. Use sealant that has a VOC content of not more than 250 g/L when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 - b. Joint-Sealant Color: White **OR** As selected from manufacturer's full range to match floor tile **OR** Match floor tile, **as directed**.
6. Sealers and Finish Coats for Resilient Terrazzo Floor Tile: Premium-type products as recommended by manufacturer for resilient terrazzo floor tile.

1.3 EXECUTION

A. Preparation

1. Prepare substrates according to manufacturer's written instructions to ensure adhesion of resilient products.
2. Concrete Substrates: Prepare according to ASTM F 710.
 - a. Verify that substrates are dry and free of curing compounds, sealers, and hardeners.
 - b. Remove substrate coatings and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, using mechanical methods recommended by manufacturer. Do not use solvents.
 - c. Alkalinity and Adhesion Testing: Perform tests recommended by manufacturer. Proceed with installation only after substrates pass testing.
 - d. Moisture Testing: Perform tests recommended by manufacturer and as follows. Proceed with installation only after substrates pass testing.
 - 1) Perform anhydrous calcium chloride test, ASTM F 1869. Proceed with installation only after substrates have maximum moisture-vapor-emission rate of **3 lb of water/1000 sq. ft. (1.36 kg of water/92.9 sq. m)** in 24 hours.
 - 2) Perform relative humidity test using in situ probes, ASTM F 2170. Proceed with installation only after substrates have a maximum 75% relative humidity level measurement.
3. Access Flooring Panels: Remove protective film of oil or other coating using method recommended by access flooring manufacturer.
4. Fill cracks, holes, and depressions in substrates with trowelable leveling and patching compound and remove bumps and ridges to produce a uniform and smooth substrate.
5. Do not install floor tiles until they are same temperature as space where they are to be installed.
 - a. Move resilient products and installation materials into spaces where they will be installed at least 48 hours in advance of installation.

6. Sweep and vacuum clean substrates to be covered by resilient products immediately before installation.

B. Floor Tile Installation

1. Comply with manufacturer's written instructions for installing floor tile.
2. Lay out floor tiles from center marks established with principal walls, discounting minor offsets, so tiles at opposite edges of room are of equal width. Adjust as necessary to avoid using cut widths that equal less than one-half tile at perimeter.
 - a. Lay tiles square with room axis **OR** at a 45-degree angle with room axis **OR** in pattern indicated, **as directed**.
3. Match floor tiles for color and pattern by selecting tiles from cartons in the same sequence as manufactured and packaged, if so numbered. Discard broken, cracked, chipped, or deformed tiles.
 - a. Lay tiles with grain running in one direction **OR** with grain direction alternating in adjacent tiles (basket-weave pattern) **OR** in pattern of colors and sizes indicated, **as directed**.
4. Scribe, cut, and fit floor tiles to butt neatly and tightly to vertical surfaces and permanent fixtures including built-in furniture, cabinets, pipes, outlets, and door frames.
5. Extend floor tiles into toe spaces, door reveals, closets, and similar openings. Extend floor tiles to center of door openings.
6. Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating on floor tiles as marked on substrates. Use chalk or other nonpermanent, nonstaining marking device.
7. Install floor tiles on covers for telephone and electrical ducts, building expansion-joint covers, and similar items in finished floor areas. Maintain overall continuity of color and pattern between pieces of tile installed on covers and adjoining tiles. Tightly adhere tile edges to substrates that abut covers and to cover perimeters.
8. Adhere floor tiles to flooring substrates using a full spread of adhesive applied to substrate to produce a completed installation without open cracks, voids, raising and puckering at joints, telegraphing of adhesive spreader marks, and other surface imperfections.
9. Seamless Installation:
 - a. Heat-Welded Seams: Comply with ASTM F 1516. Rout joints and heat weld with welding bead to permanently fuse sections into a seamless floor covering. Prepare, weld, and finish seams to produce surfaces flush with adjoining floor covering surfaces.
 - b. Chemically Bonded Seams: Bond seams with chemical-bonding compound to permanently fuse sections into a seamless floor covering. Prepare seams and apply compound to produce tightly fitted seams without gaps, overlays, or excess bonding compound on floor covering surfaces.

C. Cleaning And Protection

1. Comply with manufacturer's written instructions for cleaning and protection of floor tile.
2. Perform the following operations immediately after completing floor tile installation:
 - a. Remove adhesive and other blemishes from exposed surfaces.
 - b. Sweep and vacuum surfaces thoroughly.
 - c. Damp-mop surfaces to remove marks and soil.
3. Protect floor tile products from mars, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during remainder of construction period.
4. Floor Polish: Remove soil, visible adhesive, and surface blemishes from floor tile surfaces before applying liquid floor polish.
 - a. Apply one **OR** two **OR** three, **as directed**, coat(s).
5. Joint Sealant: Apply sealant to resilient terrazzo floor tile perimeter and around columns, at door frames, and at other joints and penetrations.
6. Sealers and Finish Coats: Remove soil, visible adhesive, and surface blemishes from resilient terrazzo floor tile surfaces before applying liquid cleaners, sealers, and finish products.
 - a. Sealer: Apply two base coats of liquid sealer.
 - b. Finish: Apply two **OR** three, **as directed**, coats of liquid floor finish.

7. Cover floor tile until Final Completion.

END OF SECTION 09 65 13 33

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SECTION 09 65 13 33a - LINOLEUM FLOOR COVERINGS

1.1 GENERAL

A. Description Of Work

1. This specification covers the furnishing and installation of materials for linoleum floor coverings. Products shall be as follows or as directed by the Owner. Installation procedures shall be in accordance with the product manufacturer's recommendations. Demolition and removal of materials shall be as required to support the work.

B. Summary

1. Section Includes:
 - a. Linoleum floor tile **OR** sheet flooring, **as directed**.

C. Submittals

1. Product Data: For each type of product indicated.
2. LEED Submittals:
 - a. Product Data for Credit MR 6.0: For linoleum flooring, including printed statement of costs for each rapidly renewable material.
 - b. Product Data for Credit EQ 4.1: For adhesives, including printed statement of VOC content.
3. Shop Drawings: For each type of floor covering. Include floor covering layouts, locations of seams, edges, columns, doorways, enclosing partitions, built-in furniture, cabinets, and cutouts.
4. Samples for Verification: In manufacturer's standard size, but not less than **6-by-9-inch (152-by-230-mm)** sections of each color and pattern of floor covering required.
 - a. Heat-Welding Bead: Include manufacturer's standard-size Samples, but not less than **9 inches (230 mm)** long, of each color required.
5. Heat-Welded Seam Samples: For each floor covering product and welding bead color and pattern combination required; with seam running lengthwise and in center of **6-by-9-inch (152-by-230-mm)** Sample applied to rigid backing and prepared by Installer for this Project.
6. Maintenance data.

D. Quality Assurance

1. Fire-Test-Response Characteristics: As determined by testing identical products according to ASTM E 648 or NFPA 253 by a qualified testing agency.
 - a. Critical Radiant Flux Classification: Class I, not less than 0.45 W/sq. cm.

E. Delivery, Storage, And Handling

1. Store floor coverings and installation materials in dry spaces protected from the weather, with ambient temperatures maintained within range recommended by manufacturer, but not less than **65 deg F (18 deg C)** or more than **90 deg F (32 deg C)**.
 - a. Floor Tile: Store on flat surfaces.
 - b. Sheet Flooring: Store rolls upright.

F. Project Conditions

1. Maintain ambient temperatures within range recommended by manufacturer, but not less than **70 deg F (21 deg C)** or more than **95 deg F (35 deg C)**, in spaces to receive floor coverings during the following time periods:
 - a. 72 hours before installation.
 - b. During installation.
 - c. 72 hours after installation.
2. Until Final Completion, maintain ambient temperatures within range recommended by manufacturer, but not less than **55 deg F (13 deg C)** or more than **95 deg F (35 deg C)**.
3. Close spaces to traffic during floor covering installation.

4. Close spaces to traffic for 72 hours after floor covering installation.
5. Install floor coverings after other finishing operations, including painting, have been completed.

1.2 PRODUCTS

A. Linoleum Floor Covering

1. Floor Tile: ASTM F 2195, Type I, linoleum floor tile with fibrous backing **OR** Type II, linoleum floor tile with special backing **OR** Type III, linoleum floor tile without backing, **as directed**.
 - a. Nominal Floor Tile Size: Manufacturer's standard **OR 12 by 12 inches (300 by 300 mm) OR 18 by 18 inches (460 by 460 mm) OR 20 by 20 inches (500 by 500 mm) OR 24 by 24 inches (600 by 600 mm), as directed.**
2. Sheet Flooring: ASTM F 2034, Type I, linoleum sheet with backing **OR** Type III, linoleum sheet with special backing, **as directed**.
 - a. Roll Size: In manufacturer's standard length by not less than **78 inches (1980 mm)** wide.
3. Seaming Method: Standard **OR** Heat welded, **as directed**.
4. Thickness: **0.08 inch (2.0 mm) OR 0.10 inch (2.5 mm) OR 0.13 inch (3.2 mm) OR 0.16 inch (4.0 mm) OR 0.18 inch (4.5 mm), as directed.**
5. Colors and Patterns: As selected from full range of industry colors.

B. Installation Materials

1. Trowelable Leveling and Patching Compounds: Latex-modified, portland cement based or blended hydraulic-cement-based formulation provided or approved by manufacturer for applications indicated.
2. Adhesives: Water-resistant type recommended by manufacturer to suit products and substrate conditions indicated.
 - a. Use adhesives that have a VOC content of not more than 50 g/L when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
3. Heat-Welding Bead: Solid-strand product of linoleum floor covering manufacturer.
 - a. As selected from manufacturer's full range to contrast with linoleum floor covering **OR** Match linoleum floor covering, **as directed**.
4. Integral-Flash-Cove-Base Accessories:
 - a. Cove Strip: **1-inch (25.4-mm)** radius provided or approved by manufacturer.
 - b. Cove-Base Cap Strip: Square metal, vinyl, or rubber cap provided or approved by manufacturer.
5. Floor Polish: Provide protective liquid floor polish products as recommended by manufacturer.

1.3 EXECUTION

A. Preparation

1. Prepare substrates according to manufacturer's written instructions to ensure adhesion of floor coverings.
2. Concrete Substrates: Prepare according to ASTM F 710.
 - a. Verify that substrates are dry and free of curing compounds, sealers, and hardeners.
 - b. Remove substrate coatings and other substances that are incompatible with floor covering adhesives and that contain soap, wax, oil, or silicone, using mechanical methods recommended by manufacturer. Do not use solvents.
 - c. Alkalinity and Adhesion Testing: Perform tests recommended by manufacturer. Proceed with installation only after substrates pass testing.
 - d. Moisture Testing: Perform tests recommended by manufacturer and as follows. Proceed with installation only after substrates pass testing.
 - 1) Perform anhydrous calcium chloride test, ASTM F 1869. Proceed with installation only after substrates have maximum moisture-vapor-emission rate of **3 lb of water/1000 sq. ft. (1.36 kg of water/92.9 sq. m)** in 24 hours.

- 2) Perform relative humidity test using in situ probes, ASTM F 2170. Proceed with installation only after substrates have maximum 75 percent relative humidity level measurement.
 3. Fill cracks, holes, and depressions in substrates with trowelable leveling and patching compound and remove bumps and ridges to produce a uniform and smooth substrate.
 4. Do not install floor coverings until they are same temperature as space where they are to be installed.
 - a. Move floor coverings and installation materials into spaces where they will be installed at least 72 hours in advance of installation.
 5. Sweep and vacuum clean substrates to be covered by floor coverings immediately before installation.
- B. Installation, General
1. Comply with manufacturer's written instructions for installing floor coverings.
 2. Scribe and cut floor coverings to butt neatly and tightly to vertical surfaces, permanent fixtures, and built-in furniture including cabinets, pipes, outlets, edgings, thresholds, and nosings.
 3. Extend floor coverings into toe spaces, door reveals, closets, and similar openings.
 4. Maintain reference markers, holes, or openings that are in place or marked for future cutting by repeating on floor coverings as marked on subfloor. Use chalk or other nonpermanent marking device.
 5. Install floor coverings on covers for telephone and electrical ducts and similar items in finished floor areas. Maintain overall continuity of color and pattern between pieces of floor covering installed on covers and adjoining floor covering. Tightly adhere floor covering edges to substrates that abut covers and to cover perimeters.
 6. Adhere floor coverings to substrates using a full spread of adhesive applied to substrate to produce a completed installation without open cracks, voids, raising and puckering at joints, telegraphing of adhesive spreader marks, and other surface imperfections.
 7. Heat-Welded Seams: Comply with ASTM F 1516. Rout joints and use welding bead to permanently fuse sections into a seamless floor covering. Prepare, weld, and finish seams to produce surfaces flush with adjoining floor covering surfaces.
- C. Linoleum Floor Tile Installation
1. Lay out floor tiles from center marks established with principal walls, discounting minor offsets, so floor tiles at opposite edges of room are of equal width. Adjust as necessary to avoid using cut widths that equal less than one-half tile at perimeter.
 - a. Lay floor tiles square with room axis **OR** at a 45-degree angle with room axis **OR** in pattern indicated, **as directed**.
 2. Match floor tiles for color and pattern by selecting tiles from cartons in same sequence as manufactured and packaged, if so numbered. Discard broken, cracked, chipped, or deformed floor tiles.
 - a. Lay floor tiles with grain running in one direction **OR** with grain direction alternating in adjacent floor tiles (basket-weave pattern) **OR** in pattern of colors and sizes indicated, **as directed**.
- D. Linoleum Sheet Flooring Installation
1. Unroll sheet floorings and allow them to stabilize before cutting and fitting.
 2. Lay out sheet floorings as follows:
 - a. Maintain uniformity of floor covering direction.
 - b. Minimize number of seams; place seams in inconspicuous and low-traffic areas, at least **6 inches (152 mm)** away from parallel joints in floor covering substrates.
 - c. Match edges of floor coverings for color shading at seams.
 - d. Avoid cross seams.
 - e. Eliminate deformations that result from hanging method used during drying process (stove bar marks).

3. Integral-Flash-Cove Base: Cove linoleum floor covering **6 inches (152 mm)** **OR** dimension indicated, **as directed**, up vertical surfaces. Support floor covering at horizontal and vertical junction with cove strip. Butt at top against cap strip.

E. Cleaning And Protection

1. Comply with manufacturer's written instructions for cleaning and protection of floor coverings.
2. Perform the following operations immediately after completing floor covering installation:
 - a. Remove adhesive and other blemishes from exposed surfaces.
 - b. Sweep and vacuum surfaces thoroughly.
 - c. Damp-mop surfaces to remove marks and soil.
3. Protect floor coverings from mars, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during remainder of construction period.
4. Floor Polish: Remove soil, visible adhesive, and surface blemishes from floor coverings before applying liquid floor polish.
 - a. Apply two **OR** three, **as directed**, coat(s).
5. After allowing drying room film (yellow film caused by linseed oil oxidation) to disappear, cover floor coverings until Final Completion.

END OF SECTION 09 65 13 33a

Task	Specification	Specification Description
09 65 13 33	01 22 16 00	No Specification Required
09 65 13 33	09 65 13 13	Cork Flooring
09 65 13 33	09 65 23 00	Resilient Sheet Flooring
09 65 13 33	09 65 13 13a	Resilient Wall Base And Accessories
09 65 13 36	09 65 13 13	Cork Flooring
09 65 13 36	09 65 13 13a	Resilient Wall Base And Accessories
09 65 16 23	09 65 13 13	Cork Flooring
09 65 16 23	09 65 23 00	Resilient Sheet Flooring
09 65 19 19	09 65 13 13	Cork Flooring
09 65 19 19	09 65 13 33	Resilient Floor Tile
09 65 19 23	09 65 13 13	Cork Flooring
09 65 19 23	09 65 13 33	Resilient Floor Tile
09 65 19 33	09 65 13 13	Cork Flooring
09 65 19 33	09 65 13 33	Resilient Floor Tile
09 65 19 43	09 65 13 13	Cork Flooring
09 65 19 43	09 65 13 33	Resilient Floor Tile

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SECTION 09 65 23 00 - RESILIENT SHEET FLOORING

1.1 GENERAL

A. Description Of Work

1. This specification covers the furnishing and installation of materials for resilient sheet floor flooring. Products shall be as follows or as directed by the Owner. Installation procedures shall be in accordance with the product manufacturer's recommendations. Demolition and removal of materials shall be as required to support the work.

B. Summary

1. Section Includes:
 - a. Vinyl sheet floor covering, with and without backing.
 - b. Rubber sheet floor covering, with and without backing.

C. Submittals

1. Product Data: For each type of product indicated.
2. LEED Submittals:
 - a. Product Data for Credit EQ 4.1: For adhesives and chemical-bonding compounds, including printed statement of VOC content.
3. Shop Drawings: For each type of floor covering. Include floor covering layouts, locations of seams, edges, columns, doorways, enclosing partitions, built-in furniture, cabinets, and cutouts.
 - a. Show details of special patterns.
4. Samples: In manufacturer's standard size, but not less than 6-by-9-inch (150-by-230-mm) sections of each different color and pattern of floor covering required.
 - a. For heat-welding bead, manufacturer's standard-size Samples, but not less than 9 inches (230 mm) long, of each color required.
5. Seam Samples: For seamless-installation technique indicated and for each floor covering product, color, and pattern required; with seam running lengthwise and in center of 6-by-9-inch (150-by-230-mm) Sample applied to a rigid backing and prepared by Installer for this Project.
6. Maintenance data.

D. Quality Assurance

1. Fire-Test-Response Characteristics: As determined by testing identical products according to ASTM E 648 or NFPA 253 by a qualified testing agency.
 - a. Critical Radiant Flux Classification: Class I, not less than 0.45 W/sq. cm.

E. Delivery, Storage, And Handling

1. Store floor coverings and installation materials in dry spaces protected from the weather, with ambient temperatures maintained within range recommended by manufacturer, but not less than 50 deg F (10 deg C) or more than 90 deg F (32 deg C). Store rolls upright.

F. Project Conditions

1. Maintain ambient temperatures within range recommended by manufacturer, but not less than 70 deg F (21 deg C) or more than 85 deg F (29 deg C), in spaces to receive floor coverings during the following time periods:
 - a. 48 hours before installation.
 - b. During installation.
 - c. 48 hours after installation.
2. Until Final Completion, maintain ambient temperatures within range recommended by manufacturer, but not less than 55 deg F (13 deg C) or more than 95 deg F (35 deg C).
3. Close spaces to traffic during floor covering installation.
4. Close spaces to traffic for 48 hours after floor covering installation.
5. Install floor coverings after other finishing operations, including painting, have been completed.

1.2 PRODUCTS

A. Vinyl Sheet Floor Covering

1. Unbacked Vinyl Sheet Floor Covering: ASTM F 1913, **0.080 inch (2.0 mm)** thick.
2. Vinyl Sheet Floor Covering with Backing: ASTM F 1303.
 - a. Type (Binder Content): Type I, minimum binder content of 90 percent **OR** Type II, minimum binder content of 34 percent, **as directed**.
 - b. Wear-Layer Thickness: Grade 1.
 - c. Overall Thickness: As standard with manufacturer.
 - d. Interlayer Material: Foamed plastic **OR** None, **as directed**.
 - e. Backing Class: Class A (fibrous) **OR** Class B (nonfoamed plastic) **OR** Class C (foamed plastic), **as directed**.
3. Wearing Surface: Smooth **OR** Embossed **OR** Smooth with embedded abrasives **OR** Embossed with embedded abrasives, **as directed**.
4. Sheet Width: As standard with manufacturer **OR** **4.9 feet (1.5 m)** **OR** **6 feet (1.8 m)** **OR** **6.5 feet (1.98 m)** **OR** **6.6 feet (2.0 m)** **OR** **9 feet (2.7 m)** **OR** **12 feet (3.6 m)**, **as directed**.
5. Seaming Method: Heat welded **OR** Chemically bonded **OR** Standard, **as directed**.
6. Colors and Patterns: As selected from full range of industry colors.

B. Rubber Sheet Floor Covering

1. Unbacked Rubber Sheet Floor Covering: ASTM F 1859.
 - a. Type: Type I (homogeneous rubber sheet) **OR** Type II (layered rubber sheet), **as directed**.
 - b. Thickness: As standard with manufacturer.
2. Rubber Sheet Floor Covering with Backing: ASTM F 1860.
 - a. Type: Type I, homogeneous rubber sheet with backing **OR** Type II, layered rubber sheet with backing, **as directed**.
 - b. Wear-Layer Thickness: As standard with manufacturer.
 - c. Overall Thickness: As standard with manufacturer.
 - d. Interlayer Material: As standard with manufacturer **OR** None, **as directed**.
 - e. Backing Type: Fibrous) **OR** Foamed rubber, **as directed**.
3. Hardness: Not less than required by ASTM F 1859 **OR** Not less than required by ASTM F 1860 **OR** Manufacturer's standard hardness, measured using Shore, Type A durometer per ASTM D 2240, **as directed**.
4. Wearing Surface: Smooth **OR** Textured **OR** Molded pattern, **as directed**.
 - a. Molded-Pattern Figure: Raised discs **OR** Raised squares, **as directed**.
5. Sheet Width: As standard with manufacturer **OR** **4.9 feet (1.5 m)** **OR** **6 feet (1.8 m)** **OR** **6.5 feet (1.98 m)** **OR** **6.6 feet (2.0 m)** **OR** **9 feet (2.7 m)** **OR** **12 feet (3.6 m)**, **as directed**.
6. Seaming Method: Heat welded **OR** Chemically bonded **OR** Standard, **as directed**.
7. Colors and Patterns: As selected from full range of industry colors.

C. Installation Materials

1. Trowelable Leveling and Patching Compounds: Latex-modified, portland cement based or blended hydraulic-cement-based formulation provided or approved by manufacturer for applications indicated.
2. Adhesives: Water-resistant type recommended by manufacturer to suit floor covering and substrate conditions indicated.
 - a. Use adhesives that have a VOC content of not more than 50 g/L **OR** 60 g/L, **as directed**, when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
3. Seamless-Installation Accessories:
 - a. Heat-Welding Bead: Manufacturer's solid-strand product for heat welding seams.
 - 1) Color: As selected from manufacturer's full range to contrast with floor covering **OR** Match floor covering, **as directed**.
 - b. Chemical-Bonding Compound: Manufacturer's product for chemically bonding seams.

- 1) VOC Content: Not more than 510 g/L. when calculated according to 40 CFR 59, Subpart D (EPA method 24).
4. Integral-Flash-Cove-Base Accessories:
 - a. Cove Strip: 1-inch (25-mm) radius provided or approved by manufacturer.
 - b. Cap Strip: Square metal, vinyl, or rubber cap **OR** Tapered vinyl cap, **as directed**, provided or approved by manufacturer.
 - c. Corners: Metal inside and outside corners and end stops provided or approved by manufacturer.
5. Floor Polish: Provide protective liquid floor polish products as recommended by manufacturer.

1.3 EXECUTION

A. Preparation

1. Prepare substrates according to manufacturer's written instructions to ensure adhesion of floor coverings.
2. Concrete Substrates: Prepare according to ASTM F 710.
 - a. Verify that substrates are dry and free of curing compounds, sealers, and hardeners.
 - b. Remove substrate coatings and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, using mechanical methods recommended by manufacturer. Do not use solvents.
 - c. Alkalinity and Adhesion Testing: Perform tests recommended by manufacturer. Proceed with installation only after substrates pass testing.
 - d. Moisture Testing: Perform tests recommended by manufacturer and as follows. Proceed with installation only after substrates pass testing.
 - 1) Perform anhydrous calcium chloride test, ASTM F 1869. Proceed with installation only after substrates have maximum moisture-vapor-emission rate of 3 lb of water/1000 sq. ft. (1.36 kg of water/92.9 sq. m) in 24 hours.
 - 2) Perform relative humidity test using in situ probes, ASTM F 2170. Proceed with installation only after substrates have a maximum 75 percent relative humidity level measurement.
3. Fill cracks, holes, and depressions in substrates with trowelable leveling and patching compound and remove bumps and ridges to produce a uniform and smooth substrate.
4. Do not install floor coverings until they are same temperature as space where they are to be installed.
 - a. Move floor coverings and installation materials into spaces where they will be installed at least 48 hours in advance of installation.
5. Sweep and vacuum clean substrates to be covered by floor coverings immediately before installation.

B. Floor Covering Installation

1. Comply with manufacturer's written instructions for installing floor coverings.
2. Unroll floor coverings and allow them to stabilize before cutting and fitting.
3. Lay out floor coverings as follows:
 - a. Maintain uniformity of floor covering direction.
 - b. Minimize number of seams; place seams in inconspicuous and low-traffic areas, at least 6 inches (152 mm) away from parallel joints in floor covering substrates.
 - c. Match edges of floor coverings for color shading at seams.
 - d. Avoid cross seams.
4. Scribe and cut floor coverings to butt neatly and tightly to vertical surfaces, permanent fixtures, and built-in furniture including cabinets, pipes, outlets, and door frames.
5. Extend floor coverings into toe spaces, door reveals, closets, and similar openings.
6. Maintain reference markers, holes, or openings that are in place or marked for future cutting by repeating on floor coverings as marked on substrates. Use chalk or other nonpermanent marking device.

7. Install floor coverings on covers for telephone and electrical ducts and similar items in installation areas. Maintain overall continuity of color and pattern between pieces of floor coverings installed on covers and adjoining floor covering. Tightly adhere floor covering edges to substrates that abut covers and to cover perimeters.
8. Adhere floor coverings to substrates using a full spread of adhesive applied to substrate to produce a completed installation without open cracks, voids, raising and puckering at joints, telegraphing of adhesive spreader marks, and other surface imperfections.
9. Seamless Installation:
 - a. Heat-Welded Seams: Comply with ASTM F 1516. Rout joints and use welding bead to permanently fuse sections into a seamless floor covering. Prepare, weld, and finish seams to produce surfaces flush with adjoining floor covering surfaces.
 - b. Chemically-Bonded Seams: Bond seams with chemical-bonding compound to permanently fuse sections into a seamless floor covering. Prepare seams and apply compound to produce tightly-fitted seams without gaps, overlays, or excess bonding compound on floor covering surfaces.
10. Integral-Flash-Cove Base: Cove floor coverings **6 inches (152 mm) OR** dimension indicated, **as directed**, up vertical surfaces. Support floor coverings at horizontal and vertical junction by cove strip. Butt at top against cap strip.
 - a. Install metal corners at inside and outside corners.

C. Cleaning And Protection

1. Comply with manufacturer's written instructions for cleaning and protection of floor coverings.
2. Perform the following operations immediately after completing floor covering installation:
 - a. Remove adhesive and other blemishes from floor covering surfaces.
 - b. Sweep and vacuum floor coverings thoroughly.
 - c. Damp-mop floor coverings to remove marks and soil.
3. Protect floor coverings from mars, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during remainder of construction period.
4. Floor Polish: Remove soil, visible adhesive, and surface blemishes from floor covering before applying liquid floor polish.
 - a. Apply one **OR** two **OR** three, **as directed**, coat(s).
5. Cover floor coverings until Final Completion.

END OF SECTION 09 65 23 00



Task	Specification	Specification Description
09 65 23 00	09 65 13 13	Cork Flooring
09 65 43 00	09 65 13 13	Cork Flooring
09 65 43 00	09 65 23 00	Resilient Sheet Flooring

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SECTION 09 65 66 00 - FLUID-APPLIED ATHLETIC FLOORING

1.1 GENERAL

A. Description Of Work

1. This specification covers the furnishing and installation of materials for fluid-applied sports flooring. Products shall be as follows or as directed by the Owner. Installation procedures shall be in accordance with the product manufacturer's recommendations. Demolition and removal of materials shall be as required to support the work.

B. Summary

1. This Section includes polyurethane flooring that is fluid applied directly on substrates or over base mats.

C. Submittals

1. Product Data: For each type of product indicated.
2. Shop Drawings: Show installation details for flooring including layout, colors, widths, and dimensions of game lines and markers and locations of athletic equipment floor inserts.
3. Samples: For each color, gloss, and texture of flooring required, **12 inches (305 mm)** square, applied to a rigid backing. Include sample sets showing the game-line paint and marker paint colors applied to the flooring.
4. Qualification Data: For Installer.
5. Maintenance Data: For fluid-applied sports flooring to include in maintenance manuals.

D. Quality Assurance

1. Installer Qualifications: An installer (applicator) who is approved, trained, or certified by fluid-applied sports flooring manufacturer.
2. Game Lines and Markers: Comply with requirements of National Collegiate Athletic Association (NCAA) **OR** National Federation of State High School Associations, **as directed**, for sports activities indicated.

E. Field Conditions

1. Environmental Limitations: Comply with flooring manufacturer's written instructions for substrate temperature, ambient temperature, humidity, ventilation, and other conditions affecting flooring application.
 - a. Do not apply flooring until spaces are enclosed and weatherproof; wet work in spaces is complete and dry; and overhead work, including installing mechanical systems, lighting, and athletic equipment, is complete.
2. Conditioning Period: Begins not less than seven days before flooring application, is continuous through application, and continues not less than three days after application.
 - a. During conditioning period, maintain an ambient temperature between **65 and 75 deg F (18 and 24 deg C)** and not more than 50 percent relative humidity in spaces to receive flooring.
 - b. After conditioning period, maintain relative humidity and ambient temperature planned for building occupants.

1.2 PRODUCTS

A. Direct-Applied Flooring:

1. Description: Fluid-applied athletic flooring system consisting of primer and polyurethane body and top coats applied directly to substrate.
2. Performance:
 - a. Low-Emitting Materials: Provide products with the following limits for VOC content when calculated according to 40 CFR 59, Subpart D (EPA Method 24):

- 1) Primer: VOC content of not less than 250 g/L.
- 2) Body and Top Coats: VOC content of not more than 100 g/L.
- b. Low-Emitting Materials: Provide adhesives, paints and coatings, and flooring systems that comply with the maximum allowable concentrations of VOC's when tested according to California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
3. Materials:
 - a. Primer: Manufacturer's primer recommended for substrate indicated.
 - b. Body Coat(s): Two-component, self-leveling, pigmented, polyurethane containing no rubber fillers and no mercury.
 - c. Topcoat (Finish Coat): Manufacturer's standard pigmented polyurethane.
 - d. Finishes:
 - 1) Color: As selected from manufacturer's full range.
 - 2) Surface Texture: Manufacturer's standard.
- B. Flooring Applied over Base Mats:
 1. Description: Fluid-applied athletic flooring system consisting of resilient base mat adhered to substrate, base mat sealer, and fluid-applied polyurethane body and top coats.
 2. Performance:
 - a. Low-Emitting Materials: Provide products with the following limits for VOC content when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 - 1) Base Mat Adhesive: VOC content of not more than 60 g/L.
 - 2) Base Mat Sealer: VOC content of not more than 200 g/L.
 - 3) Body and Topcoats: VOC content of not more than 100 g/L.
 - b. Low-Emitting Materials: Provide adhesives, paints and coatings, and flooring systems that comply with the maximum allowable concentrations of VOC's when tested according to California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
 3. Materials:
 - a. Base Mat: Manufacturer's standard base mats of granulated recycled rubber in polyurethane binder.
 - 1) Thickness: **5/32 inch (4 mm) OR 1/4 inch (6 mm) OR 9/32 inch (7 mm) OR 11/32 inch (9 mm) OR 15/32 inch (12 mm).**
 - b. Base-Mat Adhesive: Manufacturer's standard two-component polyurethane.
 - c. Base-Mat Sealer: Manufacturer's standard two-component polyurethane compound formulated for sealing base mat.
 - d. Body Coat(s): Two-component, self-leveling, pigmented, polyurethane containing no rubber fillers and no mercury.
 - e. Topcoat (Finish Coat): Manufacturer's standard pigmented polyurethane.
 4. Finishes:
 - a. Color: As selected by Architect from manufacturer's full range.
 - b. Surface Texture: Manufacturer's standard.
- C. Accessories
 1. Trowelable Leveling and Patching Compound: Latex-modified, hydraulic-cement-based formulation approved by flooring manufacturer.
 2. Game-Line and Marker Paint: Complete system including primer, if any, compatible with flooring and recommended in writing by flooring and paint manufacturers for use indicated.
 - a. VOC content: Provide products with VOC content of not more than 150 g/L when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 - b. Colors: As selected **OR** As required to comply with game-line and marker requirements of sports association indicated, **as directed**.

1.3 EXECUTION

- A. Examination
1. Examine substrates, with Installer present, for compliance with requirements for installation tolerances, moisture content, and other conditions affecting performance.
 - a. Verify that finishes of substrates comply with tolerances and other requirements specified in other Sections and that substrates are free of cracks, ridges, depressions, scale, and foreign deposits that might interfere with adhesion of resilient products.
 - b. Proceed with installation only after unsatisfactory conditions have been corrected.
- B. Preparation
1. Concrete Substrates: Prepare and clean substrates according to manufacturer's written instructions.
 - a. Remove laitance, glaze, efflorescence, curing compounds, form-release agents, dust, dirt, grease, oil, and other contaminants that might impair flooring bond. Remove contaminants using mechanical means.
 - b. Treat nonmoving substrate cracks and control joints to prevent cracks from telegraphing (reflecting) through flooring according to manufacturer's written recommendations.
 - c. Protect substrate voids and joints to prevent flooring resins from flowing into or leaking through them.
 2. Protect walls, floor openings, athletic equipment inserts, electrical openings, door frames, and other obstructions during installation. Cover floor and wall areas at mixing stations.
- C. Flooring Installation, General
1. General: Mix and apply flooring components according to manufacturer's written instructions.
 - a. At substrate expansion, isolation, and other moving joints, install continuous joint of same width through flooring.
- D. Installation of Direct-Applied Flooring:
1. Apply primer over prepared substrate at manufacturer's recommended spreading rate.
 2. Apply body coat(s) and topcoat to produce a uniform, level surface and finish.
- E. Installation of Flooring Applied over Base Mats:
- a. Adhesively apply resilient base mats to substrate according to manufacturer's written instructions.
 - 1) Base mats must not be in compression. Leave gap of width recommended in writing by manufacturer at butted base-mat sheets, walls, floor openings, athletic equipment inserts, electrical openings, door frames, and other obstructions.
 - 2) Roll base mats to set them into adhesive and eliminate air pockets.
 - 3) Repair ridges at seams, loose areas, and air pockets according to manufacturer's written instructions.
 - b. Apply seal coat to base mats before applying body coat(s).
 - c. Smooth ridges and high spots in seal coat before applying elastomeric resin.
 - d. Apply elastomeric resin and topcoat to produce a uniform surface and finish.
- F. Game Lines And Markers
1. Mask flooring surfaces at game lines and markers, and apply paint to produce sharp edges.
 - a. Where game lines cross, break minor game line at intersection; do not overlap lines.
 - b. Apply game lines and markers in widths and colors according to requirements indicated on Drawings **OR** sports association indicated, **as directed**.
- G. Protection
1. Protect fluid-applied sports flooring during remainder of construction period to allow it to cure and to ensure that flooring and finish are without damage or deterioration at the time of Final Completion.

END OF SECTION 09 65 66 00

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SECTION 09 65 66 00a - RESILIENT SPORTS-FLOOR COVERINGS

1.1 GENERAL

A. Description Of Work

1. This specification covers the furnishing and installation of materials for resilient sports-floor coverings. Products shall be as follows or as directed by the Owner. Installation procedures shall be in accordance with the product manufacturer's recommendations. Demolition and removal of materials shall be as required to support the work.

B. Summary

1. This Section includes the following:
 - a. Interlocking, rubber floor tile.
 - b. Interlocking, suspended, polymer floor tile.
 - c. Interlocking, open-grid, vinyl floor tile.
 - d. Rubber mats.
 - e. Rubber floor tile.
 - f. Rubber-strip floor tile.
 - g. Rubber sheet floor covering.
 - h. Sheet vinyl floor covering.

C. Submittals

1. Product Data: For each type of product indicated.
2. Shop Drawings: Show installation details and locations of the following:
 - a. Border tiles.
 - b. Floor patterns.
 - c. Layout, colors, widths, and dimensions of game lines.
 - d. Locations of floor inserts for athletic equipment.
 - e. Seam locations.
3. Samples: For each exposed finish.
4. LEED Submittals:
 - a. Credit EQ 4.1: Manufacturers' product data for adhesives, including printed statement of VOC content.
 - b. Credit EQ 4.2: Manufacturers' product data for game-line and marker paints, including printed statement of VOC content.
 - c. Product Data for Credit MR 4.1 and Credit MR 4.2, **as directed**: For products having recycled content, documentation indicating percentages by weight of postconsumer and preconsumer recycled content.
 - 1) Include statement that indicates costs for each product having recycled content.
5. Maintenance data.

D. Delivery, Storage, And Handling

1. Deliver materials in original packages and containers, with seals unbroken, bearing manufacturer's labels indicating brand name and directions for storing.
2. Store materials to prevent deterioration. Store tiles on flat surfaces and rolls upright.

E. Field Conditions

1. Adhesively Applied Products:
 - a. Maintain temperatures within range recommended in writing by manufacturer, but not less than **70 deg F (21 deg C)** or more than **95 deg F (35 deg C)**, in spaces to receive floor coverings during the following time periods:
 - 1) 48 hours before installation, unless longer period is recommended in writing by manufacturer.
 - 2) During installation.

- 3) 48 hours after installation, unless longer period is recommended in writing by manufacturer.
- b. After postinstallation period, maintain temperatures within range recommended in writing by manufacturer, but not less than **55 deg F (13 deg C)** or more than **95 deg F (35 deg C)**.
- c. Close spaces to traffic during floor covering installation.
- d. Close spaces to traffic for 48 hours after floor covering installation, unless manufacturer recommends longer period in writing.
2. Install floor coverings after other finishing operations, including painting, have been completed.

1.2 PRODUCTS

A. Interlocking, Rubber Floor Tile

1. Material: Rubber **OR** Recycled-rubber compound, **as directed**.
2. Installation Method: Free lay.
3. Tile Interlock: Visible **OR** Hidden, **as directed**.
4. Traffic-Surface Texture: Smooth **OR** Nondirectional, stipple texture **OR** Textured, **as directed**.
 - a. Provide reversible tiles (with traffic-surface texture on both sides).
5. Size: Manufacturer's standard-size square tile, not less than **24 inches (610 mm)** square.
6. Thickness: **3/8 inch (9.5 mm) OR 7/16 inch (11.1 mm) OR 1/2 inch (13 mm) OR 9/16 inch (14.3 mm) OR 3/4 inch (19 mm)**, **as directed**.
7. Color and Pattern: As selected from manufacturer's full range **OR** As indicated by manufacturer's designations, **as directed**.
8. Accessories:
 - a. Border Tiles: Interlocking, beveled-edge tiles, of same material as floor tile, with bevels that transition from thickness of floor tile to surface below it, with straight outside edges, and for use where floor covering corners and edges do not abut vertical surfaces.
 - 1) Color and Pattern: Matching floor tile **OR** As selected from manufacturer's full range to contrast with floor tile **OR** As indicated by manufacturer's designations, **as directed**.

B. Interlocking, Suspended, Polymer Floor Tile

1. Material and Construction: High-impact-polymer modular floor tile with top suspended over supporting backing that intermittently contacts the substrate.
 - a. Traffic Surface: Solid.
2. Installation Method: Free lay.
3. Tile Interlock: Manufacturer's standard.
4. Size: Manufacturer's standard-size square tile **OR 12 inches (305 mm)** square **OR 9.8 inches (250 mm)** square, **as directed**.
5. Thickness: **1/2 inch (13 mm)**.
6. Color: As selected from manufacturer's full range **OR** As indicated by manufacturer's designations, **as directed**.
7. Accessories:
 - a. Border Tiles: Interlocking, beveled-edge tiles, of same material as floor tile, with bevels that transition from thickness of floor tile to surface below it, with straight outside edges, and for use where floor covering corners and edges do not abut vertical surfaces.
 - 1) Color: Matching floor tile **OR** As selected from manufacturer's full range to contrast with floor tile **OR** As indicated by manufacturer's designations, **as directed**.
 - b. Game-Line and Marker Paint: Complete system including primer, if any, compatible with floor covering and recommended in writing by floor covering and paint manufacturers for use indicated.
 - c. Underlayment:
 - 1) Material: Manufacturer's standard rubber compound **OR** Recycled-rubber compound, **as directed**.
 - 2) Thickness: **0.08 inch (2 mm) OR 0.12 inch (3 mm)**, **as directed**.

- C. Interlocking, Open-Grid, Vinyl Floor Tile
1. Material: Vinyl **OR** Recycled-plastic compound, **as directed**.
 2. Installation Method: Free lay.
 3. Tile Interlock: Manufacturer's standard.
 4. Size: **12 inches (305 mm)** square.
 5. Thickness: **1/4 inch (6.4 mm) OR 3/8 inch (9.5 mm) OR 7/16 inch (11.1 mm) OR 3/4 inch (19 mm)**, **as directed**.
 6. Color: As selected from manufacturer's full range **OR** As indicated by manufacturer's designations, **as directed**.
 7. Accessories:
 - a. Border Tiles: Interlocking, beveled-edge tiles, of same material as floor tile, with bevels that transition from thickness of floor tile to surface below it, with straight outside edges, and for use where floor covering corners and edges do not abut vertical surfaces.
 - 1) Color: Matching floor tile **OR** As selected from manufacturer's full range to contrast with floor tile **OR** As indicated by manufacturer's designations, **as directed**.
- D. Rubber Mats
1. Material: Recycled-rubber compound.
 2. Installation Method: Free lay.
 3. Traffic-Surface Texture: Smooth.
 4. Size: **48 by 72 inches (1219 by 1829 mm)**.
 5. Thickness: **3/8 inch (9.5 mm) OR 1/2 inch (13 mm)**, **as directed**.
 6. Color and Pattern: As selected from manufacturer's full range **OR** As indicated by manufacturer's designations, **as directed**.
- E. Rubber Floor Tile
1. Material: Rubber **OR** Recycled-rubber compound **OR** Rubber wear layer and rubber shock-absorbent layer, vulcanized together, **as directed**.
 2. Installation Method: Adhered.
 3. Traffic-Surface Texture: Smooth **OR** Nondirectional, stipple texture **OR** Textured, **as directed**.
 4. Size: Manufacturer's standard-size square tile **OR 18 inches (457 mm) square OR 24 inches (610 mm) square OR 36 inches (914 mm) square**, **as directed**.
 5. Thickness: **1/4 inch (6.4 mm) OR 3/8 inch (9.5 mm)**, **as directed**.
 6. Color and Pattern: As selected from manufacturer's full range **OR** As indicated by manufacturer's designations, **as directed**.
 7. Accessories:
 - a. Trowelable Leveling and Patching Compound: Latex-modified, hydraulic-cement-based formulation approved by floor covering manufacturer.
 - b. Installation Adhesive: Water-resistant type recommended in writing by manufacturer for substrate and conditions indicated.
 - 1) Use adhesive that has a VOC content of 60 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- F. Rubber-Strip Floor Tile
1. Materials and Construction: Close-nap, carpetlike tiles of rubber-fabric strips, made from recycled tires, bonded to a dry-adhesive backing that acts as a catalyst with installation adhesive to form tile-to-substrate bond.
 2. Fire-Test-Response Characteristics: Passing 16 CFR 1630 (DOC FF-1-70).
 3. Installation Method: Adhered.
 4. Size: **12 inches (305 mm)** square.
 5. Thickness: **3/8 inch (9.5 mm)**.
 6. Color and Pattern: As selected from manufacturer's full range **OR** As indicated by manufacturer's designations, **as directed**.
 7. Accessories:
 - a. Trowelable Leveling and Patching Compound: Latex-modified, hydraulic-cement-based formulation approved by floor covering manufacturer.

- b. Installation Adhesive: Water-resistant type recommended in writing by manufacturer for substrate and conditions indicated.
 - 1) Use adhesive that has a VOC content of 60 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

G. Rubber Sheet Flooring

- 1. Description: Rubber athletic flooring provided as rolled goods for adhered installation.
- 2. Material: Recycled-rubber compound **OR** Rubber wear layer and rubber shock-absorbent layer, vulcanized together, **as directed**.
- 3. Traffic-Surface Texture: Smooth.
- 4. Roll Size: Not less than **48 inches (1219 mm)** wide by longest length that is practical to minimize splicing during installation.
- 5. Thickness: **1/4 inch (6.4 mm) OR 3/8 inch (9.5 mm), as directed**.
- 6. Color and Pattern: As selected from manufacturer's full range **OR** As indicated by manufacturer's designations, **as directed**.
- 7. Border: Interlocking, beveled-edge tiles, of same material as floor tile; with bevels that transition from thickness of floor tile to surface below it; with straight outside edges; and for use where flooring corners and edges do not abut vertical surfaces.
 - a. Border Color and Pattern: Matching floor tile **OR** As selected from manufacturer's full range to contrast with floor tile, **as directed**.

H. Sheet Vinyl Flooring

- 1. Description: Sheet vinyl flooring specifically designed for adhered athletic flooring applications.
- 2. Unbacked Sheet Vinyl Flooring: ASTM F 1913, **0.080 inch (2.0 mm)** thick.
 - a. Separate underlayment pad of bonded recycled rubber and polyurethane particles.
- 3. Sheet Vinyl Flooring with Backing: ASTM F 1303.
 - a. Type (Binder Content): I, minimum binder content of 90 percent **OR** II, minimum binder content of 34 percent, **as directed**.
 - b. Wear-Layer Thickness: Grade 1.
 - c. Interlayer Material: Foamed plastic **OR** None, **as directed**.
 - d. Backing Class: Class B (nonfoamed plastic) **OR** C (foamed plastic), **as directed**.
- 4. Seaming Method: Heat welded **OR** Chemically bonded, **as directed**.
- 5. Traffic-Surface Texture: Smooth **OR** Embossed, **as directed**.
- 6. Applied Finish: Factory-applied UV urethane **OR** Field-applied polyurethane, **as directed**.
- 7. Roll Size: Not less than **48 inches (1219 mm)** wide by longest length that is practical to minimize splicing during installation.
- 8. Color and Pattern: As selected from manufacturer's full range **OR** As indicated by manufacturer's designations, **as directed**.

I. Accessories:

- 1. Trowelable Leveling and Patching Compound: Latex-modified, hydraulic-cement-based formulation approved by floor covering manufacturer.
- 2. Adhesives: Water-resistant type recommended in writing by manufacturer for substrate and conditions indicated.
 - a. Use adhesives that have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- 3. Game-Line and Marker Paint: Complete system including primer, if any, compatible with floor covering and recommended in writing by floor covering and paint manufacturers for use indicated.
 - a. VOC content: Provide products with VOC content not more than 150 g/L when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

1.3 EXECUTION

A. Preparation

1. Prepare substrates according to manufacturer's written recommendations to ensure adhesion of floor coverings.
 2. Concrete Substrates: Prepare according to ASTM F 710.
 - a. Verify that substrates are dry and free of curing compounds, sealers, and hardeners.
 - b. Alkalinity and Adhesion Testing: Perform tests recommended in writing by manufacturer. Proceed with installation only after substrates pass testing.
 - c. Moisture Testing:
 - 1) Perform anhydrous calcium chloride test, ASTM F 1869. Proceed with installation only after substrates have maximum moisture-vapor-emission rate of **3 lb of water/1000 sq. ft. (1.36 kg of water/92.9 sq. m)** in 24 hours.
 - a) Perform tests so that each test area does not exceed **200 sq. ft. (18.6 sq. m)** and perform not less than 2 tests in each installation area and with test areas evenly spaced in installation areas.
 - 2) Perform tests recommended in writing by manufacturer. Proceed with installation only after substrates pass testing.
 3. Remove substrate coatings and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, using mechanical methods recommended in writing by manufacturer. Do not use solvents.
 4. Use trowelable leveling and patching compound to fill cracks, holes, and depressions in substrates.
 5. Move floor coverings and installation materials into spaces where they will be installed at least 48 hours in advance of installation, unless manufacturer recommends a longer period in writing.
 - a. Do not install floor coverings until they are same temperature as space where they are to be installed.
 6. Sweep and vacuum clean substrates to be covered by floor coverings immediately before installation. After cleaning, examine substrates for moisture, alkaline salts, carbonation, and dust. Proceed with installation only after unsatisfactory conditions have been corrected.
- B. Flooring Installation, General
1. Comply with manufacturer's written installation instructions.
 2. Scribe, cut, and fit floor coverings to butt neatly and tightly to vertical surfaces, equipment anchors, floor outlets, and other interruptions of floor surface.
 3. Extend floor coverings into toe spaces, door reveals, closets, and similar openings, unless otherwise indicated.
 4. Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating subfloor markings on floor coverings. Use nonpermanent, nonstaining marking device.
- C. Floor Tile Installation
1. Lay out tiles from center marks established with principal walls, discounting minor offsets, so tiles at opposite edges of room are of equal width. Adjust as necessary to avoid using cut widths that equal less than one-half tile at perimeter.
 - a. Lay tiles square with room axis **OR** at a 45-degree angle with room axis **OR** in pattern indicated, **as directed**.
 2. Discard broken, cracked, chipped, or deformed tiles.
 3. Match tiles for color and pattern by selecting tiles from cartons in same sequence as manufactured and packaged, if so numbered.
 - a. Lay tiles with grain running in one direction **OR** with grain direction alternating in adjacent tiles (basket-weave pattern) **OR** in pattern of colors and sizes indicated, **as directed**.
- D. Sheet Flooring Installation
1. Unroll sheet floor coverings and allow them to stabilize before cutting and fitting.
 2. Lay out sheet floor coverings as follows:
 - a. Maintain uniformity of floor covering direction.
 - b. Minimize number of seams; place seams in inconspicuous and low-traffic areas, at least **6 inches (152 mm)** away from parallel joints in floor covering substrates.
 - c. Match edges of floor coverings for color shading at seams.

- d. Locate seams per approved Shop Drawings.
- 3. Adhered Flooring: Adhere products to substrates using a full spread of adhesive applied to substrate to comply with adhesive and flooring manufacturers' written instructions, including those for trowel notching, adhesive mixing, and adhesive open and working times.
 - a. Provide completed installation without open cracks, voids, raising and puckering at joints, telegraphing of adhesive spreader marks, and other surface imperfections.
- 4. Vinyl Sheet Flooring Seams: Prepare and finish seams to produce surfaces flush with adjoining flooring surfaces.
 - a. Heat-Welded Seams: Comply with ASTM F 1516. Rout joints and use welding bead to permanently fuse sections into a seamless flooring.
 - b. Chemically Bonded Seams: Comply with ASTM F 693. Seal seams to prevent openings from forming between cut edges and to prevent penetration of dirt, liquids, and other substances into seams.
- E. Game Lines And Markers
 - 1. Mask floor coverings at game lines and markers, and apply paint to produce sharp edges. Where cross, break minor game line at intersection; do not overlap lines.
 - 2. Lay out game lines and markers to comply with rules and diagrams published by National Collegiate Athletic Association (NCAA) **OR** National Federation of State High School Associations for athletic activities indicated.
- F. Field-Applied Finishes
 - 1. Apply finish after game-line and marker paint is fully cured.
 - 2. Apply finish according to manufacturer's written instructions to produce a sealed surface that is ready for use.
 - 3. Do not cover floor coverings after finishing until finish reaches full cure.
- G. Cleaning And Protecting
 - 1. Perform the following operations immediately after completing floor covering installation:
 - a. Remove adhesive and other blemishes from floor covering surfaces.
 - b. Sweep and vacuum floor coverings thoroughly.
 - c. Damp-mop floor coverings to remove marks and soil.
 - 1) Do not wash floor coverings until after time period recommended in writing by manufacturer.
 - 2. Protect floor coverings from mars, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during remainder of construction period. Use protection methods recommended in writing by manufacturer.
 - a. Do not move heavy and sharp objects directly over floor coverings. Protect floor coverings with plywood or hardboard panels to prevent damage from storing or moving objects over floor coverings.

END OF SECTION 09 65 66 00a



Task	Specification	Specification Description
09 65 66 00	09 65 13 33	Resilient Floor Tile
09 66 13 00	09 01 60 91	Portland Cement Terrazzo Flooring
09 66 13 13	09 01 60 91	Portland Cement Terrazzo Flooring
09 66 13 16	09 01 60 91	Portland Cement Terrazzo Flooring
09 66 13 19	09 01 60 91	Portland Cement Terrazzo Flooring
09 66 16 13	09 01 60 91	Portland Cement Terrazzo Flooring

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SECTION 09 66 23 00 - RESINOUS MATRIX TERRAZZO FLOORING

1.1 GENERAL

A. Description Of Work

1. This specification covers the furnishing and installation of materials for resinous matrix terrazzo flooring. Products shall be as follows or as directed by the Owner. Installation procedures shall be in accordance with the product manufacturer's recommendations. Demolition and removal of materials shall be as required to support the work.

B. Summary

1. Section Includes:
 - a. Thin-set epoxy-resin terrazzo flooring and base.
 - b. Precast terrazzo units.

C. Submittals

1. Product Data: For each type of product indicated.
2. LEED Submittals:
 - a. Product Data for Credit MR 4.1 and Credit MR 4.2, **as directed**: For marble chips, aggregates, documentation indicating percentages by weight of postconsumer and preconsumer recycled content.
 - 1) Include statement that indicates cost for each product having recycled content.
 - b. Product Data for Credit EQ 4.1: For adhesives, including printed statement of VOC content.
3. Shop Drawings: Include terrazzo installation requirements. Include plans, elevations, sections, component details, and attachments to other work.
4. Samples: For each type, material, color, and pattern of terrazzo and accessory required showing the full range of color, texture, and pattern variations expected.
5. Installer certificates.
6. Qualification data.
7. Material certificates.
8. Maintenance data.

D. Quality Assurance

1. Installer Qualifications: A qualified installer who is acceptable to terrazzo manufacturer to install manufacturer's products.
 - a. Engage an installer who is certified in writing by terrazzo manufacturer as qualified to install manufacturer's products.
 - b. Engage an installer who is a contractor member of NTMA.
2. NTMA Standards: Comply with NTMA's "Terrazzo Specifications and Design Guide" and with written recommendations for terrazzo type indicated unless more stringent requirements are specified.
3. Preinstallation Conference: Conduct conference at Project site.

E. Delivery, Storage, And Handling

1. Deliver materials to Project site in supplier's original wrappings and containers, labeled with source's or manufacturer's name, material or product brand name, and lot number if any.
2. Store materials in their original, undamaged packages and containers, inside a well-ventilated area protected from weather, moisture, soiling, extreme temperatures, and humidity.

F. Project Conditions

1. Environmental Limitations: Comply with manufacturer's written instructions for substrate temperature, ambient temperature, moisture, ventilation, and other conditions affecting terrazzo installation.

2. Field Measurements: Verify actual dimensions of construction contiguous with precast terrazzo by field measurements before fabrication.
3. Provide permanent lighting or, if permanent lighting is not in place, simulate permanent lighting conditions during terrazzo installation.
4. Close spaces to traffic during terrazzo application and for not less than 24 hours after application unless manufacturer recommends a longer period.
5. Control and collect dust produced by grinding operations. Protect adjacent construction from detrimental effects of grinding operations.
 - a. Provide dustproof partitions and temporary enclosures to limit dust migration and to isolate areas from noise.

1.2 PRODUCTS

A. Epoxy-Resin Terrazzo

1. Materials:
 - a. Flexible Reinforcing Membrane: Manufacturer's resinous membrane for substrate crack preparation and reflective crack reduction.
 - 1) Reinforcement: Fiberglass scrim.
 - b. Primer: Manufacturer's product recommended for substrate and use indicated.
 - c. Epoxy-Resin Matrix: Manufacturer's standard recommended for use indicated and in color required for mix indicated.
 - 1) Physical Properties without Marble Chips **OR** Aggregates, **as directed**:
 - a) Hardness: 60 to 85 per ASTM D 2240, Shore D.
 - b) Minimum Tensile Strength: **3000 psi (20.7 MPa)** per ASTM D 638 for a **2-inch (51-mm)** specimen made using a "C" die per ASTM D 412.
 - c) Minimum Compressive Strength: **10,000 psi (6.9 MPa)** per ASTM D 695, Specimen B cylinder.
 - d) Chemical Resistance: No deleterious effects by contaminants listed below after seven-day immersion at room temperature per ASTM D 1308.
 - i. Distilled water.
 - ii. Mineral water.
 - iii. Isopropanol.
 - iv. Ethanol.
 - v. 0.025 percent detergent solution.
 - vi. 1.0 percent soap solution.
 - vii. 10 percent sodium hydroxide.
 - viii. 10 percent hydrochloric acid.
 - ix. 30 percent sulfuric acid.
 - x. 5 percent acetic acid.
 - 2) Physical Properties with Marble Chips **OR** Aggregates, **as directed**: For resin blended with Georgia white marble, ground, grouted, and cured per requirements in NTMA's "Terrazzo Specifications and Design Guide," comply with the following:
 - a) Flammability: Self-extinguishing, maximum extent of burning **0.25 inch (6.35 mm)** per ASTM D 635.
 - b) Thermal Coefficient of Linear Expansion: **0.0025 inch/inch per deg F (0.0025 mm/mm per 0.5556 deg C)** for temperature range of **minus 12 to plus 140 deg F (minus 24 to plus 60 deg C)** per ASTM D 696.
 - d. Marble Chips **OR** Aggregates, **as directed**: Complying with NTMA gradation standards for mix indicated and containing no deleterious or foreign matter.
 - 1) Abrasion and Impact Resistance: Less than 40 percent loss per ASTM C 131.
 - 2) 24-Hour Absorption Rate: Less than 0.75 percent.
 - 3) Dust Content: Less than 1.0 percent by weight.
 - e. Finishing Grout: Resin based.

2. Terrazzo (for NTMA-formulated design mixes): Comply with NTMA's "Terrazzo Specifications and Design Guide" and manufacturer's written instructions for matrix and marble-chip proportions and mixing.
 - a. Formulated Mix Color and Pattern: As selected by the Owner from manufacturer's full range **OR** As selected from NTMA standard-terrazzo plates **OR** As selected from NTMA thin-set terrazzo plates, **as directed**.
 3. Terrazzo (for custom design mixes): Comply with NTMA's "Terrazzo Specifications and Design Guide" and manufacturer's written instructions for matrix and marble-chip **OR** aggregate, **as directed**, proportions and mixing.
 - a. Custom Mix Color and Pattern: Match sample **OR** Match existing, **as directed**.
- B. Strip Materials
1. Thin-Set Divider Strips: L-type angle or T-type, **1/4 inch (6.4 mm)** deep.
 - a. Material: White-zinc alloy **OR** Brass **OR** Aluminum **OR** Plastic, in color selected from manufacturer's full range, **as directed**.
 - b. Top Width: **1/8 inch (3.2 mm)** **OR** **1/4 inch (6.4 mm)**, **as directed**.
 2. Heavy-Top Divider Strips: L-type angle in depth required for topping thickness indicated.
 - a. Bottom-Section Material: Galvanized steel **OR** Matching top-section material, **as directed**.
 - b. Top-Section Material: White-zinc alloy **OR** Brass **OR** Aluminum **OR** Plastic, in color selected from manufacturer's full range, **as directed**.
 - c. Top-Section Width: **1/8 inch (3.2 mm)** **OR** **1/4 inch (6.4 mm)** **OR** **3/8 inch (9.5 mm)** **OR** **1/2 inch (12.7 mm)**, **as directed**.
 3. Control-Joint Strips: Separate, double L-type angles, positioned back to back, that match material, thickness, and color of divider strips and in depth required for topping thickness indicated.
 4. Accessory Strips: Match divider strip width, material, and color unless otherwise indicated. Use the following types of accessory strips as required to provide a complete installation:
 - a. Base-bead strips for exposed top edge of terrazzo base.
 - b. Edge-bead strips for exposed edges of terrazzo.
 - c. Nosings for terrazzo stair treads and landings.
 5. Abrasive Strips (for terrazzo stair treads and landings): Silicon carbide or aluminum oxide, or combination of both, in epoxy-resin binder and set in channel.
 - a. Width: **1/2 inch (12.7 mm)**.
 - b. Depth: As required by terrazzo thickness.
 - c. Length: **4 inches (100 mm)** less than stair width **OR** As indicated, **as directed**.
 - d. Color: As selected from manufacturer's full range.
- C. Miscellaneous Accessories
1. Strip Adhesive: Epoxy-resin adhesive recommended by adhesive manufacturer for this use and acceptable to terrazzo manufacturer.
 - a. Use adhesives that have a VOC content of 70 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 2. Anchoring Devices:
 - a. Strips: Provide mechanical anchoring devices for strip materials as required for secure attachment to substrate.
 - b. Precast Terrazzo: Provide mechanical anchoring devices as recommended by fabricator for proper anchorage and support of units for conditions of installation and support.
 3. Patching and Fill Material: Terrazzo manufacturer's resinous product approved and recommended by manufacturer for application indicated.
 4. Joint Compound: Terrazzo manufacturer's resinous product approved and recommended by manufacturer for application indicated.
 5. Cleaner: Chemically neutral cleaner with pH factor between 7 and 10 that is biodegradable, phosphate free, and recommended by sealer manufacturer for use on terrazzo type indicated.
 6. Sealer: Slip- and stain-resistant penetrating-type sealer that is chemically neutral with pH factor between 7 and 10; does not affect color or physical properties of terrazzo; is recommended by

sealer manufacturer; and complies with NTMA's "Terrazzo Specifications and Design Guide" for terrazzo type indicated **OR** Acrylic **OR** Urethane **OR** Chemical-resistant epoxy, **as directed**.

D. Precast Terrazzo

1. Precast Terrazzo Units: Precast epoxy-resin terrazzo base, stair tread, threshold, bench, and planter units.
2. Precast Terrazzo Base Units: **1/4 inch (6.4 mm)** thick; cast in maximum lengths possible, but not less than **36 inches (900 mm)**; with rounded, finished top edge.
 - a. Type: Coved with minimum **3/4-inch (19-mm)** radius **OR** Straight **OR** Splayed **OR** As indicated, **as directed**.
 - b. Height: **6 inches (152 mm)** **OR** **4 inches (101 mm)** **OR** As indicated, **as directed**.
 - c. Outside Corner Units: With finished returned edges at outside corner.
 - d. Color, Pattern, and Finish: As selected from manufacturer's full range **OR** Match sample **OR** Match adjacent poured-in-place terrazzo flooring, **as directed**.
3. Precast Terrazzo Stair Treads: **1/2 inch (12.7 mm)** thick with rounded nosing edge.
 - a. Abrasive Strips: Three-line **OR** Two-line **OR** One-line **OR** Abrasive nosing strip and two-line, **as directed**, abrasive inserts at nosings.
 - b. Color, Pattern, and Finish: As selected from manufacturer's full range **OR** Match sample **OR** Match adjacent poured-in-place terrazzo flooring, **as directed**.
4. Precast Terrazzo Finishing (for custom precast terrazzo components):
 - a. Finish exposed-to-view edges or reveals to match face finish.
 - b. Ease exposed edges to **1/8-inch (3-mm)** radius.

1.3 EXECUTION

A. Preparation

1. Clean substrates of substances, including oil, grease, and curing compounds, that might impair terrazzo bond. Provide clean, dry, and neutral substrate for terrazzo application.
2. Concrete Slabs:
 - a. Provide sound concrete surfaces free of laitance, glaze, efflorescence, curing compounds, form-release agents, dust, dirt, grease, oil, and other contaminants incompatible with terrazzo.
 - 1) Shot-blast surfaces with an apparatus that abrades the concrete surface, contains the dispensed shot within the apparatus, and recirculates the shot by vacuum pickup.
 - 2) Repair damaged and deteriorated concrete according to terrazzo manufacturer's written recommendations.
 - 3) Use patching and fill material to fill holes and depressions in substrates according to terrazzo manufacturer's written instructions.
 - b. Verify that concrete substrates are visibly dry and free of moisture.
 - c. Moisture Testing:
 - 1) Test for moisture by anhydrous calcium chloride method according to ASTM F 1869. Proceed with installation only after substrates have maximum moisture-vapor-emission rate of **3 lb of water/1000 sq. ft. (1.36 kg of water/92.9 sq. m)** in 24 hours.
 - 2) Test for moisture by relative humidity probe and digital meter method according to ASTM F 2170. Proceed with installation only after substrates have a maximum relative-humidity-measurement reading of 70 to 75 percent in 24 hours.
 - 3) Test for moisture content by method recommended in writing by terrazzo manufacturer. Proceed with installation only after substrates pass testing.
3. Protect other work from dust generated by grinding operations. Control dust to prevent air pollution and comply with environmental protection regulations.
 - a. Erect and maintain temporary enclosures and other suitable methods to limit dust migration and to ensure adequate ambient temperatures and ventilation conditions during installation.

4. Installation of terrazzo indicates acceptance of surfaces and conditions.

B. Epoxy-Resin Terrazzo Installation

1. General:
 - a. Comply with NTMA's written recommendations for terrazzo and accessory installation.
 - b. Place, rough grind, grout, cure grout, fine grind, and finish terrazzo according to manufacturer's written instructions and NTMA's "Terrazzo Specifications and Design Guide."
 - c. Installation Tolerance: Limit variation in terrazzo surface from level to **1/4 inch in 10 feet (6 mm in 3 m)**; noncumulative.
 - d. Ensure that matrix components and fluids from grinding operations do not stain terrazzo by reacting with divider and control-joint strips.
 - e. Delay fine grinding until heavy trade work is complete and construction traffic through area is restricted.
2. Thickness: **1/4 inch (6.4 mm) OR 3/8 inch (9.5 mm) OR As indicated, as directed**, nominal.
3. Flexible Reinforcing Membrane:
 - a. Prepare and prefill substrate cracks with membrane material.
 - b. Install membrane to produce full substrate coverage in areas to receive terrazzo.
 - c. Reinforce membrane with fiberglass scrim.
 - d. Prepare membrane according to manufacturer's written instructions before applying substrate primer.
4. Primer: Apply to terrazzo substrates according to manufacturer's written instructions.
5. Strip Materials:
 - a. Divider and Control-Joint Strips:
 - 1) Locate divider strips in locations indicated.
 - 2) Install control-joint strips back to back directly above concrete-slab control joints **OR** in locations indicated, **as directed**.
 - 3) Install control-joint strips with **1/4-inch (6.4-mm)** gap between strips, and install sealant in gap.
 - 4) Install strips in adhesive setting bed without voids below strips, or mechanically anchor strips as required to attach strips to substrate, as recommended by strip manufacturer.
 - b. Accessory Strips: Install accessory strips as required to provide a complete installation **OR** in locations indicated, **as directed**.
 - c. Abrasive Strips: Install with surface of abrasive strip positioned **1/16 inch (1.6 mm) OR 1/32 inch (0.8 mm), as directed**, higher than terrazzo surface.
6. Fine Grinding: Grind with stones 120 grit or finer until all grout is removed from surface. Repeat rough grinding, grout coat, and fine grinding if large voids exist after initial fine grinding. Produce surface with a minimum of 70 percent aggregate exposure.
7. Repair: Remove and replace terrazzo areas that evidence lack of bond with substrate. Cut out terrazzo areas in panels defined by strips and replace to match adjacent terrazzo, or repair panels according to NTMA's written recommendations, as approved by the Owner.

C. Precast Terrazzo Installation

1. Install precast terrazzo units using method recommended NTMA and manufacturer unless otherwise indicated.
2. Installation Tolerance: Set units with alignment level and true to dimensions, varying **1/8-inch (3.2-mm)** maximum in length, height, or width; noncumulative.
3. Do not install units that are chipped, cracked, discolored, or not properly finished.
4. Seal joints between units with joint compound matching precast terrazzo matrix **OR** joint sealant, **as directed**.

D. Cleaning And Protection

1. Cleaning:
 - a. Remove grinding dust from installation and adjacent areas.



- b. Wash surfaces with cleaner according to NTMA's written recommendations and manufacturer's written instructions; rinse surfaces with water and allow to dry thoroughly.
 2. Sealing:
 - a. Seal surfaces according to NTMA's written recommendations.
 - b. Apply sealer according to sealer manufacturer's written instructions.
 3. Protection: Provide final protection and maintain conditions, in a manner acceptable to Installer, that ensure that terrazzo is without damage or deterioration at time of Final Completion.

END OF SECTION 09 66 23 00

NOT FOR BID

Task	Specification	Specification Description
09 66 23 16	09 66 23 00	Resinous Matrix Terrazzo Flooring
09 66 33 13	09 66 23 00	Resinous Matrix Terrazzo Flooring
09 66 33 16	09 66 23 00	Resinous Matrix Terrazzo Flooring
09 66 33 19	09 66 23 00	Resinous Matrix Terrazzo Flooring

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SECTION 09 67 16 00 - RESINOUS FLOORING

1.1 GENERAL

A. Description Of Work

1. This specification covers the furnishing and installation of materials for resinous flooring. Products shall be as follows or as directed by the Owner. Installation procedures shall be in accordance with the product manufacturer's recommendations. Demolition and removal of materials shall be as required to support the work.

B. Summary

1. Section Includes:
 - a. Decorative resinous flooring systems.
 - b. Industrial resinous flooring systems.
 - c. High-performance resinous flooring systems.

C. Submittals

1. Product Data: For each type of product indicated. Include manufacturer's technical data, application instructions, and recommendations for each resinous flooring component required.
2. LEED Submittal:
 - a. Product Data for Credit EQ 4.2: For resinous flooring systems, documentation including printed statement of VOC content and chemical components.
3. Samples: For each resinous flooring system required, 6 inches (150 mm) square, applied to a rigid backing by Installer for this Project.
4. Product Schedule: For resinous flooring. Use same designations indicated on Drawings.
5. Installer Certificates: Signed by manufacturer certifying that installers comply with specified requirements.
6. Material Certificates: For each resinous flooring component, from manufacturer.
7. Material Test Reports: For each resinous flooring system.
8. Maintenance Data: For resinous flooring to include in maintenance manuals.

D. Quality Assurance

1. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for installation of flooring systems required for this Project.
 - a. Engage an installer who is certified in writing by resinous flooring manufacturer as qualified to apply resinous flooring systems indicated.
2. Source Limitations: Obtain primary resinous flooring materials, including primers, resins, hardening agents, grouting coats, and topcoats, from single source from single manufacturer. Provide secondary materials, including patching and fill material, joint sealant, and repair materials, of type and from source recommended by manufacturer of primary materials.
3. Preinstallation Conference: Conduct conference at Project site.

E. Delivery, Storage, And Handling

1. Deliver materials in original packages and containers, with seals unbroken, bearing manufacturer's labels indicating brand name and directions for storage and mixing with other components.

F. Project Conditions

1. Environmental Limitations: Comply with resinous flooring manufacturer's written instructions for substrate temperature, ambient temperature, moisture, ventilation, and other conditions affecting resinous flooring application.
2. Lighting: Provide permanent lighting or, if permanent lighting is not in place, simulate permanent lighting conditions during resinous flooring application.

3. Close spaces to traffic during resinous flooring application and for not less than 24 hours after application unless manufacturer recommends a longer period.

1.2 PRODUCTS

A. Materials

1. VOC Content of Resinous Flooring: Provide resinous flooring systems, for use inside the weatherproofing system, that comply with the following limits for VOC content when calculated according to 40 CFR 59, Subpart D (EPA Method 24):
 - a. Resinous Flooring: 100 g/L.

B. Decorative Resinous Flooring

1. Resinous Flooring: Abrasion-, impact- and chemical-resistant, decorative-aggregate-filled, epoxy-resin-based, monolithic floor surfacing designed to produce a seamless floor and integral cove base, **as directed**.
2. System Characteristics:
 - a. Color and Pattern: As selected from manufacturer's full range **OR** As indicated by product designation, **as directed**.
 - b. Wearing Surface: Textured for slip resistance **OR** Orange-peel texture **OR** Smooth **OR** Manufacturer's standard wearing surface, **as directed**.
 - c. Overall System Thickness: **1/16 inch (1.6 mm) OR 1/8 inch (3.2 mm) OR 3/16 inch (4.8 mm) OR 1/4 inch (6.4 mm), as directed**.
 - d. Federal Agency Approvals: USDA **OR** FDA, **as directed**, approved for food-processing environments.
3. Body Coats:
 - a. Resin: Epoxy.
 - b. Formulation Description: 100 percent solids **OR** High solids **OR** Water based, **as directed**.
 - c. Application Method: Self-leveling slurry with broadcast aggregates **OR** Self-leveling slurry **OR** Troweled or screeded, **as directed**.
 - 1) Thickness of Coats: **1/16 inch (1.6 mm) OR 1/8 inch (3.2 mm) OR 3/16 inch (4.8 mm) OR 1/4 inch (6.4 mm), as directed**.
 - 2) Number of Coats: One **OR** Two, **as directed**.
 - d. Aggregates: Manufacturer's standard **OR** Colored quartz (ceramic-coated silica) **OR** Vinyl flakes **OR** Granite **OR** Natural silica, **as directed**.
4. Topcoat: Sealing or finish coats.
 - a. Resin: Epoxy **OR** Urethane **OR** Vinyl ester, **as directed**.
 - b. Formulation Description: 100 percent solids **OR** High solids **OR** Water based, **as directed**.
 - c. Type: Clear **OR** Pigmented, **as directed**.
 - d. Finish: Matte **OR** Gloss, **as directed**.
 - e. Number of Coats: One **OR** Two, **as directed**.
5. System Physical Properties: Provide resinous flooring system with the following minimum physical property requirements when tested according to test methods indicated:
 - a. Compressive Strength: per ASTM C 579.
 - b. Tensile Strength: per ASTM C 307.
 - c. Flexural Modulus of Elasticity: per ASTM C 580.
 - d. Water Absorption: per ASTM C 413.
 - e. Coefficient of Thermal Expansion: per ASTM C 531.
 - f. Indentation: per MIL-D-3134.
 - g. Impact Resistance: No chipping, cracking, or delamination and not more than **1/16-inch (1.6-mm) permanent indentation per MIL-D-3134**.
 - h. Resistance to Elevated Temperature: No slip or flow of more than **1/16 inch (1.6 mm) per MIL-D-3134**.
 - i. Abrasion Resistance: maximum weight loss per ASTM D 4060.
 - j. Flammability: Self-extinguishing per ASTM D 635.

- k. Critical Radiant Flux: 0.45 W/sq. cm **OR** 0.22 W/sq. cm, **as directed**, or greater per NFPA 253.
 - l. Hardness: Shore D per ASTM D 2240.
 - m. Bond Strength: 100 percent concrete failure per ACI 503R.
 - 6. System Chemical Resistance: Test specimens of cured resinous flooring system are unaffected when tested according to ASTM D 1308 for 50 percent immersion **OR** ASTM D 543, Procedure A, for immersion **OR** ASTM C 267 for immersion, **as directed**, in reagents **as directed** for no fewer than seven days.
- C. Industrial Resinous Flooring
 - 1. Resinous Flooring: Abrasion-, impact- and chemical-resistant, industrial-aggregate-filled, resin-based, monolithic floor surfacing designed to produce a seamless floor and integral cove base, **as directed**.
 - 2. System Characteristics:
 - a. Color and Pattern: As selected from manufacturer's full range **OR** As indicated by product designation, **as directed**.
 - b. Wearing Surface: Textured for slip resistance **OR** Orange-peel texture **OR** Smooth **OR** Manufacturer's standard wearing surface, **as directed**.
 - c. Overall System Thickness: 1/16 inch (1.6 mm) **OR** 1/8 inch (3.2 mm) **OR** 3/16 inch (4.8 mm) **OR** 1/4 inch (6.4 mm), **as directed**.
 - d. Federal Agency Approvals: USDA **OR** FDA, **as directed**, approved for food-processing environments.
 - 3. Body Coats:
 - a. Resin: Epoxy **OR** Urethane **OR** Vinyl ester, **as directed**.
 - b. Formulation Description: 100 percent solids **OR** High solids **OR** Water based, **as directed**.
 - c. Application Method: Self-leveling slurry with broadcast aggregates **OR** Self-leveling slurry **OR** Troweled or screeded, **as directed**.
 - 1) Thickness of Coats: 1/16 inch (1.6 mm) **OR** 1/8 inch (3.2 mm) **OR** 3/16 inch (4.8 mm) **OR** 1/4 inch (6.4 mm), **as directed**.
 - 2) Number of Coats: One **OR** Two, **as directed**.
 - d. Aggregates: Manufacturer's standard **OR** Colored quartz (ceramic-coated silica) **OR** Vinyl flakes **OR** Granite **OR** Natural silica, **as directed**.
 - 4. Topcoat: Sealing or finish coats.
 - a. Resin: Epoxy **OR** Urethane **OR** Vinyl ester, **as directed**.
 - b. Formulation Description: 100 percent solids **OR** High solids **OR** Water based, **as directed**.
 - c. Type: Clear **OR** Pigmented, **as directed**.
 - d. Finish: Matte **OR** Gloss, **as directed**.
 - e. Number of Coats: One **OR** Two, **as directed**.
 - 5. System Physical Properties: Provide resinous flooring system with the following minimum physical property requirements when tested according to test methods indicated:
 - a. Compressive Strength: per ASTM C 579.
 - b. Tensile Strength: per ASTM C 307.
 - c. Flexural Modulus of Elasticity: per ASTM C 580.
 - d. Water Absorption: per ASTM C 413.
 - e. Coefficient of Thermal Expansion: per ASTM C 531.
 - f. Indentation: percent maximum per MIL-D-3134.
 - g. Impact Resistance: No chipping, cracking, or delamination and not more than 1/16-inch (1.6-mm) permanent indentation per MIL-D-3134.
 - h. Resistance to Elevated Temperature: No slip or flow of more than 1/16 inch (1.6 mm) per MIL-D-3134.
 - i. Abrasion Resistance: maximum weight loss per ASTM D 4060.
 - j. Flammability: Self-extinguishing per ASTM D 635.
 - k. Critical Radiant Flux: 0.45 W/sq. cm **OR** 0.22 W/sq. cm, **as directed**, or greater per NFPA 253.
 - l. Hardness: Shore D per ASTM D 2240.
 - m. Bond Strength: 100 percent concrete failure per ACI 503R.

6. System Chemical Resistance: Test specimens of cured resinous flooring system are unaffected when tested according to ASTM D 1308 for 50 percent immersion **OR** ASTM D 543, Procedure A, for immersion **OR** ASTM C 267 for immersion, **as directed**, in reagents **as directed** for no fewer than seven days.

D. High-Performance Resinous Flooring

1. Resinous Flooring: Abrasion-, impact- and chemical-resistant, high-performance-aggregate-filled, resin-based, monolithic floor surfacing designed to produce a seamless floor and integral cove base, **as directed**.
2. System Characteristics:
 - a. Color and Pattern: As selected from manufacturer's full range **OR** As indicated by product designation, **as directed**.
 - b. Wearing Surface: Textured for slip resistance **OR** Orange-peel texture **OR** Smooth **OR** Manufacturer's standard wearing surface, **as directed**.
 - c. Overall System Thickness: **1/16 inch (1.6 mm)** **OR** **1/8 inch (3.2 mm)** **OR** **3/16 inch (4.8 mm)** **OR** **1/4 inch (6.4 mm)**, **as directed**.
 - d. Federal Agency Approvals: USDA **OR** FDA, **as directed**, approved for food-processing environments.
3. Body Coats:
 - a. Resin: Epoxy **OR** Epoxy novolac **OR** Urethane **OR** Vinyl ester **OR** Methyl methacrylate, **as directed**.
 - b. Formulation Description: 100 percent solids **OR** High solids **OR** Water based, **as directed**.
 - c. Application Method: Self-leveling slurry with broadcast aggregates **OR** Self-leveling slurry **OR** Troweled or screeded, **as directed**.
 - 1) Thickness of Coats: **1/16 inch (1.6 mm)** **OR** **1/8 inch (3.2 mm)** **OR** **3/16 inch (4.8 mm)** **OR** **1/4 inch (6.4 mm)**, **as directed**.
 - 2) Number of Coats: One **OR** Two, **as directed**.
 - d. Aggregates: Manufacturer's standard **OR** Colored quartz (ceramic-coated silica) **OR** Vinyl flakes **OR** Granite **OR** Natural silica, **as directed**.
4. Topcoat: Sealing or finish coats.
 - a. Resin: Epoxy **OR** Epoxy novolac **OR** Urethane **OR** Vinyl ester **OR** Methyl methacrylate, **as directed**.
 - b. Formulation Description: 100 percent solids **OR** High solids **OR** Water based, **as directed**.
 - c. Type: Clear **OR** Pigmented, **as directed**.
 - d. Finish: Matte **OR** Gloss, **as directed**.
 - e. Number of Coats: One **OR** Two, **as directed**.
5. System Physical Properties: Provide resinous flooring system with the following minimum physical property requirements when tested according to test methods indicated:
 - a. Compressive Strength: per ASTM C 579.
 - b. Tensile Strength: per ASTM C 307.
 - c. Flexural Modulus of Elasticity: per ASTM C 580.
 - d. Water Absorption: per ASTM C 413.
 - e. Coefficient of Thermal Expansion: per ASTM C 531.
 - f. Indentation: percent maximum per MIL-D-3134.
 - g. Impact Resistance: No chipping, cracking, or delamination and not more than **1/16-inch (1.6-mm)** permanent indentation per MIL-D-3134.
 - h. Resistance to Elevated Temperature: No slip or flow of more than **1/16 inch (1.6 mm)** per MIL-D-3134.
 - i. Abrasion Resistance: maximum weight loss per ASTM D 4060.
 - j. Flammability: Self-extinguishing per ASTM D 635.
 - k. Critical Radiant Flux: 0.45 W/sq. cm **OR** 0.22 W/sq. cm, **as directed**, or greater per NFPA 253.
 - l. Hardness: Shore D per ASTM D 2240.
 - m. Bond Strength: 100 percent concrete failure per ACI 503R.

6. System Chemical Resistance: Test specimens of cured resinous flooring system are unaffected when tested according to ASTM D 1308 for 50 percent immersion **OR** ASTM D 543, Procedure A, for immersion **OR** ASTM C 267 for immersion, **as directed**, in reagents **as directed** for no fewer than seven days.

E. Accessories

1. Primer: Type recommended by manufacturer for substrate and body coats indicated.
 - a. Formulation Description: 100 percent solids **OR** High solids **OR** Water based, **as directed**.
2. Waterproofing Membrane: Type recommended by manufacturer for substrate and primer and body coats indicated.
 - a. Formulation Description: 100 percent solids **OR** High solids, **as directed**.
3. Reinforcing Membrane: Flexible resin formulation that is recommended by manufacturer for substrate and primer and body coats indicated and that prevents substrate cracks from reflecting through resinous flooring.
 - a. Formulation Description: 100 percent solids **OR** High solids, **as directed**.
 - 1) Provide fiberglass scrim embedded in reinforcing membrane.
4. Patching and Fill Material: Resinous product of or approved by resinous flooring manufacturer and recommended by manufacturer for application indicated.

1.3 EXECUTION

A. Preparation

1. General: Prepare and clean substrates according to resinous flooring manufacturer's written instructions for substrate indicated. Provide clean, dry substrate for resinous flooring application.
2. Concrete Substrates: Provide sound concrete surfaces free of laitance, glaze, efflorescence, curing compounds, form-release agents, dust, dirt, grease, oil, and other contaminants incompatible with resinous flooring.
 - a. Roughen concrete substrates as follows:
 - 1) Shot-blast surfaces with an apparatus that abrades the concrete surface, contains the dispensed shot within the apparatus, and recirculates the shot by vacuum pickup.
OR
Comply with ASTM C 811 requirements unless manufacturer's written instructions are more stringent.
 - b. Repair damaged and deteriorated concrete according to resinous flooring manufacturer's written instructions.
 - c. Verify that concrete substrates are dry and moisture-vapor emissions are within acceptable levels according to manufacturer's written instructions.
 - 1) Perform anhydrous calcium chloride test, ASTM F 1869. Proceed with application of resinous flooring only after substrates have maximum moisture-vapor-emission rate of **3 lb of water/1000 sq. ft. (1.36 kg of water/92.9 sq. m)** of slab area in 24 hours.
 - 2) Perform plastic sheet test, ASTM D 4263. Proceed with application only after testing indicates absence of moisture in substrates.
 - 3) Perform relative humidity test using in situ probes, ASTM F 2170. Proceed with installation only after substrates have a maximum 75 percent relative humidity level measurement.
 - d. Alkalinity and Adhesion Testing: Verify that concrete substrates have pH within acceptable range. Perform tests recommended by manufacturer. Proceed with application only after substrates pass testing.
3. Resinous Materials: Mix components and prepare materials according to resinous flooring manufacturer's written instructions.
4. Use patching and fill material to fill holes and depressions in substrates according to manufacturer's written instructions.
5. Treat control joints and other nonmoving substrate cracks to prevent cracks from reflecting through resinous flooring according to manufacturer's written instructions.

B. Application

1. General: Apply components of resinous flooring system according to manufacturer's written instructions to produce a uniform, monolithic wearing surface of thickness indicated.
 - a. Coordinate application of components to provide optimum adhesion of resinous flooring system to substrate, and optimum intercoat adhesion.
 - b. Cure resinous flooring components according to manufacturer's written instructions. Prevent contamination during application and curing processes.
 - c. At substrate expansion and isolation joints, comply with resinous flooring manufacturer's written instructions.
2. Apply primer over prepared substrate at manufacturer's recommended spreading rate.
3. Apply waterproofing membrane, where indicated, in manufacturer's recommended thickness.
 - a. Apply waterproofing membrane to integral cove base substrates.
4. Apply reinforcing membrane to substrate cracks **OR** entire substrate surface, **as directed**.
5. Integral Cove Base: Apply cove base mix to wall surfaces before applying flooring. Apply according to manufacturer's written instructions and details including those for taping, mixing, priming, troweling, sanding, and topcoating of cove base. Round internal and external corners.
 - a. Integral Cove Base: **4 inches (100 mm)** high.
6. Apply self-leveling slurry body coats in thickness indicated for flooring system.
 - a. Broadcast aggregates at rate recommended by manufacturer and, after resin is cured, remove excess aggregates to provide surface texture indicated.
7. Apply troweled or screeded body coats in thickness indicated for flooring system. Hand or power trowel and grout to fill voids. When cured, remove trowel marks and roughness using method recommended by manufacturer.
8. Apply grout coat, of type recommended by resinous flooring manufacturer, to fill voids in surface of final body coat and to produce wearing surface indicated.
9. Apply topcoats in number indicated for flooring system and at spreading rates recommended in writing by manufacturer.

C. Field Quality Control

1. Core Sampling: At the direction of the Owner and at locations designated by the Owner, take one core sample per **1000 sq. ft. (92.9 sq. m)** of resinous flooring, or portion of, to verify thickness. For each sample that fails to comply with requirements, take two additional samples. Repair damage caused by coring and correct deficiencies.
2. Material Sampling: the Owner may at any time and any number of times during resinous flooring application require material samples for testing for compliance with requirements.
 - a. Contractor will engage an independent testing agency to take samples of materials being used. Material samples will be taken, identified, sealed, and certified in presence of Contractor.
 - b. Testing agency will test samples for compliance with requirements, using applicable referenced testing procedures or, if not referenced, using testing procedures listed in manufacturer's product data.
 - c. If test results show applied materials do not comply with specified requirements, pay for testing, remove noncomplying materials, prepare surfaces coated with unacceptable materials, and reapply flooring materials to comply with requirements.

D. Protection

1. Protect resinous flooring from damage and wear during the remainder of construction period. Use protective methods and materials, including temporary covering, recommended in writing by resinous flooring manufacturer.

END OF SECTION 09 67 16 00



Task	Specification	Specification Description
09 67 23 00	09 67 16 00	Resinous Flooring

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SECTION 09 68 13 00 - CARPET TILE

1.1 GENERAL

A. Description Of Work

1. This specification covers the furnishing and installation of materials for carpet tile. Products shall be as follows or as directed by the Owner. Installation procedures shall be in accordance with the product manufacturer's recommendations. Demolition and removal of materials shall be as required to support the work.

B. Summary

1. This Section includes modular, fusion-bonded **OR** tufted, **as directed**, carpet tile.

C. Submittals

1. Product Data: For each product indicated.
2. Shop Drawings: Show the following:
 - a. Columns, doorways, enclosing walls or partitions, built-in cabinets, and locations where cutouts are required in carpet tiles.
 - b. Existing flooring materials to be removed.
 - c. Existing flooring materials to remain.
 - d. Carpet tile type, color, and dye lot.
 - e. Type of subfloor.
 - f. Type of installation.
 - g. Pattern of installation.
 - h. Pattern type, location, and direction.
 - i. Pile direction.
 - j. Type, color, and location of insets and borders.
 - k. Type, color, and location of edge, transition, and other accessory strips.
 - l. Transition details to other flooring materials.
3. Samples: For each of the following products and for each color and texture required. Label each Sample with manufacturer's name, material description, color, pattern, and designation indicated on Drawings and in schedules.
 - a. Carpet Tile: Full-size Sample.
 - b. Exposed Edge, Transition, and other Accessory Stripping: **12-inch-** (300-mm-) long Samples.
4. LEED Submittal:
 - a. Product Data for Credit EQ 4.3:
 - 1) For carpet tile, documentation indicating compliance with testing and product requirements of Carpet and Rug Institute's "Green Label Plus" program.
 - 2) For installation adhesive, including printed statement of VOC content.
5. Product Schedule: For carpet tile. Use same designations indicated on Drawings.
6. Maintenance data.

D. Quality Assurance

1. Installer Qualifications: An experienced installer who is certified by the Floor Covering Installation Board or who can demonstrate compliance with its certification program requirements.
2. Fire-Test-Response Characteristics: Provide products with the critical radiant flux classification indicated in Part 2, as determined by testing identical products per ASTM E 648 by an independent testing and inspecting agency acceptable to authorities having jurisdiction.
3. Preinstallation Conference: Conduct conference at Project site.

E. Delivery, Storage, And Handling

1. Comply with CRI 104, Section 5, "Storage and Handling."

F. Project Conditions

1. Comply with CRI 104, Section 7.2, "Site Conditions; Temperature and Humidity" and Section 7.12, "Ventilation."
2. Environmental Limitations: Do not install carpet tiles until wet work in spaces is complete and dry, and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.
3. Do not install carpet tiles over concrete slabs until slabs have cured and are sufficiently dry to bond with adhesive and concrete slabs have pH range recommended by carpet tile manufacturer.
4. Where demountable partitions or other items are indicated for installation on top of carpet tiles, install carpet tiles before installing these items.

G. Warranty

1. Special Warranty for Carpet Tiles: Manufacturer's standard form in which manufacturer agrees to repair or replace components of carpet tile installation that fail in materials or workmanship within specified warranty period.
 - a. Warranty does not include deterioration or failure of carpet tile due to unusual traffic, failure of substrate, vandalism, or abuse.
 - b. Failures include, but are not limited to, more than 10 percent loss of face fiber, edge raveling, snags, runs, loss of tuft bind strength, dimensional stability, excess static discharge, and delamination.
 - c. Warranty Period: 10 years from date of Final Completion.

1.2 PRODUCTS

A. Carpet Tile

1. Fiber Content: 100 percent nylon 6, 6 **OR** 100 percent nylon 6 **OR** 100 percent polypropylene **OR** 100 percent wool **OR** 80 percent wool; 20 percent nylon 6, 6 **OR** 80 percent wool; 20 percent nylon 6, **as directed**.
2. Fiber Type: **<Insert proprietary fiber type.>**
3. Pile Characteristic: Level-loop **OR** Cut **OR** Cut-and-loop, **as directed**, pile.
4. Yarn Twist: **<Insert twist in TPI (TPCM).>**
5. Yarn Count: **<Insert yarn count.>**
6. Density: **<Insert oz./cu. yd. (g/cu. cm).>**
7. Pile Thickness: **<Insert inches (mm)>** for finished carpet tile per ASTM D 6859.
8. Stitches: **<Insert stitches per inch (mm).>**
9. Gage: **<Insert gage in ends per inch (mm).>**
10. Surface Pile Weight: **<Insert oz./sq. yd. (g/sq. m).>**
11. Total Weight: **<Insert oz./sq. yd. (g/sq. m)>** for finished carpet tile.
12. Primary Backing/Backcoating: Manufacturer's standard composite materials **OR** PVC **OR** Fiberglass-reinforced PVC **OR** Fiberglass-reinforced amorphous resin **OR** Reinforced polyurethane composite cushion **OR** Reinforced polyurethane composite **OR** Reinforced thermoplastic copolymer, **as directed**.
13. Secondary Backing: Manufacturer's standard material.
14. Backing System: **<Insert proprietary name.>**
15. Size: **18 by 18 inches (457 by 457 mm) OR 24 by 24 inches (610 by 610 mm) OR 18 by 36 inches (457 by 914 mm) OR 36 by 36 inches (914 by 914 mm), as directed.**
16. Applied Soil-Resistance Treatment: Manufacturer's standard material.
17. Antimicrobial Treatment: Manufacturer's standard material.
18. Performance Characteristics: As follows:
 - a. Critical Radiant Flux Classification: Not less than 0.45 W/sq. cm **OR** 0.22 W/sq. cm, **as directed**.
 - b. Dry Breaking Strength: Not less than **100 lbf (445 N)** per ASTM D 2646.
 - c. Tuft Bind: Not less than **3 lbf (13 N) OR 5 lbf (22 N) OR 6.2 lbf (28 N) OR 8 lbf (36 N) OR 10 lbf (45 N), as directed**, per ASTM D 1335.

- d. Delamination: Not less than **3.5 lbf/in. (15 N/mm)** **OR** **4 lbf/in. (18 N/mm)**, **as directed**, per ASTM D 3936.
- e. Dimensional Tolerance: Within **1/32 inch (0.8 mm)** of specified size dimensions, as determined by physical measurement.
- f. Dimensional Stability: 0.2 percent or less per ISO 2551 (Aachen Test).
- g. Resistance to Insects: Comply with AATCC 24.
- h. Noise Reduction Coefficient (NRC): **<Insert NRC>** per ASTM C 423.
- i. Colorfastness to Crocking: Not less than 4, wet and dry, per AATCC 165.
- j. Colorfastness to Light: Not less than 4 after 40 **OR** 60, **as directed**, AFU (AATCC fading units) per AATCC 16, Option E.
- k. Antimicrobial Activity: Not less than 2-mm halo of inhibition for gram-positive bacteria; not less than 1-mm halo of inhibition for gram-negative bacteria; no fungal growth; per AATCC 174.
- l. Electrostatic Propensity: Less than 3.5 **OR** 2, **as directed**, kV per AATCC 134.
- m. Environmental Requirements: Provide carpet tile that complies with testing and product requirements of Carpet and Rug Institute's "Green Label Plus" program.

B. Installation Accessories

- 1. Trowelable Leveling and Patching Compounds: Latex-modified, hydraulic-cement-based formulation provided or recommended by carpet tile manufacturer.
- 2. Adhesives: Water-resistant, mildew-resistant, nonstaining, pressure-sensitive type to suit products and subfloor conditions indicated, that complies with flammability requirements for installed carpet tile and is recommended by carpet tile manufacturer for releasable installation.
 - a. VOC Limits: Provide adhesives with VOC content not more than 50 g/L when calculated according to 40 CFR 59, Subpart D (EPA method 24).

1.3 EXECUTION

A. Preparation

- 1. General: Comply with CRI 104, Section 6.2, "Site Conditions; Floor Preparation," and with carpet tile manufacturer's written installation instructions for preparing substrates indicated to receive carpet tile installation.
- 2. Use trowelable leveling and patching compounds, according to manufacturer's written instructions, to fill cracks, holes, depressions, and protrusions in substrates. Fill or level cracks, holes and depressions **1/8 inch (3 mm)** wide or wider and protrusions more than **1/32 inch (0.8 mm)**, unless more stringent requirements are required by manufacturer's written instructions.
- 3. Remove coatings, including curing compounds, and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, without using solvents. Use mechanical methods recommended in writing by carpet tile manufacturer.
- 4. Clean metal substrates of grease, oil, soil and rust, and prime if directed by adhesive manufacturer. Rough sand painted metal surfaces and remove loose paint. Sand aluminum surfaces, to remove metal oxides, immediately before applying adhesive.
- 5. Broom and vacuum clean substrates to be covered immediately before installing carpet tile.

B. Installation

- 1. General: Comply with CRI 104, Section 14, "Carpet Modules," and with carpet tile manufacturer's written installation instructions.
- 2. Installation Method: As recommended in writing by carpet tile manufacturer **OR** Glue down; install every tile with full-spread, releasable, pressure-sensitive adhesive **OR** Partial glue down; install periodic tiles with releasable, pressure-sensitive adhesive **OR** Free lay; install carpet tiles without adhesive, **as directed**.
- 3. Maintain dye lot integrity. Do not mix dye lots in same area.
- 4. Cut and fit carpet tile to butt tightly to vertical surfaces, permanent fixtures, and built-in furniture including cabinets, pipes, outlets, edgings, thresholds, and nosings. Bind or seal cut edges as recommended by carpet tile manufacturer.

5. Extend carpet tile into toe spaces, door reveals, closets, open-bottomed obstructions, removable flanges, alcoves, and similar openings.
6. Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating on finish flooring as marked on subfloor. Use nonpermanent, nonstaining marking device.
7. Install pattern parallel to walls and borders.
8. Stagger joints of carpet tiles so carpet tile grid is offset from access flooring panel grid. Do not fill seams of access flooring panels with carpet adhesive; keep seams free of adhesive.

C. Cleaning And Protection

1. Perform the following operations immediately after installing carpet tile:
 - a. Remove excess adhesive, seam sealer, and other surface blemishes using cleaner recommended by carpet tile manufacturer.
 - b. Remove yarns that protrude from carpet tile surface.
 - c. Vacuum carpet tile using commercial machine with face-beater element.
2. Protect installed carpet tile to comply with CRI 104, Section 16, "Protection of Indoor Installations."
3. Protect carpet tile against damage from construction operations and placement of equipment and fixtures during the remainder of construction period. Use protection methods indicated or recommended in writing by carpet tile manufacturer.

END OF SECTION 09 68 13 00



Task	Specification	Specification Description
09 68 16 00	09 01 60 91a	Carpet
09 68 16 00	09 68 13 00	Carpet Tile

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SECTION 09 69 13 00 - ACCESS FLOORING

1.1 GENERAL

A. Description Of Work

1. This specification covers the furnishing and installation of materials for access flooring. Product shall be as follows or as directed by the Owner. Installation procedures shall be in accordance with the product manufacturer's recommendations. Demolition and removal of materials shall be as required to support the work.

B. Summary

1. This Section includes the following:
 - a. Access flooring panels and understructure.
 - b. Floor panel coverings.

C. Definition

1. ESD: Electrostatic discharge. The transfer of electric charge between bodies at different potentials.

D. System Description

1. Access Flooring System: Assemblies composed of modular floor panels on pedestals with or without stringers.

E. Performance Requirements

1. Structural Performance: Provide access flooring systems capable of withstanding the following loads and stresses within limits and under conditions indicated, as determined by testing manufacturer's current standard products according to referenced procedures in CISC A/F, "Recommended Test Procedures for Access Floors":
 - a. Concentrated Loads: Provide floor panels, including those with cutouts, capable of withstanding a concentrated design load of **1000 lbf (4448 N) OR 1250 lbf (5560 N) OR 1500 lbf (6672 N) OR 2000 lbf (8896 N)**, as directed, with a top-surface deflection under load and a permanent set not to exceed, respectively, **0.10 and 0.010 inch (2.54 and 0.25 mm) OR 0.080 inch and 0.010 inch (2.03 and 0.25 mm)**, as directed, according to CISC A/F, Section I, "Concentrated Loads."
OR
Concentrated Loads: Provide floor panels, including those with cutouts, capable of withstanding a concentrated design load of **1000 lbf (4448 N) OR 1250 lbf (5560 N) OR 1500 lbf (6672 N) OR 2000 lbf (8896 N)**, as directed, with a bottom-surface deflection under load and a permanent set not to exceed, respectively, **0.10 and 0.010 inch (2.54 and 0.25 mm) OR 0.13 inch and 0.010 inch (3.30 and 0.25 mm)**, as directed, measured below each applied-load location at horizontal surface of nearest composite beam according to CISC A/F, Section I, "Concentrated Loads."
 - b. Ultimate Loads: Provide access flooring systems capable of withstanding a minimum ultimate concentrated load of **2000 lbf (8896 N) OR 2500 lbf (11 121 N) OR 2600 lbf (11 565 N) OR 3000 lbf (13 345 N) OR 4000 lbf (17 793 N)**, as directed, without failing, according to CISC A/F, Section II, "Ultimate Loading."
 - c. Rolling Loads: Provide access flooring systems capable of withstanding rolling loads of the following magnitude, with a combination of local and overall deformation not to exceed **0.040 inch (1.02 mm)** after exposure to rolling load over CISC A/F Path A or B, whichever path produces the greatest top-surface deformation, according to CISC A/F, Section III, "Rolling Loads."
 - 1) CISC A/F Wheel 1 Rolling Load: **600 lbf (2669 N) OR 800 lbf (3559 N) OR 1000 lbf (4448 N) OR 1200 lbf (5338 N)**, as directed.

- 2) CISC A/F Wheel 2 Rolling Load: **500 lbf (2224 N) OR 600 lbf (2669 N) OR 800 lbf (3559 N) OR 1000 lbf (4448 N), as directed.**
- d. Stringer Load Testing: Provide stringers, without panels in place, capable of withstanding a concentrated load of **75 lbf (334 N) OR 225 lbf (1001 N) OR 450 lbf (2002 N) OR 850 lbf (3781 N), as directed**, at center of span with a permanent set not to exceed **0.010 inch (0.25 mm)**, as determined per CISC A/F, Section IV, "Stringer Load Testing."
- e. Pedestal Axial Load Test: Provide pedestal assemblies, without panels or other supports in place, capable of withstanding a **5000 lbf (22 240 N) OR 6000 lbf (26 690 N), as directed**, axial load per pedestal, according to CISC A/F, Section V, "Pedestal Axial Load Test."
- f. Pedestal Overturning Moment Test: Provide pedestal assemblies, without panels or other supports in place, capable of withstanding an overturning moment per pedestal of **1000 lbf x inches (113 N x meters)**, according to CISC A/F, Section VI, "Pedestal Overturning Moment Test."
2. Floor Panel Impact-Load Performance: Provide access flooring system capable of withstanding an impact load of **75 lb (34.0 kg) OR 100 lb (45.5 kg) OR 125 lb (56.7 kg) OR 150 lb (68.0 kg) OR 175 lbs (79.4 kg), as directed**, when dropped from **36 inches (914 mm)** onto a **1-sq. in. (6.5-sq. cm)** area located anywhere on panel, without failing. Failure is defined as collapse of access flooring system.
3. Seismic Performance: Provide access flooring system capable of withstanding the effects of seismic motions determined according to ASCE 7, "Minimum Design Loads for Buildings and Other Structures": Section 9, "Earthquake Loads."
4. ESD-Control Properties: Provide floor coverings with ESD-control properties indicated as determined by testing identical products per test method indicated by an independent testing and inspecting agency.
 - a. Static-Dissipative Floor Covering Properties:
 - 1) Electrical Resistance: Test per ASTM F 150 with 100-V applied voltage **OR ESD STM 7.1, as directed.**
 - a) Average greater than 1 megohm and less than or equal to 1000 megohms when test specimens are tested surface to ground.
 - b) Average no less than 1 megohm and less than or equal to 1000 megohms when installed floor coverings are tested surface to ground.
 - 2) Static Generation: Less than 300 V when tested per AATCC-134 at 20 percent relative humidity with conductive footwear.
 - 3) Static Decay: 5000 to 0 V in less than 0.25 seconds when tested per FED-STD-101C/4046.1.
 - b. Static-Conductive Floor Covering Properties:
 - 1) Electrical Resistance: Test per ASTM F 150 with 500-V applied voltage **OR ESD STM 7.1 OR NFPA 99, Annex 2 OR UL 779, as directed.**
 - a) Average greater than 25,000 ohms and less than 1 megohm when test specimens and installed floor coverings are tested surface to surface (point to point).
 - b) Average no less than 25,000 ohms with no single measurement less than 10,000 ohms when installed floor coverings are tested surface to ground.
 - 2) Static Generation: Less than 100 V when tested per AATCC-134 at 20 percent relative humidity with conductive footwear.
 - 3) Static Decay: 5000 to 0 V in less than 0.03 **OR 0.01, as directed**, seconds when tested per FED-STD-101C/4046.1.
 - c. Antistatic Floor Covering Properties:
 - 1) Electrical Resistance: Test per ESD STM 7.1.
 - a) Average greater than 25,000 ohms and less than 1,000 megohm when test specimens and installed floor coverings are tested surface to surface (point to point).
 - 2) Static Generation: Less than 100 V when tested per AATCC-134 at 20 percent relative humidity with conductive footwear.

- d. Panel-to-Understructure Resistance: Not more than 10 ohms as measured without floor coverings.

F. Submittals

1. Product Data: For each type of product indicated.
2. Shop Drawings: Include layout of access flooring system and relationship to adjoining Work based on field-verified dimensions.
3. Shop Drawings: Include layout, details, sections, and relationship to adjoining Work.
4. LEED Submittals:
 - a. Product Data for Credit EQ 4.1: For pedestal installation adhesive, including printed statement of VOC content.
 - b. Product Data for Credit EQ 4.3: For carpet and installation adhesive, documentation indicating compliance with specified requirements.
 - c. Product Data for Credit EQ 4.4: For particleboard used in steel-encapsulated, wood core panels, documentation indicating that particleboard contains no urea formaldehyde.
5. Product test reports.

G. Quality Assurance

1. Regulatory Requirements: Fabricate and install access flooring to comply with NFPA 75 requirements for raised flooring.
2. Preinstallation Conference: Conduct conference at Project site.

1.2 PRODUCTS

A. Floor Panels And Understructure

1. Floor Panels, General: Provide modular panels complying with the following requirements that one person, using a portable lifting device, can interchange with other field panels without disturbing adjacent panels or understructure:
 - a. Nominal Panel Size: **24 by 24 inches (610 by 610 mm) OR 600 by 600 mm, as directed.**
 - b. Fabrication Tolerances: Fabricate panels to the following tolerances with squareness tolerances expressed as the difference between diagonal measurements from corner to corner:
 - 1) Size and Squareness: Plus or minus **0.015 inch (0.38 mm)** of required size, with a squareness tolerance of plus or minus **0.015 inch (0.38 mm)**, unless tolerances are otherwise indicated for a specific panel type.
 - 2) Flatness: Plus or minus **0.020 inch (0.50 mm)**, measured on a diagonal on top of panel.
 - c. Panel Attachment to Understructure: By gravity.
 - d. Panel Attachment to Understructure: By bolting to pedestal head. Provide panels with holes drilled in corners to align precisely with threaded holes in pedestal heads and to accept countersunk screws with heads flush with top of panel.
 - 1) Provide fasteners held captive to panels.
2. Steel-Encapsulated, Wood-Core Panels: Fabricated with **1-inch- (25-mm-)** thick, particleboard core, made without urea formaldehyde laminated to top and bottom steel face sheets, with metal surfaces protected against corrosion by manufacturer's standard factory-applied finish, and with a flame-spread index of 25 or less per ASTM E 84. Provide core edges enclosed with upturned, die-formed edge of bottom sheet or with perimeter steel channel welded to top sheet and welded or bonded to bottom sheet.
3. Formed-Steel Panels: Fabricated with die-cut flat top sheet and die-formed and stiffened steel bottom pan formed from cold-rolled steel sheet and joined together by resistance welding, with metal surfaces protected against corrosion by manufacturer's standard factory-applied finish to produce units of the following type:
 - a. Solid Panels: Flat, solid top surface.

- b. Perforated Panels: Perforated top surface with holes **OR** slots, **as directed**, of number, spacing, and size standard with manufacturer to produce a nominal open area of 25 percent. Provide mechanical dampers with each panel unit, **as directed**.
 - 1) Quantity: As directed.
 - 2) Finish: Manufacturer's standard **OR** To match solid panels, **as directed**.
 - c. Grates: Grating ribs arranged in manufacturer's standard pattern to produce a nominal open area of 56 percent. Provide mechanical dampers with each panel unit, **as directed**.
 - 1) Quantity: As directed.
 - 2) Finish: Manufacturer's standard **OR** To match solid panels, **as directed**.
 - 4. Cementitious-Filled, Formed-Steel Panels: Fabricated with die-cut flat top sheet and die-formed and stiffened bottom pan formed from cold-rolled steel sheet joined together by resistance welding to form an enclosed assembly, with metal surfaces protected against corrosion by manufacturer's standard factory-applied finish. Fully grout internal spaces of completed units with manufacturer's standard cementitious fill.
 - 5. Die-Cast Aluminum Panels: Fabricated from manufacturer's standard aluminum alloy but not less than the strength and corrosion resistance of Alloy UNS No. A03830 or UNS No. A03840 per ASTM B 85, to produce units of the following type and with the following finish:
 - a. Solid Panels: Flat, solid surface on top and symmetrical crossing ribs on bottom; edge machined after casting to specified tolerances.
 - b. Perforated Panels: Perforated top surface with holes **OR** slots, **as directed**, of number, spacing, and size standard with manufacturer to produce a nominal open area of 25 percent. Provide mechanical dampers with each panel unit, **as directed**.
 - 1) Quantity: As directed.
 - 2) Finish: Manufacturer's standard **OR** To match solid panels, **as directed**.
 - c. Grates: Grating ribs arranged in manufacturer's standard pattern to produce a nominal open area of 56 percent. Provide mechanical dampers with each panel unit, **as directed**.
 - 1) Quantity: As directed.
 - 2) Finish: Manufacturer's standard **OR** To match solid panels, **as directed**.
 - d. Epoxy Finish: Epoxy **OR** Conductive epoxy, **as directed**, powder coating with a minimum average thickness of **2.5 mils (0.064 mm)** and in color selected from manufacturer's full range.
 - e. Plated Finish: Nickel-chrome electrodeposited plating, **0.000005-inch (0.000127-mm)** chrome over **0.0008-inch (0.02-mm)** nickel, without copper or brass strike, to produce complete coverage over significant surfaces with a matte metallic appearance.
 - 6. Concrete-Filled, Steel Pan Panels: Fabricated with bottom pan die-formed from electrolytic-zinc-coated steel sheet and filled with lightweight concrete that is reinforced and bonded to pan by shear ties.
 - 7. Pedestals: Assembly consisting of base, column with provisions for height adjustment, and head (cap); made of steel **OR** aluminum, **as directed**.
 - a. Provide pedestals designed for use in seismic applications.
 - b. Base: Square or circular base with not less than **16 sq. in. (103 sq. cm)** of bearing area.
 - c. Column: Of height required to bring finished floor to elevations indicated. Weld to base plate.
 - d. Provide vibration-proof leveling mechanism for making and holding fine adjustments in height over a range of not less than **2 inches (51 mm)** and for locking at a selected height, so deliberate action is required to change height setting and vibratory displacement is prevented.
 - e. Head: Designed to support understructure system indicated.
 - 1) Provide sound-deadening pads or gaskets at contact points between heads and panels.
 - 2) Provide head with four holes aligned with holes in floor panels for bolting of panels to pedestals.
 - 8. Stringer Systems: Modular steel **OR** aluminum, **as directed**, stringer systems made to interlock with pedestal heads and form a grid pattern placing stringers under each edge of each floor panel

and a pedestal under each corner of each floor panel. Protect steel components with manufacturer's standard galvanized or corrosion-resistant paint finish.

- a. Bolted Stringers: System of main and cross stringers connected to pedestals with threaded fasteners accessible from above.
- b. Snap-on Stringers: System of stringers attached to pedestals with nonbolted interlocking connections to provide a stable understructure and to prevent accidental disengagement.
- c. Provide continuous gasket at contact surfaces between panel and stringers to deaden sound, to seal off underfloor cavity from above, and to maintain panel alignment and position.
- d. Provide stringers that support each edge of each panel where required to meet design-load criteria.

B. Floor Panel Coverings

1. Provide bare panels without factory-applied floor coverings on traffic surfaces.
2. General: Provide factory-applied floor coverings of type indicated that are laminated by access flooring manufacturer to tops of floor panels including perforated panels, **as directed**.
3. Colors, Textures, and Patterns: As selected from manufacturer's full range.
4. Standard Plastic Laminate: NEMA LD 3, High-Wear type, Grade HWH **OR** HDS, **as directed**; fabricated in one piece to cover each panel face within perimeter plastic **OR** with integral trim serving as, **as directed**, edging.
5. Static-Conductive Plastic Laminate: NEMA LD 3, High-Wear type, Grade CHWH **OR** CHDS, **as directed**, fabricated in one piece to cover each panel face within perimeter plastic edging or with integral trim serving as edging.
6. Solid Vinyl Tile: Static-Conductive **OR** Static-Dissipative, **as directed**, ASTM F 1700, Class I (Monolithic Vinyl Tile), Type A (Smooth Surface), fabricated in one piece to cover panel face within plastic edging.
7. Low-Emissivity, Solid Vinyl Tile: Static-Conductive **OR** Static-Dissipative, **as directed**, ASTM F 1700, Class I (Monolithic Vinyl Tile), Type A (Smooth Surface), with minimum 50 percent reduction in outgassing **OR** total mass loss of 1 percent and minimum 98 percent reduction in collected volatile condensable materials, **as directed**, compared to products with dioctyl phthalate as determined by testing per ASTM E 595.
8. Standard Commercial Carpet: Die cut and adhesively bonded to top surface of panel.
 - a. Provide factory-applied carpet with the following characteristics:
 - 1) Style: Passport.
 - 2) Fiber Type: 100% BCF nylon.
 - 3) Pile Characteristics: Level loop.
 - 4) Pile Thickness: 0.130 inch (3.30 mm).
 - 5) Stitches: 10.0/inch (10.0/2.54 cm).
 - 6) Surface Pile Weight: 26 oz./sq. yd. (881 g/sq. m).
 - 7) Total Weight: 56 oz./sq. yd. (1899 g/sq. m).
 - 8) Backing: Woven polypropylene.
 - 9) Critical Radiant Flux Rating: Minimum of 0.45 W/sq. cm per ASTM E 648.
 - b. Environmental Requirements: Provide carpet that complies with testing and product requirements of Carpet and Rug Institute's "Green Label Plus" program. Bond carpet to panels with adhesives with VOC content not more than 50g/L when calculated according to 40 CFR 59, Subpart D (EPA method 24).
9. Antistatic Carpet: Antistatic modular carpet tile bonded with conductive adhesive to **OR** with buttons that engage into positioning holes in, **as directed**, top surface of panel.
 - a. Provide carpet with the following characteristics:
 - 1) Style: Classic **OR** Contempo, **as directed**.
 - 2) Fiber Type: Solutia LXI nylon **OR** Performa SD Type 6 nylon, **as directed**
 - 3) Pile Characteristics: Textured loop **OR** Textured graphic loop, **as directed**.
 - 4) Pile Thickness: 0.125 and 0.188 inch (3.18 and 4.78 mm).
 - 5) Stitches: 11.0/inch (11.0/2.54 cm) **OR** 10.0/inch (10.0/ 2.54 cm), **as directed**.
 - 6) Surface Pile Weight: 24 oz./sq. yd. (814 g/sq. m).
 - 7) Total Weight: 148 oz./sq. yd. (5018 g/sq. m).

- 8) Backing: Static-dissipative, unitary PVC backing with conductive additive.
- 9) Critical Radiant Flux Rating: Minimum of 0.45 W/sq. cm per ASTM E 648.
- b. Environmental Requirements: Provide carpet that complies with testing and product requirements of Carpet and Rug Institute's "Green Label Plus" program. Bond carpet to panels with adhesives with VOC content not more than 50g/L when calculated according to 40 CFR 59, Subpart D (EPA method 24), **as directed**.
10. Edging: Manufacturer's standard applied **OR** integral, **as directed**, edge trim. Provide size and profile of applied edge trim that fits floor coverings selected.
11. Resilient Wall Base: ASTM F 1861, Type TS (rubber, vulcanized thermoset) **OR** TV (vinyl, thermoplastic), **as directed**, Group 1 (solid), Style B (cove), **0.080 inch (2.03 mm) OR 0.125 inch (3.18 mm), as directed**, thick and **2-1/2 inches (63.5 mm) OR 4 inches (102 mm) OR 6 inches (152 mm), as directed**, high, with matching end stops and factory-made corner units, **as directed**.

C. Accessories

1. Adhesives: Manufacturer's standard adhesive for bonding pedestal bases to subfloor.
 - a. Provide adhesive with a VOC content of 70 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
2. Post-Installed Anchors: For anchoring pedestal bases to subfloor, provide 2 **OR** 4, **as directed**, post-installed expansion anchors **OR** threaded concrete screws, **as directed**, made from carbon-steel components, zinc plated to comply with ASTM B 633, Class Fe/Zn 5 (5 microns) for Class SC 1 service condition (mild), with the capability to sustain, without failure, a load equal to 1.5 times the loads imposed by pedestal overturning moment on fasteners, as determined by testing per ASTM E 488, conducted by a qualified independent testing agency.
3. Cutouts: Provide cutouts in floor panels for cable penetrations and service outlets. Provide reinforcement or additional support, if needed, to make panels with cutouts comply with standard performance requirements.
 - a. Number, Size, Shape, and Location: **As directed**.
 - b. Trim edge of cutouts with manufacturer's standard plastic molding.
 - c. Fit cutouts with manufacturer's standard grommets in sizes indicated or, if size of cutouts exceeds maximum grommet size available, trim edge of cutouts with manufacturer's standard plastic molding having tapered top flange. Furnish removable covers for grommets, **as directed**.
 - d. Provide foam-rubber pads for sealing annular space formed in cutouts by cables.
4. Service Outlets: Standard UL-listed and -labeled assemblies, for recessed mounting flush with top of floor panels, for power, communication, and signal services, and complying with the following requirements:
 - a. Structural Performance: Cover capable of supporting a **1000-lbf (4448-N)** concentrated load.
 - b. Cover and Box Type: Hinged polycarbonate cover with opening for passage of cables when cover is closed and including frame and steel box or formed-steel plate for mounting electrical receptacles.
OR
Cover and Box Type: Grommet with twist-close cover and including steel junction box for electrical receptacle with provision for telephone Amphenol connectors and signal cables.
 - c. Location: In center of panel quadrant, unless otherwise indicated.
 - d. Receptacles and Wiring: Electrical receptacles and wiring for service outlets are specified in Division 22.
OR
Receptacles and Wiring: Equip each service outlet with power receptacles to comply with the following requirements:
 - 1) Type of Receptacle: Heavy-duty duplex, 2-pole, 3-wire grounding, 20 A, 125 V, NEMA WD 6, Configuration 5-20R, unless otherwise indicated.
 - 2) Number of Receptacles for Outlet: One **OR** Two **OR** Four, **as directed**.

- 3) Wiring Method: Factory wired for hard wiring in field with armored cable, containing 3 insulated No. 12 AWG solid-copper conductors, terminated with a **6-inch- (152-mm-)** long pigtail.
OR
Wiring Method: Power-in connectors, built into outlet housing, of type to fit power-in and power-out connectors of branch-circuit cables supplied with building electrical system.
5. Diffusers: Manufacturer's standard round diffusers, **4 inches (102 mm) OR 8 inches (203 mm), as directed**, in diameter, formed from aluminum **OR** polycarbonate plastic, **as directed**, to produce a removable 1-piece unit complete with diffuser, manually adjustable flow regulator, dirt and dust receptacle, trim ring, and underfloor compression mounting ring; precisely fitted in factory-prepared openings of standard field panels, and complying with the following requirements:
 - a. Air-Distribution Characteristics: **100 cfm (47 L/s) at 0.096-inch (24-Pa)** static pressure and a maximum noise criterion rating of 15, **as directed**.
 - b. Structural Performance: Capable of supporting a **600-lbf (2669-N)** concentrated load, **as directed**.
 - c. Fire-Test-Response Characteristics: Classified 94V-0 per UL 94.
6. Floor Grilles: Standard load-bearing grilles formed from aluminum **OR** polycarbonate plastic, **as directed**, to produce removable one-piece unit precisely fitted in factory-prepared openings of standard field panels, with adjustable/removable **OR** without, **as directed**, dampers and complying with the following requirements:
 - a. Air-Distribution Characteristics: **468 cfm at 0.10-inch wg (221 L/s at 25-Pa)** static pressure.
 - b. Structural Performance: Capable of supporting a **1000-lbf (4448-N)** concentrated load.
 - c. Fire-Test-Response Characteristics: Classified 94V-0 per UL 94.
7. Cavity Dividers: Provide manufacturer's standard metal dividers located where indicated to divide underfloor cavities.
8. Vertical Closures (Fasciae): Where underfloor cavity is not enclosed by abutting walls or other construction, provide metal-closure plates with manufacturer's standard finish.
9. Ramps: Manufacturer's standard ramp construction of width and slope indicated but not steeper than 1:12, with raised-disc or textured rubber or vinyl floor coverings, and of same materials, performance, and construction requirements as access flooring.
10. Steps: Provide steps of size and arrangement indicated with floor coverings to match access flooring. Apply nonslip aluminum nosings to treads, unless otherwise indicated.
11. Railings: Standard extruded-aluminum railings, at ramps and open-sided perimeter of access flooring where indicated. Include handrail, intermediate rails, posts, brackets, end caps, wall returns, wall and floor flanges, plates, and anchorages where required.
 - a. Provide railings that comply with structural performance requirements specified in Division 05 Section(s) "Pipe And Tube Railings" **OR** "Decorative Metal", **as directed**.
12. Panel Lifting Device: Manufacturer's standard portable lifting device of type required for specified panels. Provide one lifting devices per room of each type required.
13. Perimeter Support: Where indicated, provide manufacturer's standard method for supporting panel edge and forming transition between access flooring and adjoining floor coverings at same level as access flooring.

1.3 EXECUTION

A. Preparation

1. Lay out floor panel installation to keep the number of cut panels at floor perimeter to a minimum. Avoid using panels cut to less than **6 inches (152 mm)**.
2. Locate each pedestal, complete any necessary subfloor preparation, and vacuum clean subfloor to remove dust, dirt, and construction debris before beginning installation.

B. Installation

1. Install access flooring system and accessories under supervision of access flooring manufacturer's authorized representative to produce a rigid, firm installation that complies with performance requirements and is free of instability, rocking, rattles, and squeaks.
2. Set pedestals in adhesive as recommended in writing by access flooring manufacturer to provide full bearing of pedestal base on subfloor.
3. Attach pedestals to subfloor by post-installed mechanical anchors.
4. Adjust pedestals to permit top of installed panels to be set flat, level, and to proper height.
5. Secure stringers to pedestal heads according to access flooring manufacturer's written instructions.
6. Install flooring panels securely in place, properly seated with panel edges flush. Do not force panels into place.
 - a. Carpeted Panels: Install panels with carpet pile in same direction.
7. Scribe perimeter panels to provide a close fit with adjoining construction with no voids greater than **1/8 inch (3 mm)** where panels abut vertical surfaces.
 - a. To prevent dusting, seal cut edges of steel-encapsulated, wood-core panels with sealer recommended in writing by panel manufacturer.
8. Cut and trim access flooring and perform other dirt-or-debris-producing activities at a remote location or as required to prevent contamination of subfloor under access flooring already installed.
9. Ground flooring system as recommended by manufacturer and as needed to comply with performance requirements for electrical resistance of floor coverings.
10. Scribe and install underfloor-cavity dividers to closely fit against subfloor surfaces, and seal with mastic.
11. Scribe vertical closures to closely fit against subfloor and adjacent finished-floor surfaces. Set in mastic and seal to maintain plenum effect within underfloor cavity.
12. Clean dust, dirt, and construction debris caused by floor installation, and vacuum subfloor area, as installation of floor panels proceeds.
13. Seal underfloor air cavities at construction seams, penetrations, and perimeter to control air leakage as recommended in writing by manufacturer.
14. Install access flooring without change in elevation between adjacent panels and within the following tolerances:
 - a. Plus or minus **1/16 inch (1.5 mm) OR 1/8 inch (3 mm)**, as directed, in any **10-foot (3-m)** distance.
 - b. Plus or minus **1/8 inch (3 mm) OR 1/4 inch (6.5 mm)**, as directed, from a level plane over entire access flooring area.

C. Adjusting, Cleaning, And Protection

1. Prohibit traffic on access flooring for 24 hours and removal of floor panels for 72 hours after installation to allow pedestal adhesive to set.
2. After completing installation, vacuum clean access flooring and cover with continuous sheets of reinforced paper or plastic. Maintain protective covering until time of Final Completion.
3. Replace access flooring panels that are stained, scratched, or otherwise damaged or that do not comply with specified requirements.

END OF SECTION 09 69 13 00



Task	Specification	Specification Description
09 69 53 00	09 69 13 00	Access Flooring

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SECTION 09 72 13 00 - WALL COVERINGS

1.1 GENERAL

A. Description Of Work

1. This specification covers the furnishing and installation of materials for wall coverings. Products shall be as follows or as directed by the Owner. Installation procedures shall be in accordance with the product manufacturer's recommendations. Demolition and removal of materials shall be as required to support the work.

B. Summary

1. Section Includes:
 - a. Vinyl wall covering.
 - b. Woven glass-fiber wall covering.
 - c. Textile wall covering.
 - d. Heavy-duty synthetic textile wall covering.
 - e. Wood-veneer wall covering.
 - f. Wallpaper.

C. Submittals

1. Product Data: For each type of product indicated.
2. LEED Submittals:
 - a. Certificates for Credit MR 7: Chain-of-custody certificates certifying that wood-veneer wall coverings comply with forest certification requirements. Include evidence that manufacturer is certified for chain of custody by an FSC-accredited certification body.
 - b. Product Data for Credit EQ 4.1: For adhesives, including printed statement of VOC content.
 - c. Product Data for Credit EQ 4.2: For paints and coatings, including printed statement of VOC content and chemical components.
3. Shop Drawings: Show location and extent of each wall-covering type. Indicate pattern placement, veneer matching, seams and termination points.
4. Samples: Full width by ~~36-inch~~ (914-mm-) long section of wall covering from same print run or dye lot to be used for the Work, with specified treatments, paint, applied. Show complete pattern repeat. Mark top and face of fabric.
5. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for wall covering.
6. Maintenance Data: For wall coverings to include in maintenance manuals.

D. Quality Assurance

1. Forest Certification: Fabricate products with wood veneer produced from wood obtained from forests certified by an FSC-accredited certification body to comply with FSC STD-01-001, "FSC Principles and Criteria for Forest Stewardship."
2. Fire-Test-Response Characteristics: As determined by testing identical wall coverings applied with identical adhesives to substrates according to test method indicated below by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
 - a. Surface-Burning Characteristics: As follows, per ASTM E 84:
 - 1) Flame-Spread Index: 25 or less.
 - 2) Smoke-Developed Index: 50 **OR** 450, **as directed**, or less.
 - b. Fire-Growth Contribution: Textile wall coverings complying with acceptance criteria of IBC Standard 803.
 - c. Fire-Growth Contribution: Textile wall coverings tested according to NFPA 265 **OR** NFPA 286, **as directed**, and complying with test protocol and criteria in the IBC Standard 803.

E. Project Conditions

1. Environmental Limitations: Do not deliver or install wall coverings until spaces are enclosed and weathertight, wet work in spaces is complete and dry, work above ceilings is complete, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.
 - a. Wood-Veneer Wall Coverings: Condition spaces for not less than 48 hours before installation.
2. Lighting: Do not install wall covering until a permanent level of lighting is provided on the surfaces to receive wall covering.
3. Ventilation: Provide continuous ventilation during installation and for not less than the time recommended by wall-covering manufacturer for full drying or curing.

1.2 PRODUCTS

A. Wall Coverings

1. General: Provide rolls of each type of wall covering from same print run or dye lot.

B. Vinyl Wall Covering

1. Vinyl Wall-Covering Standards: Provide products **OR** mildew-resistant products, **as directed**, complying with the following:
 - a. FS CCC-W-408D and CFFA-W-101-D for Type I, Light-Duty **OR** Type II, Medium-Duty **OR** Type III, Heavy-Duty, **as directed**, products.
 - b. ASTM F 793 for peelable **OR** strippable, **as directed**, wall coverings that qualify as Category I, Decorative Only **OR** Category II, Decorative with Medium Serviceability **OR** Category III, Decorative with High Serviceability **OR** Category IV, Type I, Commercial Serviceability **OR** Category V, Type II, Commercial Serviceability **OR** Category VI, Type III, Commercial Serviceability, **as directed**, products.
2. Width: **27 inches (686 mm) OR 54 inches (1372 mm)**, **as directed**.
3. Backing: Scrim **OR** Osnaburg **OR** Drill **OR** Nonwoven, **as directed**, fabric.
 - a. Fiber Content: Cotton **OR** Polyester **OR** Polycotton **OR** Polyester cellulose, **as directed**.
4. Repeat: Random.
5. Colors, Textures, and Patterns: As selected from manufacturer's full range.

C. Woven Glass-Fiber Wall Covering

1. Width: **39 inches (991 m)**.
2. Colors, Textures, and Patterns: As selected from manufacturer's full range.

D. Textile Wall Covering

1. Wall-Covering Standard: Provide mildew-resistant **OR** peelable **OR** strippable, **as directed**, wall coverings that comply with ASTM F 793 for Category I, Decorative Only **OR** Category II, Decorative with Medium Serviceability **OR** Category III, Decorative with High Serviceability **OR** Category IV, Type I, Commercial Serviceability **OR** Category V, Type II, Commercial Serviceability **OR** Category VI, Type III, Commercial Serviceability, **as directed**, products.
2. Test Responses:
 - a. Colorfastness to Wet and Dry Crocking: Passes AATCC 8, Grade 3, minimum.
 - b. Colorfastness to Light: Passes AATCC 16, Option 1 or 3, Grade 4, minimum, at 40 hours.
3. Repeat: Random.
4. Applied Backing Material: Acrylic **OR** Paper, **as directed**.
5. Colors, Textures, and Patterns: As selected from manufacturer's full range.

E. Heavy-Duty Synthetic Textile Wall Covering

1. Wall-Covering Standard: Provide wall coverings **OR** mildew-resistant wall coverings, **as directed**, that comply with ASTM F 793 for Category IV, Type I, Commercial Serviceability **OR**

- Category V, Type II, Commercial Serviceability **OR** Category VI, Type III, Commercial Serviceability, **as directed**, products.
2. Test Responses:
 - a. Colorfastness to Wet and Dry Crocking: Passes AATCC 8, Class 3, minimum.
 - b. Colorfastness to Light: Passes AATCC 16A or AATCC 16E, Class 4, minimum, at 40 hours.
 3. Width: **54 inches (1372 mm) OR 60 inches (1524 mm), as directed.**
 4. Colors, Textures, and Patterns: As selected from manufacturer's full range.
- F. Wood-Veneer Wall Covering
1. Sheet Size: **24 by 96 inches (610 by 2440 mm) OR 48 by 96 inches (1220 by 2440 mm) OR 48 by 120 inches (1220 by 3050 mm), as directed.**
 2. Veneer Construction: Single ply veneer **OR** Two veneer plies assembled perpendicular to one another, **as directed.**
 3. Wood Species: Red oak **OR** Maple **OR** Cherry, **as directed.**
 4. Veneer Match: Book **OR** Slip, **as directed.**
 5. Sheet Match: Running **OR** Balance **OR** Center **OR** Sequence, as indicated **OR** Blueprint, as indicated, **as directed.**
 6. Applied Backing Material: Fabric.
 7. Finish: Factory **OR** Field, **as directed**, applied using wall-covering manufacturer's standard stain and polyurethane system.
 - a. Colors: As selected from manufacturer's full range.
- G. Wallpaper
1. Wall-Covering Standard: Provide mildew-resistant **OR** peelable **OR** strippable, **as directed**, wallpaper that complies with ASTM F 793 for Category I, Decorative Only **OR** Category II, Decorative with Medium Serviceability **OR** Category III, Decorative with High Serviceability, **as directed**, products.
 2. Width: **20-1/2 inches (520.7 mm) OR 28 inches (711.2 mm), as directed.**
 3. Repeat: Random.
 4. Colors, Textures, and Patterns: As selected from manufacturer's full range.
- H. Accessories
1. Adhesive: Mildew-resistant, nonstaining, strippable, **as directed**, adhesive, for use with specific wall covering and substrate application; as recommended in writing by wall-covering manufacturer and with a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 2. Primer/Sealer: Mildew resistant, complying with requirements in Division 09 Section "Interior Painting" and recommended in writing by wall-covering manufacturer for intended substrate.
 3. Wall Liner: Nonwoven, synthetic underlayment and adhesive as recommended by wall-covering manufacturer.
 4. Seam Tape: As recommended in writing by wall-covering manufacturer.
 5. Metal Primer: Interior ferrous metal primer complying with Division 09 Section "Interior Painting".
- 1.3 EXECUTION
- A. Preparation
1. Comply with manufacturer's written instructions for surface preparation.
 2. Clean substrates of substances that could impair bond of wall covering, including dirt, oil, grease, mold, mildew, and incompatible primers.
 3. Prepare substrates to achieve a smooth, dry, clean, structurally sound surface free of flaking, unsound coatings, cracks, and defects.
 - a. Moisture Content: Maximum of 5 percent on new plaster, concrete, and concrete masonry units when tested with an electronic moisture meter.

- b. Plaster: Allow new plaster to cure. Neutralize areas of high alkalinity. Prime with primer as recommended in writing by primer/sealer manufacturer and wall-covering manufacturer.
- c. Metals: If not factory primed, clean and apply metal as recommended in writing by primer/sealer manufacturer and wall-covering manufacturer.
- d. Gypsum Board: Prime with primer as recommended in writing by primer/sealer manufacturer and wall-covering manufacturer.
- e. Painted Surfaces: Treat areas susceptible to pigment bleeding.
- 4. Check painted surfaces for pigment bleeding. Sand gloss, semigloss, and eggshell finish with fine sandpaper.
- 5. Remove hardware and hardware accessories, electrical plates and covers, light fixture trims, and similar items.
- 6. Acclimatize wall-covering materials by removing them from packaging in the installation areas not less than 24 hours before installation.
- 7. Install wall liner, with no gaps or overlaps, where required by wall-covering manufacturer. Form smooth wrinkle-free surface for finished installation. Do not begin wall-covering installation until wall liner has dried.

B. Installation

- 1. General: Comply with wall-covering manufacturers' written installation instructions applicable to products and applications indicated except where more stringent requirements apply.
- 2. Cut wall-covering strips in roll number sequence. Change roll numbers at partition breaks and corners.
- 3. Install strips in same order as cut from roll.
- 4. Install reversing every other strip.
- 5. Install wall covering with no gaps or overlaps, no lifted or curling edges, and no visible shrinkage.
- 6. Match pattern **72 inches (1830 mm)** above the finish floor.
- 7. Install seams vertical and plumb at least **6 inches (150 mm)** from outside corners and **3 inches (75 mm) OR 6 inches (150 mm), as directed**, from inside corners unless a change of pattern or color exists at corner. No horizontal seams are permitted.
- 8. Fully bond wall covering to substrate. Remove air bubbles, wrinkles, blisters, and other defects.
- 9. Trim edges and seams for color uniformity, pattern match, and tight closure. Butt seams without any overlay or spacing between strips.

C. Field Finishing Of Wood-Veneer Wall Coverings

- 1. Apply wall-covering manufacturer's standard stain and polyurethane system according to coating manufacturer's written instructions to produce finish that is consistent in color and gloss and matches approved Samples.
- 2. Apply no fewer than two **OR** three, **as directed**, finish coats.

D. Cleaning

- 1. Remove excess adhesive at finished seams, perimeter edges, and adjacent surfaces.
- 2. Use cleaning methods recommended in writing by wall-covering manufacturer.
- 3. Replace strips that cannot be cleaned.
- 4. Reinstall hardware and hardware accessories, electrical plates and covers, light fixture trims, and similar items.

END OF SECTION 09 72 13 00



Task	Specification	Specification Description
09 72 16 13	09 72 13 00	Wall Coverings
09 72 23 00	09 72 13 00	Wall Coverings
09 73 00 00	09 01 60 91a	Carpet
09 81 16 00	09 84 13 00	Acoustical Wall Panels

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SECTION 09 84 13 00 - ACOUSTICAL WALL PANELS

1.1 GENERAL

A. Description Of Work

1. This specification covers the furnishing and installation of materials for acoustical wall panels. Products shall be as follows or as directed by the Owner. Installation procedures shall be in accordance with the product manufacturer's recommendations. Demolition and removal of materials shall be as required to support the work.

B. Summary

1. This Section includes spline-mounted **OR** back-mounted, **as directed**, acoustical wall panels.

C. Definitions

1. NRC: Noise reduction coefficient.

D. Submittals

1. Product Data: For each type of panel edge, core material, and mounting indicated.
2. Shop Drawings: For acoustical wall panels. Include mounting devices and details.
3. Coordination Drawings: Show intersections with adjacent work.
4. Samples: For each fabric and sample panels.
5. LEED Submittal:
 - a. Product Data for Credit EQ 4.1: For installation adhesive, including printed statement of VOC content.
6. Product certificates **OR** test reports, **as directed**.
7. Maintenance data.
8. Warranty: Special warranty specified in this Section.

E. Quality Assurance

1. Fire-Test-Response Characteristics: Provide acoustical wall panels with the following surface-burning characteristics as determined by testing identical products per ASTM E 84 **OR** IBC Chapter 8, **as directed**, by UL or another testing and inspecting agency acceptable to authorities having jurisdiction:
 - a. Flame-Spread Index: 25 or less.
 - b. Smoke-Developed Index: 450 or less.
2. Fire Growth Contribution: Meeting acceptance criteria of local code and authorities having jurisdiction when tested according to NFPA 265 **OR** NFPA 286, **as directed**.
3. Preinstallation Conference: Conduct conference at Project site.

F. Delivery, Storage, And Handling

1. Comply with fabric and acoustical wall panel manufacturers' written instructions for minimum and maximum temperature and humidity requirements for shipment, storage, and handling.
2. Deliver materials and panels in unopened bundles and store in a temperature-controlled dry place with adequate air circulation.
3. Protect panel edges from crushing and impact.

G. Project Conditions

1. Environmental Limitations: Do not install acoustical wall panels until spaces are enclosed and weatherproof, wet work in spaces is complete and dry, work above ceilings is complete, and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.
2. Lighting: Do not install acoustical wall panels until a permanent level of lighting **OR** a lighting level of not less than 50 fc (538 lux), **as directed**, is provided on surfaces to receive acoustical wall panels.

3. Air-Quality Limitations: Protect acoustical wall panels from exposure to airborne odors, such as tobacco smoke, and install panels under conditions free from odor contamination of ambient air.
4. Field Measurements: Verify locations of acoustical wall panels by field measurements before fabrication and indicate measurements on Shop Drawings.

H. Warranty

1. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of acoustical wall panels that fail in performance, materials, or workmanship within two years from date of Final Completion.
 - a. Failure in performance includes, but is not limited to, acoustical performance.
 - b. Failures in materials include, but are not limited to, fabric sagging, distorting, or releasing from panel edge; or warping of core.

1.2 PRODUCTS

A. Core Materials

1. Glass-Fiber Board: ASTM C 612, Type IA or Types IA and IB; density as specified, unfaced, dimensionally stable, molded rigid board, with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively.
2. Mineral-Fiber Board: Maximum flame-spread and smoke-developed indexes of 15 and 5, respectively.
3. Cementitious-Fiber Board Core: Density of not less than **20 lb/cu. ft. (320 kg/cu. m)**.
4. Tackable, Impact-Resistant, High-Density Face Layer: **1/8-inch- (3.2-mm-)** thick layer of compressed molded glass-fiber board with a minimum nominal density of **16 to 18 lb/cu. ft. (256 to 288 kg/cu. m)** laminated to face of core.
5. Impact-Resistant, Acoustically Transparent, Copolymer Face-Sheet Layer for High-Abuse Applications: **1/16- to 1/8-inch- (1.6- to 3.2-mm-)** thick layer of perforated, noncombustible, copolymer sheet laminated to face of core.
6. Wood: Clear, vertical grain, straight, kiln-dried hardwood of manufacturer's standard species, AWPAC20, Interior Type A, fire-retardant treated, low-hygroscopic-type formulation. Use fire-retardant-treatment formulations that do not bleed through or otherwise adversely affect finishes. Kiln-dry material after treatment to 5 to 10 percent moisture content.

B. Spline-Mounted Acoustical Wall Panels With Perforated Mineral-Fiber Board Core Or Cementitious-Fiber Board Core

1. Panel Construction: Manufacturer's standard panel construction consisting of facing material laminated to front face of a perforated, water-felted, mineral-fiber board **OR** cementitious-fiber board, **as directed**, core; with long edges kerfed and rabbeted to receive splines.
 - a. Mineral-Fiber Board: Not less than **13-lb/cu. ft. (208-kg/cu. m)** **OR** **20-lb/cu. ft. (320-kg/cu. m)**, **as directed**, nominal density; with perforated surface.
2. Facing Material: Fabric from same dye lot; color and pattern as indicated by manufacturer's designations **OR** matching samples **OR** as selected from manufacturer's full range **OR** as indicated on Drawings, **as directed**.
 - a. Fiber Content: 100 percent woven polyester **OR** nonwoven polyester **OR** polyolefin **OR** acoustically transparent vinyl, **as directed**.
 - b. Width: **54 inches (1371 mm)** **OR** **66 inches (1676 mm)**, **as directed**.
 - c. Applied Treatments: Stain resistance.
3. Nominal Overall Panel Thickness: **3/4 inch (19 mm)** **OR** **1 inch (25 mm)**, **as directed**.
4. NRC: For Type A mounting per ASTM E 795, NRC 0.50 to NRC 0.90 **OR** NRC 0.60 to NRC 0.70 **OR** NRC 0.65 to NRC 0.75, **as directed**.
5. Panel Width: **24 inches (610 mm)** **OR** **30 inches (762 mm)** **OR** **48 inches (1220 mm)** **OR** 600 mm **OR** As indicated on Drawings, **as directed**.
6. Panel Height: Fabricated from units **96 inches (2438 mm)** **OR** **108 inches (2743 mm)** **OR** **120 inches (3048 mm)**, **as directed**, in height; mounting height **as directed**.

7. Panel Edge: Core self-edge.
 8. Panel Short Edge Detail: Square.
- C. Spline-Mounted Acoustical Wall Panels With Glass-Fiber Board Core
1. Panel Construction: Manufacturer's standard panel construction consisting of facing material laminated to front face of a dimensionally stable, rigid glass-fiber board core with a nominal density of **6 to 7 lb/cu. ft. (96 to 112 kg/cu. m)**; with long edges kerfed and rabbeted to receive splines.
 2. Core-Face Layer: Tackable, impact-resistant, high-density board **OR** Impact-resistant, acoustically transparent, copolymer face-sheet, **as directed**.
 3. Facing Material: Fabric from same dye lot; color and pattern as indicated by manufacturer's designations **OR** matching samples **OR** as selected from manufacturer's full range **OR** as indicated on Drawings, **as directed**.
 - a. Fiber Content: 100 percent woven polyester **OR** nonwoven polyester **OR** polyolefin **OR** acoustically transparent vinyl, **as directed**.
 - b. Width: **54 inches (1371 mm) OR 66 inches (1676 mm)**, **as directed**.
 - c. Applied Treatments: Stain resistance.
 4. Nominal Overall Panel Thickness: **3/4 inch (19 mm) OR 1 inch (25 mm) OR 1-1/2 inches (38 mm) OR 2 inches (51 mm)**, **as directed**.
 5. NRC: For Type A mounting per ASTM E 795, not less than NRC 0.20 **OR** NRC 0.80 **OR** NRC 0.95, **as directed**.
 6. Panel Width: Manufacturer's standard **OR 24 inches (610 mm) OR 30 inches (762 mm) OR 48 inches (1220 mm) OR 600 mm OR 1200 mm OR** As indicated on Drawings, **as directed**.
 7. Panel Height: Fabricated from units **96 inches (2438 mm) OR 108 inches (2743 mm) OR 120 inches (3048 mm)**, **as directed**, in height; mounting height **as directed**.
 8. Panel Edge: Manufacturer's standard short edge.
 9. Panel Short Edge Detail: Square.
- D. Back-Mounted Acoustical Wall Panels With Perforated Mineral-Fiber Board Core
1. Panel Construction: Manufacturer's standard panel construction consisting of facing material laminated to front face of a perforated, water-felted, mineral-fiber board core of not less than **13-lb/cu. ft. (208-kg/cu. m) OR 20-lb/cu. ft. (320-kg/cu. m)**, **as directed**, nominal density; with perforated surface.
 2. Facing Material: Fabric from same dye lot; color and pattern as indicated by manufacturer's designations **OR** matching samples **OR** as selected from manufacturer's full range **OR** as indicated on Drawings, **as directed**.
 - a. Fiber Content: 100 percent woven polyester **OR** nonwoven polyester **OR** polyolefin **OR** acoustically transparent vinyl, **as directed**.
 - b. Width: **54 inches (1371 mm) OR 66 inches (1676 mm)**, **as directed**.
 - c. Applied Treatments: Stain resistance.
 3. Nominal Core Thickness and Overall System NRC: **1/2 inch (13 mm)** and not less than NRC 0.35 **OR 3/4 inch (19 mm)** and not less than NRC 0.45, **as directed**, for Type A mounting.
 4. Panel Width: **24 inches (610 mm) OR 30 inches (762 mm) OR 48 inches (1220 mm) OR 600 mm OR** As indicated on Drawings, **as directed**.
 5. Panel Height: Fabricated from units **96 inches (2438 mm) OR 108 inches (2743 mm) OR 120 inches (3048 mm)**, **as directed**, in height; mounting height **as directed**.
 6. Panel Edge: Core self-edge.
 7. Panel Short Edge Detail: Square.
- E. Back-Mounted, Edge-Reinforced Acoustical Wall Panels With Glass-Fiber Board Core
1. Panel Construction: Manufacturer's standard panel construction consisting of facing material laminated to front face, edges, and back border of dimensionally stable, rigid glass-fiber **OR** rock-fiber/slag-fiber, **as directed**, board core; with edges chemically hardened or impact resistant and resilient to reinforce panel perimeter against warpage and damage.
 2. Nominal Core Density: **4 to 7 lb/cu. ft. (64 to 112 kg/cu. m) OR 6 to 7 lb/cu. ft. (96 to 112 kg/cu. m)**, **as directed**.

3. Core-Face Layer: Tackable, impact-resistant, high-density board **OR** Impact-resistant, acoustically transparent, copolymer face-sheet, **as directed**.
 4. Facing Material: Fabric from same dye lot; color and pattern as indicated by manufacturer's designations **OR** matching samples **OR** as selected from manufacturer's full range **OR** as indicated on Drawings, **as directed**.
 - a. Fiber Content: 100 percent woven polyester **OR** nonwoven polyester **OR** polyolefin **OR** acoustically transparent vinyl, **as directed**.
 - b. Width: **54 inches (1371 mm)** **OR** **66 inches (1676 mm)**, **as directed**.
 - c. Applied Treatments: Stain resistance.
 5. Nominal Core Thickness and Overall System NRC: **3/4 inch (19 mm)** and not less than NRC 0.65 **OR** **1 inch (25 mm)** and not less than NRC 0.80 **OR** **1-1/2 inches (38 mm)** and not less than NRC 0.85 **OR** **2 inches (51 mm)** and not less than NRC 0.90 **OR** **2 inches (51 mm)** and not less than NRC 1.00, **as directed**, for Type A mounting per ASTM E 795.
 6. Panel Width: Manufacturer's standard **OR** **24 inches (610 mm)** **OR** **30 inches (762 mm)** **OR** **48 inches (1220 mm)** **OR** 600 mm **OR** 1200 mm **OR** As indicated on Drawings, **as directed**.
 7. Panel Height: Fabricated height as indicated on Drawings **OR** **as directed**; mounting height as indicated on Drawings **OR** **as directed**.
 8. Panel Edge Detail: Square **OR** Bullnosed (radiused) **OR** Chamfered (beveled) **OR** Mitered **OR** Custom as indicated on Drawings, **as directed**.
 9. Corner Detail: Square **OR** Round, radius as indicated **OR** Off-square, dimensions as indicated, **as directed**, to form continuous profile to match edge detail.
- F. Back-Mounted, Edge-Framed Acoustical Wall Panels With Glass-Fiber Board Core
1. Panel Construction: Manufacturer's standard panel construction consisting of facing material stretched over front face of edge-framed, dimensionally stable, rigid glass-fiber board core and bonded or attached to edges and back of frame.
 2. Nominal Core Density: **4 to 7 lb/cu. ft. (64 to 112 kg/cu. m)** **OR** **6 to 7 lb/cu. ft. (96 to 112 kg/cu. m)**, **as directed**.
 3. Core-Face Layer: Tackable, impact-resistant, high-density board **OR** Impact-resistant, acoustically transparent, copolymer face-sheet, **as directed**.
 4. Facing Material: Fabric from same dye lot; color and pattern as indicated by manufacturer's designations **OR** matching samples **OR** as selected from manufacturer's full range **OR** as indicated on Drawings, **as directed**.
 - a. Fiber Content: 100 percent woven polyester **OR** nonwoven polyester **OR** polyolefin **OR** acoustically transparent vinyl, **as directed**.
 - b. Width: **54 inches (1371 mm)** **OR** **66 inches (1676 mm)**, **as directed**.
 - c. Applied Treatments: Stain resistance.
 5. Nominal Core Thickness and Overall System NRC: **1 inch (25 mm)** and not less than NRC 0.80 **OR** **1-1/2 inches (38 mm)** and not less than NRC 0.85 **OR** **2 inches (51 mm)** and not less than NRC 0.90, **as directed**, for Type A mounting per ASTM E 795.
 6. Panel Width: Manufacturer's standard **OR** **24 inches (610 mm)** **OR** **30 inches (762 mm)** **OR** **48 inches (1220 mm)** **OR** 600 mm **OR** 1200 mm **OR** As indicated on Drawings, **as directed**.
 7. Panel Height: Fabricated height as indicated on Drawings **OR** **as directed**; mounting height as indicated on Drawings **OR** **as directed**.
 8. Panel Edge and Frame: Extruded-aluminum or zinc-coated, rolled-steel shape **OR** Extruded PVC **OR** Hardwood, rabbeted, and splined with glued joints and machined corners, **as directed**.
 - a. Panel Edge Detail: Square.
- G. Fabrication
1. Sound-Absorption Performance: Provide acoustical wall panels with minimum NRCs indicated, as determined by testing per ASTM C 423 for mounting type specified.
 2. Acoustical Wall Panels: Panel construction consisting of facing material adhered to face, **as directed**, edges and back border of dimensionally stable core; with rigid edges to reinforce panel perimeter against warpage and damage.
 - a. Glass-Fiber Board: Resin harden areas of core for attachment of mounting devices.

3. Fabric Facing: Stretched straight, on the grain, tight, square, and free from puckers, ripples, wrinkles, sags, blisters, seams, adhesive, or other foreign matter. Applied with visible surfaces fully covered.
 - a. Where square corners are indicated, tailor corners. Heat seal vinyl fabric seams at corners.
 - b. Where radius or other nonsquare corners are indicated, attach facing material so there are no seams or gathering of material.
 - c. Where fabrics with directional or repeating patterns or directional weave are indicated, mark fabric top and attach fabric in same direction so pattern or weave matches in adjacent panels.
4. Core-Face Layer: Evenly stretched over core face and edges and securely attached to core; free from puckers, ripples, wrinkles, sags.
5. Dimensional Tolerances of Finished Units: Plus or minus **1/16 inch (1.6 mm)** for the following:
 - a. Thickness.
 - b. Edge straightness.
 - c. Overall length and width.
 - d. Squareness from corner to corner.
 - e. Chords, radii, and diameters.
6. Spline-Mounting Accessories: Manufacturer's standard concealed, extruded-aluminum or plastic connecting splines designed and fabricated for screw attachment to walls, with other moldings and trim for interior and exterior corners, leveling and base support with factory-applied finish on exposed items.
 - a. Finish Color: White **OR** Black **OR** Match color of facing material **OR** Match sample, **as directed**.
7. Back-Mounting Devices: Concealed on backside of panel, recommended to support weight of panel, with base-support bracket system where recommended by manufacturer for additional support of panels, and as follows:
 - a. Adhesive. Use only adhesives that have a VOC content of 70 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 - b. Hook-and-loop tape.
 - c. Impaling clips.
 - d. Magnetic strip or devices.
 - e. Metal "Z" Clips: Two-part panel clips, with one part of each clip mechanically attached to back of panel and the other part to wall substrate, designed to allow for panel removal.
 - f. As recommended by manufacturer.
8. Owner-Furnished Fabric: Provide fabric acceptable to acoustical wall panel manufacturer for application indicated. Notify the Owner of fabric unacceptability.

1.3 EXECUTION

A. Installation

1. Install acoustical wall panels in locations indicated with vertical surfaces and edges plumb, top edges level and in alignment with other panels, faces flush, and scribed to fit adjoining work accurately at borders and at penetrations.
 - a. Cut units to be at least 50 percent of unit width, with facing material extended over cut edge to match uncut edge. Scribe acoustical wall panels to fit adjacent work. Butt joints tightly.
2. Comply with acoustical wall panel manufacturer's written instructions for installation of panels using type of concealed mounting accessories indicated or, if not indicated, as recommended by manufacturer. Anchor panels securely to supporting substrate.
3. Match and level fabric pattern and grain among adjacent panels.
4. Installation Tolerances: As follows:
 - a. Variation from Level and Plumb: Plus or minus **1/16 inch (1.6 mm)**.
 - b. Variation of Panel Joints from Hairline: Not more than **1/16 inch (1.6 mm) OR 1/32 inch (0.79 mm)**, **as directed**, wide.



- B. Cleaning
 - 1. Clip loose threads; remove pills and extraneous materials.
 - 2. Clean panels with fabric facing, on completion of installation, to remove dust and other foreign materials according to manufacturer's written instructions.
- C. Protection
 - 1. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and Installer, to ensure that acoustical wall panels are without damage or deterioration at time of Final Completion.
 - 2. Replace acoustical wall panels that cannot be cleaned and repaired, in a manner approved by the Owner, before time of Final Completion.

END OF SECTION 09 84 13 00

NOT FOR BID



Task	Specification	Specification Description
09 84 13 00	09 28 13 00	Gypsum Board
09 84 13 00	09 23 13 00	Gypsum Board Renovation
09 84 13 00	09 28 13 00a	Gypsum Board Shaft-Wall Assemblies

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SECTION 09 91 13 00 - EXTERIOR PAINTING

1.1 GENERAL

A. Description Of Work

1. This specification covers the furnishing and installation of materials for exterior painting. Products shall be as follows or as directed by the Owner. Installation procedures shall be in accordance with the product manufacturer's recommendations. Demolition and removal of materials shall be as required to support the work.

B. Summary

1. This Section includes surface preparation and the application of paint systems on the following exterior substrates:
 - a. Concrete.
 - b. Clay masonry.
 - c. Concrete masonry units (CMU).
 - d. Steel.
 - e. Galvanized metal.
 - f. Aluminum (not anodized or otherwise coated).
 - g. Wood.
 - h. Plastic trim fabrications.
 - i. Exterior portland cement (stucco).
 - j. Exterior gypsum board.

C. Submittals

1. Product Data: For each type of product indicated.
2. Samples: For each finish and for each color and texture required.
3. Product List: Printout of current "MPI Approved Products List" for each product category specified in Part 1.2, with the proposed product highlighted.

D. Quality Assurance

1. MPI Standards:
 - a. Products: Complying with MPI standards indicated and listed in "MPI Approved Products List."
 - b. Preparation and Workmanship: Comply with requirements in "MPI Architectural Painting Specification Manual" for products and paint systems indicated. For renovation projects, comply with requirements of "MPI Maintenance Repainting Manual" for products and paint systems indicated.
2. Mockups: Apply mockups of each paint system indicated and each color and finish selected to verify preliminary selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
 - a. Architect will select one surface to represent surfaces and conditions for application of each paint system specified in Part 3.
 - 1) Vertical and Horizontal Surfaces: Provide samples of at least 100 sq. ft. (9 sq. m).
 - 2) Other Items: Architect will designate items or areas required.
 - b. Final approval of color selections will be based on mockups.
 - 1) If preliminary color selections are not approved, apply additional mockups of additional colors selected by Architect at no added cost to Owner.
 - c. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
 - d. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

- E. Delivery, Storage, And Handling
 - 1. Store materials not in use in tightly covered containers in well-ventilated areas with ambient temperatures continuously maintained at not less than **45 deg F (7 deg C)**.
 - a. Maintain containers in clean condition, free of foreign materials and residue.
 - b. Remove rags and waste from storage areas daily.
- F. Project Conditions
 - 1. Apply paints only when temperature of surfaces to be painted and ambient air temperatures are between **50 and 95 deg F (10 and 35 deg C)**.
 - 2. Do not apply paints in snow, rain, fog, or mist; when relative humidity exceeds 85 percent; at temperatures less than **5 deg F (3 deg C)** above the dew point; or to damp or wet surfaces.

1.2 PRODUCTS

- A. Paint, General
 - 1. Material Compatibility:
 - a. Provide materials for use within each paint system that are compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
 - b. For each coat in a paint system, provide products recommended in writing by manufacturers of topcoat for use in paint system and on substrate indicated.
 - 2. Colors: As selected from manufacturer's full range.
- B. Block Fillers
 - 1. Interior/Exterior Latex Block Filler: MPI #4.
 - a. VOC Content: E Range of E2 **OR E3, as directed.**
- C. Primers/Sealers
 - 1. Alkali-Resistant Primer: MPI #3.
 - a. VOC Content: E Range of E1 **OR E2 OR E3, as directed.**
 - 2. Bonding Primer (Water Based): MPI #17.
 - a. VOC Content: E Range of E1 **OR E2 OR E3, as directed.**
 - 3. Bonding Primer (Solvent Based): MPI #69.
 - a. VOC Content: E Range of E1 **OR E2 OR E3, as directed.**
 - 4. Wood-Knot Sealer: Sealer recommended in writing by topcoat manufacturer for use in paint system indicated.
- D. Metal Primers
 - 1. Alkyd Anticorrosive Metal Primer: MPI #79.
 - a. VOC Content: E Range of E1 **OR E2, as directed.**
 - 2. Quick-Drying Alkyd Metal Primer: MPI #76.
 - a. VOC Content: E Range of E1 **OR E2 OR E3, as directed.**
 - 3. Cementitious Galvanized-Metal Primer: MPI #26.
 - a. VOC Content: E Range of E1.
 - 4. Waterborne Galvanized-Metal Primer: MPI #134.
 - a. VOC Content: E Range of E1 **OR E2 OR E3, as directed.**
 - b. Environmental Performance Rating: EPR 1 **OR EPR 2 OR EPR 3, as directed.**
 - 5. Quick-Drying Primer for Aluminum: MPI #95.
 - a. VOC Content: E Range of E1 **OR E2 OR E3, as directed.**
- E. Wood Primers
 - 1. Exterior Latex Wood Primer: MPI #6.
 - a. VOC Content: E Range of E1 **OR E2 OR E3, as directed.**
 - 2. Exterior Alkyd Wood Primer: MPI #5.

- a. VOC Content: E Range of E2 **OR** E3, **as directed**.
 3. Exterior Oil Wood Primer: MPI #7.
 - a. VOC Content: E Range of E2.
- F. Exterior Latex Paints
 1. Exterior Latex (Flat): MPI #10 (Gloss Level 1).
 - a. VOC Content: E Range of E1 **OR** E2 **OR** E3, **as directed**.
 2. Exterior Latex (Semigloss): MPI #11 (Gloss Level 5).
 - a. VOC Content: E Range of E1 **OR** E2 **OR** E3, **as directed**.
 3. Exterior Latex (Gloss): MPI #119 (Gloss Level 6, except minimum gloss of 65 units at 60 deg).
 - a. VOC Content: E Range of E1 **OR** E2 **OR** E3, **as directed**.
- G. Exterior Alkyd Paints
 1. Exterior Alkyd Enamel (Flat): MPI #8 (Gloss Level 1).
 - a. VOC Content: E Range of E1.
 2. Exterior Alkyd Enamel (Semigloss): MPI #94 (Gloss Level 5).
 - a. VOC Content: E Range of E1 **OR** E2, **as directed**.
 3. Exterior Alkyd Enamel (Gloss): MPI #9 (Gloss Level 6).
 - a. VOC Content: E Range of E1 **OR** E2, **as directed**.
- H. Quick-Drying Enamels
 1. Quick-Drying Enamel (Semigloss): MPI #81 (Gloss Level 5).
 - a. VOC Content: E Range of E1 **OR** E2 **OR** E3, **as directed**.
 2. Quick-Drying Enamel (High Gloss): MPI #96 (Gloss Level 7).
 - a. VOC Content: E Range of E1 **OR** E2 **OR** E3, **as directed**.
- I. Textured And High-Build Coatings
 1. Latex Stucco and Masonry Textured Coating: MPI #42.
 - a. VOC Content: E Range of E2 **OR** E3, **as directed**.
 2. High-Build Latex (Exterior): MPI #40.
 - a. VOC Content: E Range of E1 **OR** E3, **as directed**.
- J. Aluminum Paint
 1. Aluminum Paint: MPI #1.
 - a. VOC Content: E Range of E1 **OR** E2 **OR** E3, **as directed**.
- K. Floor Coatings
 1. Interior/Exterior Clear Concrete Floor Sealer (Water Based): MPI #99.
 - a. VOC Content: E Range of E1 **OR** E2 **OR** E3, **as directed**.
 2. Interior/Exterior Clear Concrete Floor Sealer (Solvent Based): MPI #104.
 - a. VOC Content: E Range of E1 **OR** E2, **as directed**.
 3. Interior/Exterior Latex Floor and Porch Paint (Low Gloss): MPI #60 (maximum Gloss Level 3).
 - a. VOC Content: E Range of E2 **OR** E3, **as directed**.
 - b. Environmental Performance Rating: EPR 3.
 4. Exterior/Interior Alkyd Floor Enamel (Gloss): MPI #27 (Gloss Level 6).
 - a. VOC Content: E Range of E1 **OR** E2, **as directed**.
 - b. Additives: Manufacturer's standard additive to increase skid resistance of painted surface.

1.3 EXECUTION

- A. Examination
 1. Examine substrates and conditions, with Applicator present, for compliance with requirements for maximum moisture content and other conditions affecting performance of work.
 2. Maximum Moisture Content of Substrates: When measured with an electronic moisture meter as follows:

- a. Concrete: 12 percent.
 - b. Masonry (Clay and CMU): 12 percent.
 - c. Wood: 15 percent.
 - d. Plaster: 12 percent.
 - e. Gypsum Board: 12 percent.
3. Verify suitability of substrates, including surface conditions and compatibility with existing finishes and primers.
4. Begin coating application only after unsatisfactory conditions have been corrected and surfaces are dry.
 - a. Beginning coating application constitutes Contractor's acceptance of substrates and conditions.
- B. Preparation And Application
 1. Comply with manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual" applicable to substrates and paint systems indicated.
 2. Clean substrates of substances that could impair bond of paints, including dirt, oil, grease, and incompatible paints and encapsulants.
 - a. Remove incompatible primers and reprime substrate with compatible primers as required to produce paint systems indicated.
 3. Apply paints to produce surface films without cloudiness, spotting, holidays, laps, brush marks, roller tracking, runs, sags, ropiness, or other surface imperfections. Cut in sharp lines and color breaks.
 4. Protect work of other trades against damage from paint application. Correct damage to work of other trades by cleaning, repairing, replacing, and refinishing, as approved by Architect, and leave in an undamaged condition.
 5. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces.
- C. Exterior Painting Schedule
 1. Paint systems herein are based on "MPI Architectural Painting Specification Manual" (hereafter, "MPI Manual"). For renovation projects, consult "MPI Maintenance Repainting Manual" and revise paint systems accordingly.
 2. For a Premium Grade system, "MPI Manual" requires intermediate coat; if Custom Grade system is required or if so directed, delete intermediate coat, **unless directed otherwise** or as otherwise required by manufacturer's recommendations.
 3. Concrete Substrates, Nontraffic Surfaces:
 - a. Latex System: MPI EXT 3.1A.
 - 1) Prime Coat: Exterior latex matching topcoat.
 - 2) Intermediate Coat: Exterior latex matching topcoat.
 - 3) Topcoat: Exterior latex (flat) **OR** (semigloss) **OR** (gloss), **as directed**.
 - b. Latex Aggregate/Latex System: MPI EXT 3.1 B.
 - 1) Prime Coat: Latex stucco and masonry textured coating.
 - 2) Intermediate Coat: Exterior latex matching topcoat.
 - 3) Topcoat: Exterior latex (flat) **OR** (semigloss) **OR** (gloss), **as directed**.
 - c. Latex Over Alkali-Resistant Primer System: MPI EXT 3.1K.
 - 1) Prime Coat: Alkali-resistant primer.
 - 2) Intermediate Coat: Exterior latex matching topcoat.
 - 3) Topcoat: Exterior latex (flat) **OR** (semigloss) **OR** (gloss), **as directed**.
 - d. High-Build Latex System: MPI EXT 3.1L, applied to form dry film thickness of not less than **10 mils (0.25 mm)**.
 - 1) Prime Coat: As recommended in writing by topcoat manufacturer.
 - 2) Intermediate Coat: As recommended in writing by topcoat manufacturer.
 - 3) Topcoat: High-build latex (exterior).
 - e. Latex Aggregate System: MPI EXT 3.1N.
 - 1) Prime Coat: As recommended in writing by topcoat manufacturer.

- 2) Intermediate Coat: As recommended in writing by topcoat manufacturer.
- 3) Topcoat: Latex stucco and masonry textured coating.
4. Concrete Substrates, Traffic Surfaces:
 - a. Latex Floor Paint System: MPI EXT 3.2A.
 - 1) Prime Coat: Interior/exterior latex floor and porch paint (low gloss).
 - 2) Intermediate Coat: Interior/exterior latex floor and porch paint (low gloss).
 - 3) Topcoat: Interior/exterior latex floor and porch paint (low gloss).
 - b. Alkyd Floor Enamel System: MPI EXT 3.2D.
 - 1) Prime Coat: Exterior/interior alkyd floor enamel (gloss).
 - 2) Intermediate Coat: Exterior/interior alkyd floor enamel (gloss).
 - 3) Topcoat: Exterior/interior alkyd floor enamel (gloss).
 - c. Clear Sealer System: MPI EXT 3.2G.
 - 1) Prime Coat: Interior/exterior clear concrete floor sealer (solvent based).
 - 2) Intermediate Coat: Interior/exterior clear concrete floor sealer (solvent based).
 - 3) Topcoat: Interior/exterior clear concrete floor sealer (solvent based).
 - d. Water-Based Clear Sealer System: MPI EXT 3.2H.
 - 1) Prime Coat: Interior/exterior clear concrete floor sealer (water based).
 - 2) Intermediate Coat: Interior/exterior clear concrete floor sealer (water based).
 - 3) Topcoat: Interior/exterior clear concrete floor sealer (water based).
5. Clay-Masonry Substrates:
 - a. Latex System: MPI EXT 4.1A.
 - 1) Prime Coat: Exterior latex matching topcoat.
 - 2) Intermediate Coat: Exterior latex matching topcoat.
 - 3) Topcoat: Exterior latex (flat) **OR** (semigloss) **OR** (gloss), **as directed**.
 - b. High-Build Latex System: MPI EXT 4.1H, applied to form dry film thickness of not less than **10 mils (0.25 mm)**.
 - 1) Prime Coat: As recommended in writing by topcoat manufacturer.
 - 2) Intermediate Coat: As recommended in writing by topcoat manufacturer.
 - 3) Topcoat: High-build latex (exterior).
 - c. Latex Aggregate System: MPI EXT 4.1B.
 - 1) Prime Coat: As recommended in writing by topcoat manufacturer.
 - 2) Intermediate Coat: As recommended in writing by topcoat manufacturer.
 - 3) Topcoat: Latex stucco and masonry textured coating.
6. CMU Substrates:
 - a. Latex System: MPI EXT 4.2A.
 - 1) Prime Coat: Interior/exterior latex block filler.
 - 2) Intermediate Coat: Exterior latex matching topcoat.
 - 3) Topcoat: Exterior latex (flat) **OR** (semigloss) **OR** (gloss), **as directed**.
 - b. Latex Over Alkali-Resistant Primer System: MPI EXT 4.2L.
 - 1) Prime Coat: Alkali-resistant primer.
 - 2) Intermediate Coat: Exterior latex matching topcoat.
 - 3) Topcoat: Exterior latex (flat) **OR** (semigloss) **OR** (gloss), **as directed**.
 - c. High-Build Latex System: MPI EXT 4.2K, applied to form dry film thickness of not less than **10 mils (0.25 mm)**.
 - 1) Prime Coat: As recommended in writing by topcoat manufacturer.
 - 2) Intermediate Coat: As recommended in writing by topcoat manufacturer.
 - 3) Topcoat: High-build latex (exterior).
 - d. Latex Aggregate System: MPI EXT 4.2B.
 - 1) Prime Coat: As recommended in writing by topcoat manufacturer.
 - 2) Intermediate Coat: As recommended in writing by topcoat manufacturer.
 - 3) Topcoat: Latex stucco and masonry textured coating.
7. Steel Substrates:
 - a. Quick-Drying Enamel System: MPI EXT 5.1A.
 - 1) Prime Coat: Quick-drying alkyd metal primer.
 - 2) Intermediate Coat: Quick-drying enamel matching topcoat.
 - 3) Topcoat: Quick-drying enamel (semigloss) **OR** (high gloss), **as directed**.

- b. Alkyd System: MPI EXT 5.1D.
 - 1) Prime Coat: Alkyd anticorrosive metal primer.
 - 2) Intermediate Coat: Exterior alkyd enamel matching topcoat.
 - 3) Topcoat: Exterior alkyd enamel (flat) **OR** (semigloss) **OR** (gloss), **as directed**.
 - c. Aluminum Paint System: MPI EXT 5.1K.
 - 1) Prime Coat: Alkyd anticorrosive metal primer.
 - 2) Intermediate Coat: Aluminum paint.
 - 3) Topcoat: Aluminum paint.
 8. Galvanized-Metal Substrates: Galvanized-metal substrates should not be chromate passivated (commercially known as "bonderized") if primer is field applied. If galvanized metal is chromate passivated, consult manufacturers for appropriate surface preparation and primers.
 - a. Latex System: MPI EXT 5.3A.
 - 1) Prime Coat: Cementitious galvanized-metal primer.
 - 2) Intermediate Coat: Exterior latex matching topcoat.
 - 3) Topcoat: Exterior latex (flat) **OR** (semigloss) **OR** (gloss), **as directed**.
 - b. Latex Over Water-Based Primer System: MPI EXT 5.3H. "MPI Manual" recommends latex over water-based primer system for low-contact/traffic areas.
 - 1) Prime Coat: Waterborne galvanized-metal primer.
 - 2) Intermediate Coat: Exterior latex matching topcoat.
 - 3) Topcoat: Exterior latex (flat) **OR** (semigloss) **OR** (gloss), **as directed**.
 - c. Alkyd System: MPI EXT 5.3B.
 - 1) Prime Coat: Cementitious galvanized-metal primer.
 - 2) Intermediate Coat: Exterior alkyd enamel matching topcoat.
 - 3) Topcoat: Exterior alkyd enamel (flat) **OR** (semigloss) **OR** (gloss), **as directed**.
 9. Aluminum Substrates:
 - a. Latex System: MPI EXT 5.4H.
 - 1) Prime Coat: Quick-drying primer for aluminum.
 - 2) Intermediate Coat: Exterior latex matching topcoat.
 - 3) Topcoat: Exterior latex (flat) **OR** (semigloss) **OR** (gloss), **as directed**.
 - b. Alkyd System: MPI EXT 5.4F.
 - 1) Prime Coat: Quick-drying primer for aluminum.
 - 2) Intermediate Coat: Exterior alkyd enamel matching topcoat.
 - 3) Topcoat: Exterior alkyd enamel (flat) **OR** (semigloss) **OR** (gloss), **as directed**.
 10. Glue-Laminated Beam and Column Substrates:
 - a. Latex System: MPI EXT 6.1L.
 - 1) Prime Coat: Exterior latex wood primer.
 - 2) Intermediate Coat: Exterior latex matching topcoat.
 - 3) Topcoat: Exterior latex (flat) **OR** (semigloss) **OR** (gloss), **as directed**.
 - b. Latex Over Alkyd Primer System: MPI EXT 6.1A.
 - 1) Prime Coat: Exterior alkyd **OR** oil, **as directed**, wood primer.
 - 2) Intermediate Coat: Exterior latex matching topcoat.
 - 3) Topcoat: Exterior latex (flat) **OR** (semigloss) **OR** (gloss), **as directed**.
 - c. Alkyd System: MPI EXT 6.1B.
 - 1) Prime Coat: Exterior alkyd **OR** oil, **as directed**, wood primer.
 - 2) Intermediate Coat: Exterior alkyd enamel matching topcoat.
 - 3) Topcoat: Exterior alkyd enamel (flat) **OR** (semigloss) **OR** (gloss), **as directed**.
 11. Dressed Lumber Substrates: Including architectural woodwork **OR** doors, **as directed**.
 - a. Latex System: MPI EXT 6.3L.
 - 1) Prime Coat: Exterior latex wood primer.
 - 2) Intermediate Coat: Exterior latex matching topcoat.
 - 3) Topcoat: Exterior latex (flat) **OR** (semigloss) **OR** (gloss), **as directed**. Flat paint is not recommended for use on doors.
 - b. Latex Over Alkyd Primer System: MPI EXT 6.3A.
 - 1) Prime Coat: Exterior alkyd **OR** oil, **as directed**, wood primer.
 - 2) Intermediate Coat: Exterior latex matching topcoat.

- 3) Topcoat: Exterior latex (flat) **OR** (semigloss) **OR** (gloss), **as directed**. Flat paint is not recommended for use on doors.
- c. Alkyd System: MPI EXT 6.3B.
 - 1) Prime Coat: Exterior alkyd **OR** oil, **as directed**, wood primer.
 - 2) Intermediate Coat: Exterior alkyd enamel matching topcoat.
 - 3) Topcoat: Exterior alkyd enamel (flat) **OR** (semigloss) **OR** (gloss), **as directed**. Flat paint is not recommended for use on doors.
12. Wood Panel Substrates: Including plywood siding **OR** fascias **OR** soffits, **as directed**.
 - a. Latex System: MPI EXT 6.4K.
 - 1) Prime Coat: Exterior latex wood primer.
 - 2) Intermediate Coat: Exterior latex matching topcoat.
 - 3) Topcoat: Exterior latex (flat) **OR** (semigloss) **OR** (gloss), **as directed**.
 - b. Latex Over Alkyd Primer System: MPI EXT 6.4G.
 - 1) Prime Coat: Exterior alkyd wood primer.
 - 2) Intermediate Coat: Exterior latex matching topcoat.
 - 3) Topcoat: Exterior latex (flat) **OR** (semigloss) **OR** (gloss), **as directed**.
 - c. Alkyd System: MPI EXT 6.4B.
 - 1) Prime Coat: Exterior alkyd **OR** oil, **as directed**, wood primer.
 - 2) Intermediate Coat: Exterior alkyd enamel matching topcoat.
 - 3) Topcoat: Exterior alkyd enamel (flat) **OR** (semigloss) **OR** (gloss), **as directed**.
13. Wood Shingle and Shake Substrates (Excluding Roofs):
 - a. Latex System: MPI EXT 6.6E.
 - 1) Prime Coat: Exterior latex wood primer.
 - 2) Intermediate Coat: Exterior latex matching topcoat.
 - 3) Topcoat: Exterior latex (flat) **OR** (semigloss) **OR** (gloss), **as directed**.
 - b. Latex Over Alkyd Primer System: MPI EXT 6.6A.
 - 1) Prime Coat: Exterior alkyd **OR** oil, **as directed**, wood primer.
 - 2) Intermediate Coat: Exterior latex matching topcoat.
 - 3) Topcoat: Exterior latex (flat) **OR** (semigloss) **OR** (gloss), **as directed**.
 - c. Alkyd System: MPI EXT 6.6B.
 - 1) Prime Coat: Exterior alkyd **OR** oil, **as directed**, wood primer.
 - 2) Intermediate Coat: Exterior alkyd enamel matching topcoat.
 - 3) Topcoat: Exterior alkyd enamel (flat) **OR** (semigloss) **OR** (gloss), **as directed**.
14. Dimension Lumber Substrates, Nontraffic Surfaces: Including board siding **OR** fencing **OR** undersides of decking, **as directed**.
 - a. Latex System: MPI EXT 6.2M.
 - 1) Prime Coat: Exterior latex wood primer.
 - 2) Intermediate Coat: Exterior latex matching topcoat.
 - 3) Topcoat: Exterior latex (flat) **OR** (semigloss) **OR** (gloss), **as directed**.
 - b. Latex Over Alkyd Primer System: MPI EXT 6.2A.
 - 1) Prime Coat: Exterior alkyd **OR** oil, **as directed**, wood primer.
 - 2) Intermediate Coat: Exterior latex matching topcoat.
 - 3) Topcoat: Exterior latex (flat) **OR** (semigloss) **OR** (gloss), **as directed**.
 - c. Alkyd System: MPI EXT 6.2C.
 - 1) Prime Coat: Exterior alkyd **OR** oil, **as directed**, wood primer.
 - 2) Intermediate Coat: Exterior alkyd enamel matching topcoat.
 - 3) Topcoat: Exterior alkyd enamel (flat) **OR** (semigloss) **OR** (gloss), **as directed**.
15. Dimension Lumber Substrates, Traffic Surfaces: Including lumber decking **OR** stairs, **as directed**.
 - a. Latex System: MPI EXT 6.5E.
 - 1) Prime Coat: Exterior latex wood primer.
 - 2) Intermediate Coat: Interior/exterior latex floor and porch (low gloss).
 - 3) Topcoat: Interior/exterior latex floor and porch (low gloss).
 - a) With additive to increase skid resistance of painted surface.
 - b. Latex Over Alkyd Primer System: MPI EXT 6.5A.
 - 1) Prime Coat: Exterior alkyd wood primer.

- 2) Intermediate Coat: Interior/exterior latex floor and porch (low gloss).
- 3) Topcoat: Interior/exterior latex floor and porch (low gloss).
 - a) With additive to increase skid resistance of painted surface.
- c. Alkyd Floor Enamel System: MPI EXT 6.5B.
 - 1) Prime Coat: Exterior/interior alkyd floor enamel (gloss).
 - 2) Intermediate Coat: Exterior/interior alkyd floor enamel (gloss).
 - 3) Topcoat: Exterior/interior alkyd floor enamel (gloss).
 - a) With additive to increase skid resistance of painted surface.
- 16. Plastic Trim Fabrication Substrates:
 - a. Latex System: MPI EXT 6.8A.
 - 1) Prime Coat: Bonding primer (water based) **OR** (solvent based), **as directed**.
 - 2) Intermediate Coat: Exterior latex matching topcoat.
 - 3) Topcoat: Exterior latex (flat) **OR** (semigloss) **OR** (gloss), **as directed**.
 - b. Alkyd System: MPI EXT 6.8B.
 - 1) Prime Coat: Bonding primer (water based) **OR** (solvent based), **as directed**.
 - 2) Intermediate Coat: Exterior alkyd enamel matching topcoat.
 - 3) Topcoat: Exterior alkyd enamel (flat) **OR** (semigloss) **OR** (gloss), **as directed**.
- 17. Stucco Substrates:
 - a. Latex System: MPI EXT 9.1A.
 - 1) Prime Coat: Exterior latex matching topcoat.
 - 2) Intermediate Coat: Exterior latex matching topcoat.
 - 3) Topcoat: Exterior latex (flat) **OR** (semigloss) **OR** (gloss), **as directed**.
 - b. Latex Over Alkali-Resistant Primer System: MPI EXT 9.1J.
 - 1) Prime Coat: Alkali-resistant primer.
 - 2) Intermediate Coat: Exterior latex matching topcoat.
 - 3) Topcoat: Exterior latex (flat) **OR** (semigloss) **OR** (gloss), **as directed**.
 - c. High-Build Latex System: MPI EXT 9.1H, applied to form dry film thickness of not less than **10 mils (0.25 mm)**.
 - 1) Prime Coat: As recommended in writing by topcoat manufacturer.
 - 2) Intermediate Coat: As recommended in writing by topcoat manufacturer.
 - 3) Topcoat: High-build latex (exterior).
- 18. Exterior Gypsum Board Substrates:
 - a. Latex System: MPI EXT 9.2A.
 - 1) Prime Coat: Exterior latex matching topcoat.
 - 2) Intermediate Coat: Exterior latex matching topcoat.
 - 3) Topcoat: Exterior latex (flat) **OR** (semigloss) **OR** (gloss), **as directed**.

END OF SECTION 09 91 13 00

SECTION 09 91 13 00a - WOOD STAINS AND TRANSPARENT FINISHES

1.1 GENERAL

A. Description Of Work

1. This specification covers the furnishing and installation of materials for wood stains and transparent finishes. Products shall be as follows or as directed by the Owner. Installation procedures shall be in accordance with the product manufacturer's recommendations. Demolition and removal of materials shall be as required to support the work.

B. Summary

1. This Section includes surface preparation and the application of wood finishes on the following substrates:
 - a. Exterior Substrates:
 - 1) Exposed glue-laminated beams and columns.
 - 2) Exposed dimension lumber (rough carpentry).
 - 3) Dressed lumber (finish carpentry).
 - 4) Exposed wood panel products.
 - 5) Wood decks and stairs.
 - 6) Wood shingles and shakes (excluding roofs).
 - b. Interior Substrates:
 - 1) Exposed glue-laminated beams and columns.
 - 2) Exposed dimension lumber (rough carpentry).
 - 3) Dressed lumber (finish carpentry).
 - 4) Exposed wood panel products.

C. Submittals

1. Product Data: For each type of product indicated.
2. LEED Submittal:
 - a. Product Data for Credit EQ 4.2: For interior primers, stains, and transparent finishes, including printed statement of VOC content.
3. Samples: For each finish and for each color and texture required.
4. Product List: Printout of MPI's current "MPI Approved Products List" for each product category specified in Part 1.2, with the product proposed for use highlighted.

D. Quality Assurance

1. MPI Standards:
 - a. Products: Complying with MPI standards indicated and listed in its "MPI Approved Products List."
 - b. Preparation and Workmanship: Comply with requirements in "MPI Architectural Painting Specification Manual" for products and finish systems indicated.

E. Delivery, Storage, And Handling

1. Store materials not in use in tightly covered containers in well-ventilated areas with ambient temperatures continuously maintained at not less than **45 deg F (7 deg C)**.
 - a. Maintain containers in clean condition, free of foreign materials and residue.
 - b. Remove rags and waste from storage areas daily.

F. Project Conditions

1. Apply finishes only when temperature of surfaces to be finished and ambient air temperatures are between **50 and 95 deg F (10 and 35 deg C)**.
2. Do not apply exterior finishes in snow, rain, fog, or mist; when relative humidity exceeds 85 percent; at temperatures less than **5 deg F (3 deg C)** above the dew point; or to damp or wet surfaces.

1.2 PRODUCTS

A. Materials, General

1. Material Compatibility:
 - a. Provide materials for use within each finish system that are compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
 - b. For each coat in a finish system, provide products recommended in writing by manufacturers of topcoat for use in finish system and on substrate indicated.
2. VOC Content of Field-Applied Interior Primers, Stains, and Transparent Finishes: Provide products that comply with the following limits for VOC content, exclusive of colorants added to a tint base, when calculated according to 40 CFR 59, Subpart D (EPA Method 24); these requirements do not apply to primers, stains, and transparent finishes that are applied in a fabrication or finishing shop:
 - a. Flat Primers: VOC content of not more than 50 g/L.
 - b. Nonflat Primers: VOC content of not more than 150 g/L.
 - c. Primers, Sealers, and Undercoaters: VOC content of not more than 200 g/L.
 - d. Clear Wood Finishes, Varnishes: VOC not more than 350 g/L.
 - e. Clear Wood Finishes, Lacquers: VOC not more than 550 g/L.
 - f. Floor Coatings: VOC not more than 100 g/L.
 - g. Shellacs, Clear: VOC not more than 730 g/L.
 - h. Stains: VOC not more than 250 g/L.
3. Stain Colors: As selected from manufacturer's full range **OR** Match samples **OR** As indicated in a color schedule, **as directed**.

B. Wood Fillers

1. Wood Filler Paste: MPI #91.
 - a. VOC Content: E Range of E1 **OR** E2 **OR** E3, **as directed**.

C. Primers And Sealers

1. Exterior Alkyd Wood Primer: MPI #5.
 - a. VOC Content: E Range of E2 **OR** E3, **as directed**.
2. Exterior Latex Wood Primer: MPI #6.
 - a. VOC Content: E Range of E1 **OR** E2 **OR** E3, **as directed**.
3. Exterior Oil Wood Primer: MPI #7.
 - a. VOC Content: E Range of E2.
4. Wood Preservative: MPI #37.
 - a. VOC Content: E Range of E1 **OR** E3, **as directed**.
5. Alkyd Sanding Sealer: MPI #102.
 - a. VOC Content: E Range of E1 **OR** E2 **OR** E3, **as directed**.
6. Lacquer Sanding Sealer: MPI #84.
 - a. VOC Content: E Range of E1 **OR** E2 **OR** E3, **as directed**.
7. Shellac: MPI #88.
 - a. VOC Content: E Range of E2 **OR** E3, **as directed**.

D. Stains

1. Exterior Semitransparent Stain (Solvent Based): MPI #13.
 - a. VOC Content: E Range of E1 **OR** E2, **as directed**.
2. Exterior Solid-Color Stain (Solvent Based): MPI #14.
 - a. VOC Content: E Range of E1 **OR** E2 **OR** E3, **as directed**.
3. Exterior, Solid-Color Latex Stain: MPI #16.
 - a. VOC Content: E Range of E1 **OR** E2 **OR** E3, **as directed**.
4. Stain for Wood Decks: MPI #33.
 - a. VOC Content: E Range of E1 **OR** E3, **as directed**.
5. Interior Wood Stain (Semitransparent): MPI #90.

- a. VOC Content: E Range of E1 **OR** E2, **as directed**.

E. Varnishes

1. Exterior Marine Spar Varnish (Gloss): MPI #28, Gloss Level 7.
 - a. VOC Content: E Range of E1 **OR** E2, **as directed**.
2. Exterior Varnish (Gloss): MPI #29, Gloss Level 6.
 - a. VOC Content: E Range of E1.
3. Exterior Varnish (Semigloss): MPI #30, Gloss Level 5.
 - a. VOC Content: E Range of E1.
4. Interior Varnish (Flat): MPI #73, Gloss Level 1, alkyd type.
 - a. VOC Content: E Range of E1 **OR** E2 **OR** E3, **as directed**.
5. Interior Varnish (Semigloss): MPI #74, Gloss Level 5, alkyd type.
 - a. VOC Content: E Range of E1 **OR** E2 **OR** E3, **as directed**.
6. Interior Varnish (Gloss): MPI #75, Gloss Level 6, alkyd type.
 - a. VOC Content: E Range of E1 **OR** E2 **OR** E3, **as directed**.

F. Polyurethane Finishes

1. Two-Component Aliphatic Polyurethane (Clear): MPI #78.
 - a. VOC Content: E Range of E1 **OR** E2 **OR** E3, **as directed**.
2. Interior, Oil-Modified, Clear Urethane (Satin): MPI #57, Gloss Level 4.
 - a. VOC Content: E Range of E1 **OR** E2, **as directed**.
3. Interior, Oil-Modified, Clear Urethane (Gloss): MPI #56, Gloss Level 6.
 - a. VOC Content: E Range of E1 **OR** E2 **OR** E3, **as directed**.
4. Moisture-Cured Clear Polyurethane (Flat): MPI #71, Gloss Level 1.
 - a. VOC Content: E Range of E2.
5. Moisture-Cured Clear Polyurethane (Gloss): MPI #31.
 - a. VOC Content: E Range of E1 **OR** E2 **OR** E3, **as directed**.

G. Waterborne Acrylic Finishes

1. Waterborne Clear Acrylic (Satin): MPI #128, Gloss Level 4.
 - a. VOC Content: E Range of E1 **OR** E2 **OR** E3, **as directed**.
 - b. Environmental Performance Rating: EPR 1 **OR** EPR 2 **OR** EPR 3, **as directed**.
2. Waterborne Clear Acrylic (Semigloss): MPI #129, Gloss Level 5.
 - a. VOC Content: E Range of E1 **OR** E2 **OR** E3, **as directed**.
 - b. Environmental Performance Rating: EPR 1 **OR** EPR 2 **OR** EPR 3, **as directed**.
3. Waterborne Clear Acrylic (Gloss): MPI #130, Gloss Level 6.
 - a. VOC Content: E Range of E1 **OR** E2 **OR** E3, **as directed**.
 - b. Environmental Performance Rating: EPR 1 **OR** EPR 2 **OR** EPR 3, **as directed**.

H. Lacquers

1. Lacquer (Clear Flat): MPI #87, Gloss Level 1.
 - a. VOC Content: E Range of E1 **OR** E2 **OR** E3, **as directed**.
2. Lacquer (Clear Satin): MPI #85, Gloss Level 4.
 - a. VOC Content: E Range of E1 **OR** E2 **OR** E3, **as directed**.
3. Lacquer (Clear Gloss): MPI #86, Gloss Level 6.
 - a. VOC Content: E Range of E1 **OR** E2 **OR** E3, **as directed**.

I. Oil Finish

1. Danish Oil: MPI #92.
 - a. VOC Content: E Range of E3.

1.3 EXECUTION

A. Preparation

1. Comply with manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual" applicable to substrates indicated.
 2. Remove plates, machined surfaces, and similar items already in place that are not to be finished. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and finishing.
 - a. After completing finishing operations, reinstall items that were removed; use workers skilled in the trades involved. Remove surface-applied protection if any.
 3. Clean and prepare surfaces to be finished according to manufacturer's written instructions for each particular substrate condition and as specified.
 - a. Remove surface dirt, oil, or grease by washing with a detergent solution; rinse thoroughly with clean water and allow to dry. Remove grade stamps and pencil marks by sanding lightly. Remove loose wood fibers by brushing.
 - b. Remove mildew by scrubbing with a commercial wash formulated for mildew removal and as recommended by stain manufacturer.
 - c. Countersink steel nails, if used, and fill with putty tinted to final color to eliminate rust leach stains.
 4. Apply wood filler paste to open-grain woods, as defined in "MPI Architectural Painting Specification Manual," to produce smooth, glasslike finish.
- B. Application
1. Apply finishes according to manufacturer's written instructions.
 - a. Use applicators and techniques suited for finish and substrate indicated.
 - b. Finish surfaces behind movable equipment and furniture same as similar exposed surfaces.
 2. Apply finishes to produce surface films without cloudiness, holidays, lap marks, brush marks, runs, ropiness, or other surface imperfections.
- C. Field Quality Control
1. The following procedure may be requested at any time and as often as the Owner deems necessary during the period when finishes are being applied:
 - a. Engage the services of a qualified testing agency to sample finish materials being used. Samples of material delivered to Project site will be taken, identified, sealed, and certified in presence of Contractor.
 - b. Testing agency will perform tests for compliance with product requirements.
 - c. the Owner may direct Contractor to stop applying finishes if test results show materials being used do not comply with product requirements. Contractor shall remove noncomplying materials from Project site, pay for testing, and refinish surfaces finished with rejected materials. Contractor will be required to remove rejected materials from previously finished surfaces if, on refinishing with complying materials, the two finishes are incompatible.
- D. Cleaning And Protection
1. At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.
 2. After completing finish application, clean spattered surfaces. Remove spattered materials by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.
 3. Protect work of other trades against damage from finish application. Correct damage by cleaning, repairing, replacing, and refinishing, as approved by the Owner, and leave in an undamaged condition.
 4. At completion of construction activities of other trades, touch up and restore damaged or defaced finished wood surfaces.
- E. Exterior Wood-Finish-System Schedule
1. Exposed Glue-Laminated Beam and Column Substrates:
 - a. Solid-Color, Solvent-Based Stain System: MPI EXT 6.1C.

- 1) Prime Coat: Exterior alkyd **OR** oil, **as directed**, wood primer.
- 2) Two Stain Coats: Exterior solid-color stain (solvent based).
- b. Varnish Over Semitransparent Stain System: MPI EXT 6.1D.
 - 1) Stain Coat: Exterior semitransparent stain (solvent based).
 - 2) Three (for a Premium Grade system) **OR** Two, **as directed**, Finish Coats: Exterior marine spar varnish (gloss) **OR** varnish (gloss) **OR** varnish (semigloss), **as directed**.
- c. Varnish System: MPI EXT 6.1K.
 - 1) Four (for a Premium Grade system) **OR** Three, **as directed**, Finish Coats: Exterior marine spar varnish (gloss) **OR** varnish (gloss) **OR** varnish (semigloss), **as directed**.
- d. Clear, Two-Component Polyurethane Over Stain System: MPI EXT 6.1E.
 - 1) Stain Coat: Exterior semitransparent stain (solvent based).
 - 2) Three (for a Premium Grade system) **OR** Two, **as directed**, Finish Coats: Two-component aliphatic polyurethane (clear).
- e. Clear, Two-Component Polyurethane System: MPI EXT 6.1H.
 - 1) Three Finish Coats: Two-component aliphatic polyurethane (clear).
2. Exposed Rough Carpentry Substrates:
 - a. Solid-Color Latex Stain System: MPI EXT 6.2B.
 - 1) Prime Coat: Exterior alkyd **OR** oil, **as directed**, wood primer.
 - 2) Two Stain Coats (for a Premium Grade system) **OR** One Stain Coat, **as directed**: Exterior, solid-color latex stain.
 - b. Solid-Color, Solvent-Based Stain System: MPI EXT 6.2D.
 - 1) Prime Coat: Exterior alkyd **OR** oil, **as directed**, wood primer.
 - c. Two Stain Coats (for a Premium Grade system) One Stain Coat, **as directed**: Exterior solid-color stain (solvent based).
 - d. Semitransparent Stain System: MPI EXT 6.2L.
 - 1) Two Stain Coats: Exterior semitransparent stain (solvent based).
 - e. Varnish Over Semitransparent Stain System: MPI EXT 6.2E.
 - 1) Stain Coat: Exterior semitransparent stain (solvent based).
 - 2) Three (for a Premium Grade system) **OR** Two, **as directed**, Finish Coats: Exterior marine spar varnish (gloss) **OR** varnish (gloss) **OR** varnish (semigloss), **as directed**.
 - f. Varnish System: MPI EXT 6.2K.
 - 1) Four (for a Premium Grade system) **OR** Three, **as directed**, Finish Coats: Exterior varnish (marine spar, high gloss) **OR** (gloss) **OR** (semigloss), **as directed**.
 - g. Clear, Two-Component Polyurethane System: MPI EXT 6.2H.
 - 1) Three Finish Coats: Two-component aliphatic polyurethane (clear).
3. Finish Carpentry Substrates:
 - a. Solid-Color Latex Stain System: MPI EXT 6.3K.
 - 1) Prime Coat: Exterior alkyd **OR** oil, **as directed**, wood primer.
 - 2) Two Stain Coats (for a Premium Grade system) **OR** One Stain Coat, **as directed**: Exterior, solid-color latex stain.
 - b. Solid-Color, Solvent-Based Stain System: MPI EXT 6.3C.
 - 1) Prime Coat: Exterior alkyd **OR** oil, **as directed**, wood primer.
 - 2) Two Stain Coats (for a Premium Grade system) **OR** One Stain Coat, **as directed**: Exterior solid-color stain (solvent based).
 - c. Semitransparent Stain System: MPI EXT 6.3D.
 - 1) Two Stain Coats: Exterior semitransparent stain (solvent based).
 - d. Varnish Over Semitransparent Stain System: MPI EXT 6.3E.
 - 1) Stain Coat: Exterior semitransparent stain (solvent based).
 - 2) Three (for a Premium Grade system) **OR** Two, **as directed**, Finish Coats: Exterior varnish (marine spar, high gloss) **OR** (gloss) **OR** (semigloss), **as directed**.
 - e. Varnish System: MPI EXT 6.3F.
 - 1) Four (for a Premium Grade system) **OR** Three, **as directed**, Finish Coats: Exterior varnish (marine spar, high gloss) **OR** (gloss) **OR** (semigloss), **as directed**.
 - f. Clear, Two-Component Polyurethane System: MPI EXT 6.3G.
 - 1) Three Finish Coats: Two-component aliphatic polyurethane (clear).

F. Exposed Wood Panel-Product Substrates:

- a. Solid-Color Latex Stain System: MPI EXT 6.4A.
 - 1) Prime Coat: Exterior alkyd **OR** latex **OR** oil, **as directed**, wood primer.
 - 2) Two Stain Coats (for a Premium Grade system) **OR** One Stain Coat, **as directed**: Exterior, solid-color latex stain.
 - b. Solid-Color, Solvent-Based Stain System: MPI EXT 6.4C.
 - 1) Prime Coat (for a Premium Grade system): Exterior alkyd **OR** oil, **as directed**, wood primer.
 - 2) Two Stain Coats: Exterior solid-color stain (solvent based).
 - c. Semitransparent Stain System: MPI EXT 6.4D.
 - 1) Two Stain Coats: Exterior semitransparent stain (solvent based).
 - d. Varnish Over Semitransparent Stain System: MPI EXT 6.4J.
 - 1) Stain Coat: Exterior semitransparent stain (solvent based).
 - 2) Three (for a Premium Grade system) **OR** Two, **as directed**, Finish Coats: Exterior varnish (marine spar, high gloss) **OR** (gloss) **OR** (semigloss), **as directed**.
 - e. Varnish System: MPI EXT 6.4H.
 - 1) Four (for a Premium Grade system) **OR** Three, **as directed**, Finish Coats: Exterior varnish (marine spar, high gloss) **OR** (gloss) **OR** (semigloss), **as directed**.
2. Wood Deck and Stair Substrates:
- a. MPI EXT 6.5D.
 - 1) Preservative Coat: Wood preservative.
 - 2) Two Stain Coats (for a Premium Grade system) **OR** One Stain Coat, **as directed**: Stain for wood decks.
 - b. MPI EXT 6.5F.
 - 1) Two Stain Coats: Stain for wood decks.
3. Wood Shingle and Shake Substrates (Excluding Roofs):
- a. Solid-Color Latex Stain System: MPI EXT 6.6D.
 - 1) Prime Coat: Exterior alkyd **OR** oil, **as directed**, wood primer.
 - 2) Two Stain Coats (for a Premium Grade system) **OR** One Stain Coat, **as directed**: Exterior, solid-color latex stain.
 - b. Solid-Color, Solvent-Based Stain System: MPI EXT 6.6C.
 - 1) Prime Coat: Exterior alkyd **OR** oil, **as directed**, wood primer.
 - 2) Two Stain Coats (for a Premium Grade system) **OR** One Stain Coat, **as directed**: Exterior solid-color stain (solvent based).
 - c. Semitransparent Stain System: MPI EXT 6.6F.
 - 1) Two Stain Coats: Exterior semitransparent stain (solvent based).

G. Interior Wood-Finish-System Schedule

1. Exposed Glue-Laminated Beam and Column Substrates:
 - a. Alkyd Varnish Over Stain System: MPI INT 6.1K.
 - 1) Stain Coat: Interior wood stain (semitransparent).
 - 2) Three (for a Premium Grade system) **OR** Two, **as directed**, Finish Coats: Interior varnish (flat) **OR** (semigloss) **OR** (gloss), **as directed**.
 - b. Alkyd Varnish Over Stain and Sealer System: MPI INT 6.1P.
 - 1) Stain Coat: Interior wood stain (semitransparent).
 - 2) Seal Coat: Alkyd sanding sealer.
 - 3) Two Finish Coats (for a Premium Grade system) **OR** One Finish Coat, **as directed**: Interior varnish (flat) **OR** (semigloss) **OR** (gloss), **as directed**.
 - c. Alkyd Varnish Over Sealer System: MPI INT 6.1C.
 - 1) Seal Coat: Alkyd sanding sealer.
 - 2) Two Finish Coats: Interior varnish (flat) **OR** (semigloss) **OR** (gloss), **as directed**.
 - d. Polyurethane Varnish Over Stain System: MPI INT 6.1J.
 - 1) Stain Coat: Interior wood stain (semitransparent).
 - 2) Three (for a Premium Grade system) **OR** Two, **as directed**, Finish Coats: Interior, oil-modified, clear urethane (satin) **OR** (gloss), **as directed**.

- e. Polyurethane Varnish System: MPI INT 6.1D.
 - 1) One Factory-Applied Finish Coat: Matching field-applied finish coats.
 - 2) Two Field-Applied Finish Coats: Interior, oil-modified, clear urethane (satin) **OR** (gloss), **as directed**.
- f. Moisture-Cured Clear Polyurethane Over Stain System: MPI INT 6.1S.
 - 1) Stain Coat: Interior wood stain (semitransparent).
 - 2) Three (for a Premium Grade system) **OR** Two, **as directed**, Finish Coats: Moisture-cured clear polyurethane (flat) **OR** (gloss), **as directed**.
- g. Waterborne Clear Acrylic Over Stain System: MPI INT 6.1R.
 - 1) Stain Coat: Interior wood stain (semitransparent).
 - 2) Three (for a Premium Grade system) **OR** Two, **as directed**, Finish Coats: Waterborne clear acrylic (satin) **OR** (semigloss) **OR** (gloss), **as directed**.
- h. Waterborne Clear Acrylic System: MPI INT 6.F.
 - 1) Three Finish Coats: Waterborne clear acrylic (satin) **OR** (semigloss) **OR** (gloss), **as directed**.
- i. Solid-Color Latex Stain System: MPI INT 6.1T.
 - 1) Prime Coat: Exterior alkyd **OR** oil, **as directed**, wood primer.
 - 2) Two Stain Coats (for a Premium Grade system) **OR** One Stain Coat, **as directed**: Exterior, solid-color latex stain.
- j. Solid-Color, Solvent-Based Stain System: MPI INT 6.1H.
 - 1) Two Stain Coats: Exterior solid-color stain (solvent based).
- k. Semitransparent Stain System: MPI INT 6.1G.
 - 1) Two Stain Coats: Exterior semitransparent stain (solvent based).
2. Exposed Rough Carpentry Substrates:
 - a. Alkyd Varnish Over Stain and Sealer System: MPI INT 6.2K.
 - 1) Stain Coat: Interior wood stain (semitransparent).
 - 2) Seal Coat: Alkyd sanding sealer.
 - 3) Two Finish Coats (for a Premium Grade system) **OR** One Finish Coat, **as directed**: Interior varnish (flat) **OR** (semigloss) **OR** (gloss), **as directed**.
 - b. Alkyd Varnish Over Sealer System: MPI INT 6.2P.
 - 1) Seal Coat: Alkyd sanding sealer.
 - 2) Two Finish Coats (for a Premium Grade system) **OR** One Finish Coat, **as directed**: Interior varnish (flat) **OR** (semigloss) **OR** (gloss), **as directed**.
 - c. Polyurethane Varnish Over Stain System: MPI INT 6.2J.
 - 1) Stain Coat: Interior wood stain (semitransparent).
 - 2) Three (for a Premium Grade system) **OR** Two, **as directed**, Finish Coats: Interior, oil-modified, clear urethane (satin) **OR** (gloss), **as directed**.
 - d. Polyurethane Varnish System: MPI INT 6.2H.
 - 1) Three (for a Premium Grade system) **OR** Two, **as directed**, Finish Coats: Interior, oil-modified, clear urethane (satin) **OR** (gloss), **as directed**.
 - e. Moisture-Cured Clear Polyurethane Over Stain System: MPI INT 6.2N.
 - 1) Stain Coat: Interior wood stain (semitransparent).
 - 2) Three (for a Premium Grade system) **OR** Two, **as directed**, Finish Coats: Moisture-cured clear polyurethane (flat) **OR** (gloss), **as directed**.
 - f. Waterborne Clear Acrylic Over Stain System: MPI INT 6.2M.
 - 1) Stain Coat: Interior wood stain (semitransparent).
 - 2) Three (for a Premium Grade system) **OR** Two, **as directed**, Finish Coats: Waterborne clear acrylic (satin) **OR** (semigloss) **OR** (gloss), **as directed**.
3. Finish Carpentry Substrates:
 - a. Alkyd Varnish Over Stain and Sealer System: MPI INT 6.3D.
 - 1) Stain Coat: Interior wood stain (semitransparent).
 - 2) Seal Coat: Alkyd sanding sealer **OR** Shellac, **as directed**.
 - 3) Two Finish Coats (for a Premium Grade system) **OR** One Finish Coat, **as directed**: Interior varnish (semigloss) **OR** (gloss), **as directed**.
 - b. Alkyd Varnish Over Sealer System: MPI INT 6.3J.
 - 1) Seal Coat: Alkyd sanding sealer **OR** Shellac, **as directed**.

- 2) Two Finish Coats (for a Premium Grade system) **OR** One Finish Coat, **as directed**: Interior varnish (semigloss) **OR** (gloss), **as directed**.
- c. Polyurethane Varnish Over Stain System: MPI INT 6.3E.
 - 1) Stain Coat: Interior wood stain (semitransparent).
 - 2) Three (for a Premium Grade system) **OR** Two, **as directed**, Finish Coats: Interior, oil-modified, clear urethane (satin) **OR** (gloss), **as directed**.
- d. Polyurethane Varnish System: MPI INT 6.3K.
 - 1) One Factory-Applied Finish Coat: Matching field-applied finish coats.
 - 2) Two Field-Applied Finish Coats: Interior, oil-modified, clear urethane (satin) **OR** (gloss), **as directed**.
- e. Moisture-Cured Clear Polyurethane Over Stain System: MPI INT 6.3Y.
 - 1) Stain Coat: Interior wood stain (semitransparent).
 - 2) Three (for a Premium Grade system) **OR** Two, **as directed**, Finish Coats: Moisture-cured clear polyurethane (flat) **OR** (gloss), **as directed**.
- f. Moisture-Cured Clear Polyurethane System: MPI INT 6.3X.
 - 1) Three (for a Premium Grade system) **OR** Two, **as directed**, Finish Coats: Moisture-cured clear polyurethane (flat) **OR** (gloss), **as directed**.
- g. Clear, Two-Component Polyurethane System: MPI INT 6.3Z.
 - 1) Three (for a Premium Grade system) Two, **as directed**, Finish Coats: Two-component aliphatic polyurethane (clear).
- h. Waterborne Clear Acrylic Over Stain System: MPI INT 6.3W.
 - 1) Stain Coat: Interior wood stain (semitransparent).
 - 2) Three (for a Premium Grade system) **OR** Two, **as directed**, Finish Coats: Waterborne clear acrylic (satin) **OR** (semigloss) **OR** (gloss), **as directed**.
- i. Waterborne Clear Acrylic System: MPI INT 6.3Q.
 - 1) Three Finish Coats: Waterborne clear acrylic (satin) **OR** (semigloss) **OR** (gloss), **as directed**.
- j. Lacquer Over Stain and Sealer System: MPI INT 6.3F.
 - 1) Stain Coat: Interior wood stain (semitransparent).
 - 2) Seal Coat: Lacquer sanding sealer.
 - 3) Two Finish Coats (for a Premium Grade system) **OR** One Finish Coat, **as directed**: Lacquer (clear flat **OR** satin **OR** gloss, **as directed**).
- k. Lacquer Over Sealer System: MPI INT 6.3H.
 - 1) Seal Coat: Lacquer sanding sealer.
 - 2) Two Finish Coats (for a Premium Grade system) **OR** One Finish Coat, **as directed**: Lacquer (clear flat **OR** satin **OR** gloss, **as directed**).
- l. Semitransparent Stain System: MPI INT 6.3C.
 - 1) Two Stain Coats: Exterior semitransparent stain (solvent based).
- m. Danish Oil System: MPI INT 6.3M.
 - 1) Two Finish Coats: Danish oil.
4. Exposed Wood Panel-Product Substrates:
 - a. Alkyd Varnish Over Sealer and Stain System: MPI INT 6.4D.
 - 1) Stain Coat: Interior wood stain (semitransparent).
 - 2) Seal Coat: Alkyd sanding sealer **OR** Shellac, **as directed**.
 - 3) Two Finish Coats (for a Premium Grade system) **OR** One Finish Coat, **as directed**: Interior varnish (flat) **OR** (semigloss) **OR** (gloss), **as directed**.
 - b. Alkyd Varnish Over Sealer System: MPI INT 6.4G.
 - 1) Seal Coat: Alkyd sanding sealer **OR** Shellac, **as directed**.
 - 2) Two Finish Coats (for a Premium Grade system) **OR** One Finish Coat, **as directed**: Interior varnish (flat) **OR** (semigloss) **OR** (gloss), **as directed**.
 - c. Polyurethane Varnish Over Stain System: MPI INT 6.4E.
 - 1) Stain Coat: Interior wood stain (semitransparent).
 - 2) Three (for a Premium Grade system) **OR** Two, **as directed**, Finish Coats: Interior, oil-modified, clear urethane (satin) **OR** (gloss), **as directed**.
 - d. Polyurethane Varnish System: MPI INT 6.4.J.

- 1) One Factory-Applied Finish Coat: Matching field-applied finish coats.
- 2) Two Field-Applied Finish Coats: Interior, oil-modified, clear urethane (satin) **OR** (gloss), **as directed**.
- e. Moisture-Cured Clear Polyurethane Over Stain System: MPI INT 6.4V.
 - 1) Stain Coat: Interior wood stain (semitransparent).
 - 2) Three (for a Premium Grade system) Two, **as directed**, Finish Coats: Moisture-cured clear polyurethane (flat) **OR** (gloss), **as directed**.
- f. Waterborne Clear Acrylic Over Stain System: MPI INT 6.4U.
 - 1) Stain Coat: Interior wood stain (semitransparent).
 - 2) Three (for a Premium Grade system) **OR** Two, **as directed**, Finish Coats: Waterborne clear acrylic (satin) **OR** (semigloss) **OR** (gloss), **as directed**.
- g. Lacquer Over Stain and Sealer System: MPI INT 6.4F.
 - 1) Stain Coat: Interior wood stain (semitransparent).
 - 2) Seal Coat: Lacquer sanding sealer.
 - 3) Two Finish Coats (for a Premium Grade system) **OR** One Finish Coat, **as directed**: Lacquer (clear flat **OR** satin **OR** gloss, **as directed**).
- h. Lacquer Over Sealer System: MPI INT 6.4Y.
 - 1) Seal Coat: Lacquer sanding sealer.
 - 2) Three (for a Premium Grade system) Two, **as directed**, Finish Coats: Lacquer (clear flat **OR** satin **OR** gloss, **as directed**).
- i. Semitransparent Stain System: MPI INT 6.4C.
 - 1) Two Stain Coats: Exterior semitransparent stain (solvent based).
- j. Danish Oil System: MPI INT 6.4K.
 - 1) Two Finish Coats: Danish oil.

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SECTION 09 91 13 00b - HIGH-TEMPERATURE-RESISTANT COATINGS

1.1 GENERAL

A. Description Of Work

1. This specification covers the furnishing and installation of materials for high-temperature-resistant coatings. Products shall be as follows or as directed by the Owner. Installation procedures shall be in accordance with the product manufacturer's recommendations. Demolition and removal of materials shall be as required to support the work.

B. Summary

1. This Section includes surface preparation and application of high-temperature-resistant coating systems on steel substrates subject to high temperatures.

C. Submittals

1. Product Data: For each type of product indicated.
2. Samples: For each coating and for each color and texture required.
3. LEED Submittal:
 - a. Product Data for Credit EQ 4.2: For coatings, including printed statement of VOC content and chemical components.

D. Quality Assurance

1. Master Painters Institute (MPI) Standards:
 - a. Products: Complying with MPI standards indicated and listed in "MPI Approved Products List" **OR** "MPI Maintenance Repainting Manual," **as directed**.
 - b. Preparation and Workmanship: Comply with requirements in "MPI Architectural Painting Specification Manual" **OR** "MPI Maintenance Repainting Manual," **as directed**, for products and coating systems indicated.

E. Delivery, Storage, And Handling

1. Store materials not in use in tightly covered containers in well-ventilated areas with ambient temperatures continuously maintained at not less than **45 deg F (7 deg C)**.
 - a. Maintain containers in clean condition, free of foreign materials and residue.
 - b. Remove rags and waste from storage areas daily.

F. Project Conditions

1. Apply coatings only when temperature of surfaces to be coated and surrounding air temperatures are between **50 and 104 deg F (10 and 40 deg C)**.
2. Do not apply coatings in snow, rain, fog, or mist; when relative humidity exceeds 85 percent; at temperatures less than **5 deg F (3 deg C)** above the dew point; or to damp or wet surfaces.

1.2 PRODUCTS

A. High-Temperature-Resistant Coatings

1. VOC Content of Interior Paints and Coatings: Provide products that comply with the following limits for VOC content when calculated according to 40 CFR 59, Subpart D (EPA Method 24) :
 - a. Flat Paints, Coatings, and Primers: VOC content of not more than 50 g/L.
 - b. Nonflat Paints, Coatings, and Primers: VOC content of not more than 150 g/L.
 - c. Anticorrosive and Anti-Rust Paints Applied to Ferrous Metals: VOC content of not more than 250 g/L.
 - d. Flat Interior Topcoat Paints: VOC content of not more than 50 g/L.
 - e. Nonflat Interior Topcoat Paints: VOC content of not more than 150 g/L.

- f. Anti-Corrosive and Anti-Rust Paints Applied to Ferrous Metals: VOC not more than 250 g/L.
 - g. Primers, Sealers, and Undercoaters: VOC content of not more than 200 g/L.
 - h. Zinc-Rich Industrial Maintenance Primers: VOC content of not more than 340 g/L.
2. Chemical Components of Interior Paints and Coatings: Provide topcoat paints and anti-corrosive and anti-rust paints applied to ferrous metals that comply with the following chemical restrictions; these requirements do not apply to paints and coatings that are applied in a fabrication or finishing shop:
 - a. Aromatic Compounds: Paints and coatings shall not contain more than 1.0 percent by weight of total aromatic compounds (hydrocarbon compounds containing 1 or more benzene rings).
 - b. Restricted Components: Paints and coatings shall not contain any of the following:
 - 1) Acrolein.
 - 2) Acrylonitrile.
 - 3) Antimony.
 - 4) Benzene.
 - 5) Butyl benzyl phthalate.
 - 6) Cadmium.
 - 7) Di (2-ethylhexyl) phthalate.
 - 8) Di-n-butyl phthalate.
 - 9) Di-n-octyl phthalate.
 - 10) 1,2-dichlorobenzene.
 - 11) Diethyl phthalate.
 - 12) Dimethyl phthalate.
 - 13) Ethylbenzene.
 - 14) Formaldehyde.
 - 15) Hexavalent chromium.
 - 16) Isophorone.
 - 17) Lead.
 - 18) Mercury.
 - 19) Methyl ethyl ketone.
 - 20) Methyl isobutyl ketone.
 - 21) Methylene chloride.
 - 22) Naphthalene.
 - 23) Toluene (methylbenzene).
 - 24) 1,1,1-trichloroethane.
 - 25) Vinyl chloride.
3. Colors: As selected from manufacturer's full range **OR** Match samples, **as directed**.
4. Primer: Undercoating recommended in writing for use in coating system by manufacturer of high-temperature-resistant coating under conditions indicated.
5. Heat-Resistant Enamel (Gloss): MPI #21.
 - a. VOC Content: Minimum E Range of E1 **OR** E2 **OR** E3, **as directed**.
6. Inorganic Zinc Primer: MPI #19.
 - a. VOC Content: Minimum E Range of 0 **OR** E1 **OR** E2 **OR** E3, **as directed**.
7. Aluminum Heat-Resistant Enamel: MPI #2.
 - a. VOC Content: Minimum E Range of E1 **OR** E2 **OR** E3, **as directed**.
8. High-Heat-Resistant Coating: MPI #22.
 - a. VOC Content: Minimum E Range of E1 **OR** E2 **OR** E3, **as directed**.

1.3 EXECUTION

A. Preparation

1. Comply with manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual" **OR** "MPI Maintenance Repainting Manual," **as directed**, applicable to substrates indicated.
 2. Remove plates, machined surfaces, and similar items already in place that are not to be coated. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and coating.
 - a. After completing coating operations, reinstall items that were removed; use workers skilled in the trades involved.
 3. Clean steel substrates of substances that could impair bond of coatings, including dirt, oil, grease, and incompatible paints and encapsulants.
 - a. Remove incompatible primers as required to produce coating systems indicated.
- B. Application
1. Apply high-temperature-resistant coating systems according to manufacturer's written instructions.
 - a. Use applicators and techniques suited for coating and substrate indicated.
 - b. Coat surfaces behind movable equipment and furniture same as similar exposed surfaces. Before final installation, coat surfaces behind permanently fixed equipment or furniture with prime coat only.
 - c. Coat back sides of access panels, removable or hinged covers, and similar hinged items to match exposed surfaces.
- C. Field Quality Control
1. Contractor shall invoke the following procedure at any time and as often as necessary during the period when coatings are being applied:
 - a. Engage the services of a qualified testing agency to sample coating material being used. Samples of material delivered to Project site will be taken, identified, sealed, and certified in presence of Contractor.
 - b. Testing agency will perform tests for compliance with specified requirements.
 - c. the Owner may direct Contractor to stop applying coatings if test results show materials being used do not comply with specified requirements. Contractor shall remove noncomplying coating materials from Project site, pay for testing, and recoat surfaces coated with rejected materials. Contractor will be required to remove rejected materials from previously coated surfaces if, on recoating with complying materials, the two coatings are incompatible.
- D. Cleaning And Protection
1. At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.
 2. After completing coating application, clean spattered surfaces. Remove spattered coatings by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.
 3. Protect work of other trades against damage from coating operation. Correct damage by cleaning, repairing, replacing, and recoating, as approved by the Owner, and leave in an undamaged condition.
 4. At completion of construction activities of other trades, touch up and restore damaged or defaced coated surfaces.
- E. High-Temperature-Resistant Coating Schedule
1. Heat-Resistant Enamel (Gloss) Coating System (System below corresponds with MPI EXT 5.2A and MPI INT 5.2A coating systems) {suitable for use on surfaces that reach a maximum temperature of 400 deg F (205 deg C)}:
 - a. Surface Preparation: Clean using methods recommended in writing by finish-coat manufacturer, but not less than blast cleaning according to SSPC-SP 5/NACE No. 1, "White Metal Blast Cleaning **OR** SSPC-SP 10/NACE No. 2, "Near-White Blast Cleaning **OR** SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning," **as directed**.
 - b. Prime Coat: Primer.



- c. Finish Coat(s): Heat-resistant enamel (gloss), MPI #21, in number of coats recommended in writing by manufacturer for conditions indicated.
2. Inorganic Zinc Primer Coating System (System below corresponds with MPI EXT 5.2C and MPI INT 5.2C coating systems) {suitable for use on surfaces that reach a maximum temperature of 750 deg F (400 deg C)}:
 - a. Surface Preparation: Clean using methods recommended in writing by finish-coat manufacturer, but not less than blast cleaning according to SSPC-SP 5/NACE No. 1, "White Metal Blast Cleaning **OR** SSPC-SP 10/NACE No. 2, "Near-White Blast Cleaning **OR** SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning," **as directed**.
 - b. Prime Coat: Primer.
 - c. Finish Coat(s): Inorganic zinc primer, MPI #19, in number of coats recommended in writing by manufacturer for conditions indicated.
3. Aluminum Heat-Resistant Enamel Coating System (System below corresponds with MPI EXT 5.2B and MPI INT 5.2B coating systems) {suitable for use on surfaces that reach a maximum temperature of 800 deg F (427 deg C)}:
 - a. Surface Preparation: Clean using methods recommended in writing by finish-coat manufacturer, but not less than blast cleaning according to SSPC-SP 5/NACE No. 1, "White Metal Blast Cleaning **OR** SSPC-SP 10/NACE No. 2, "Near-White Blast Cleaning **OR** SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning," **as directed**.
 - b. Prime Coat: Primer.
 - c. Finish Coat(s): Aluminum heat-resistant enamel, MPI #2, in number of coats recommended in writing by manufacturer for conditions indicated.
4. High-Heat-Resistant Coating System (System below corresponds with MPI EXT 5.2D and MPI INT 5.2D coating systems) {suitable for use on surfaces that reach a maximum temperature of 1100 deg F (593 deg C)}:
 - a. Surface Preparation: Clean using methods recommended in writing by finish-coat manufacturer, but not less than blast cleaning according to SSPC-SP 5/NACE No. 1, "White Metal Blast Cleaning **OR** SSPC-SP 10/NACE No. 2, "Near-White Blast Cleaning **OR** SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning," **as directed**.
 - b. Prime Coat: Primer.
 - c. Finish Coat(s): High-heat-resistant coating, MPI #22, in number of coats recommended in writing by manufacturer for conditions indicated.

END OF SECTION 09 91 13 00b



Task	Specification	Specification Description
09 91 13 00	01 22 16 00	No Specification Required

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SECTION 09 91 23 00 - INTERIOR PAINTING

1.1 GENERAL

A. Description Of Work

1. This specification covers the furnishing and installation of materials for interior painting. Products shall be as follows or as directed by the Owner. Installation procedures shall be in accordance with the product manufacturer's recommendations. Demolition and removal of materials shall be as required to support the work.

B. Summary

1. This Section includes surface preparation and the application of paint systems on the following interior substrates:
 - a. Concrete.
 - b. Clay masonry.
 - c. Concrete masonry units (CMU).
 - d. Steel.
 - e. Galvanized metal.
 - f. Aluminum (not anodized or otherwise coated).
 - g. Wood.
 - h. Gypsum board.
 - i. Plaster.
 - j. Spray-textured ceilings.
 - k. Cotton or canvas insulation covering.

C. Submittals

1. Product Data: For each type of product indicated.
2. Samples: For each finish and for each color and texture required.
3. Product List: Printout of current "MPI Approved Products List" for each product category specified in Part 1.2, with the proposed product highlighted.
4. LEED Submittal:
 - a. Product Data for Credit EQ 4.2: For paints, including printed statement of VOC content and chemical components.

D. Quality Assurance

1. MPI Standards:
 - a. Products: Complying with MPI standards indicated and listed in "MPI Approved Products List."
 - b. Preparation and Workmanship: Comply with requirements in "MPI Architectural Painting Specification Manual" for products and paint systems indicated.
2. Mockups: Apply mockups of each paint system indicated and each color and finish selected to verify preliminary selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
 - a. Architect will select one surface to represent surfaces and conditions for application of each paint system specified in Part 3.
 - 1) Vertical and Horizontal Surfaces: Provide samples of at least 100 sq. ft. (9 sq. m).
 - 2) Other Items: Architect will designate items or areas required.
 - b. Final approval of color selections will be based on mockups.
 - 1) If preliminary color selections are not approved, apply additional mockups of additional colors selected by Architect at no added cost to Owner.
 - c. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.

- d. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

E. Delivery, Storage, And Handling

- 1. Store materials not in use in tightly covered containers in well-ventilated areas with ambient temperatures continuously maintained at not less than 45 deg F (7 deg C).
 - a. Maintain containers in clean condition, free of foreign materials and residue.
 - b. Remove rags and waste from storage areas daily.

F. Project Conditions

- 1. Apply paints only when temperature of surfaces to be painted and ambient air temperatures are between 50 and 95 deg F (10 and 35 deg C).
- 2. Do not apply paints when relative humidity exceeds 85 percent; at temperatures less than 5 deg F (3 deg C) above the dew point; or to damp or wet surfaces.

1.2 PRODUCTS

A. Paint, General

- 1. Material Compatibility:
 - a. Provide materials for use within each paint system that are compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
 - b. For each coat in a paint system, provide products recommended in writing by manufacturers of topcoat for use in paint system and on substrate indicated.
- 2. VOC Content of Field-Applied Interior Paints and Coatings: Provide products that comply with the following limits for VOC content, exclusive of colorants added to a tint base, when calculated according to 40 CFR 59, Subpart D (EPA Method 24); these requirements do not apply to paints and coatings that are applied in a fabrication or finishing shop:
 - a. Flat Paints, Coatings, and Primers: VOC content of not more than 50 g/L.
 - b. Nonflat Paints, Coatings, and Primers: VOC content of not more than 150 g/L.
 - c. Anti-Corrosive and Anti-Rust Paints Applied to Ferrous Metals: VOC not more than 250 g/L.
 - d. Floor Coatings: VOC not more than 100 g/L.
 - e. Shellacs, Clear: VOC not more than 730 g/L.
 - f. Shellacs, Pigmented: VOC not more than 550 g/L.
 - g. Flat Topcoat Paints: VOC content of not more than 50 g/L.
 - h. Nonflat Topcoat Paints: VOC content of not more than 150 g/L.
 - i. Anti-Corrosive and Anti-Rust Paints Applied to Ferrous Metals: VOC not more than 250 g/L.
 - j. Floor Coatings: VOC not more than 100 g/L.
 - k. Shellacs, Clear: VOC not more than 730 g/L.
 - l. Shellacs, Pigmented: VOC not more than 550 g/L.
 - m. Primers, Sealers, and Undercoaters: VOC content of not more than 200 g/L.
 - n. Dry-Fog Coatings: VOC content of not more than 400 g/L.
 - o. Zinc-Rich Industrial Maintenance Primers: VOC content of not more than 340 g/L.
 - p. Pre-Treatment Wash Primers: VOC content of not more than 420 g/L.
- 3. Chemical Components of Field-Applied Interior Paints and Coatings: Provide topcoat paints and anti-corrosive and anti-rust paints applied to ferrous metals that comply with the following chemical restrictions; these requirements do not apply to paints and coatings that are applied in a fabrication or finishing shop:
 - a. Aromatic Compounds: Paints and coatings shall not contain more than 1.0 percent by weight of total aromatic compounds (hydrocarbon compounds containing one or more benzene rings).
 - b. Restricted Components: Paints and coatings shall not contain any of the following:

- 1) Acrolein.
 - 2) Acrylonitrile.
 - 3) Antimony.
 - 4) Benzene.
 - 5) Butyl benzyl phthalate.
 - 6) Cadmium.
 - 7) Di (2-ethylhexyl) phthalate.
 - 8) Di-n-butyl phthalate.
 - 9) Di-n-octyl phthalate.
 - 10) 1,2-dichlorobenzene.
 - 11) Diethyl phthalate.
 - 12) Dimethyl phthalate.
 - 13) Ethylbenzene.
 - 14) Formaldehyde.
 - 15) Hexavalent chromium.
 - 16) Isophorone.
 - 17) Lead.
 - 18) Mercury.
 - 19) Methyl ethyl ketone.
 - 20) Methyl isobutyl ketone.
 - 21) Methylene chloride.
 - 22) Naphthalene.
 - 23) Toluene (methylbenzene).
 - 24) 1,1,1-trichloroethane.
 - 25) Vinyl chloride.
4. Colors: As selected from manufacturer's full range **OR** Match samples **OR** As indicated in a color schedule, **as directed**.
- B. Block Fillers
1. Interior/Exterior Latex Block Filler: MPI #4.
 - a. VOC Content: E Range of E2 **OR** E3, **as directed**.
- C. Primers/Sealers
1. Interior Latex Primer/Sealer: MPI #50.
 - a. VOC Content: E Range of E1 **OR** E2 **OR** E3, **as directed**.
 - b. Environmental Performance Rating: EPR 1 **OR** EPR 2 **OR** EPR 3, **as directed**.
 2. Interior Alkyd Primer/Sealer: MPI #45.
 - a. VOC Content: E Range of E1 **OR** E2, **as directed**.
 3. Wood-Knot Sealer: Sealer recommended in writing by topcoat manufacturer for use in paint systems indicated.
- D. Metal Primers
1. Alkyd Anticorrosive Metal Primer: MPI #79.
 - a. VOC Content: E Range of E1 **OR** E2, **as directed**.
 2. Quick-Drying Alkyd Metal Primer: MPI #76.
 - a. VOC Content: E Range of E1 **OR** E2 **OR** E3, **as directed**.
 3. Rust-Inhibitive Primer (Water Based): MPI #107.
 - a. VOC Content: E Range of E1 **OR** E2 **OR** E3, **as directed**.
 - b. Environmental Performance Rating: EPR 1 **OR** EPR 2 **OR** EPR 3, **as directed**.
 4. Cementitious Galvanized-Metal Primer: MPI #26.
 - a. VOC Content: E Range of E1.
 5. Waterborne Galvanized-Metal Primer: MPI #134.
 - a. VOC Content: E Range of E1 **OR** E2 **OR** E3, **as directed**.
 - b. Environmental Performance Rating: EPR 1 **OR** EPR 2 **OR** EPR 3, **as directed**.
 6. Vinyl Wash Primer: MPI #80.
 - a. VOC Content: E Range of E2 **OR** E3, **as directed**.



7. Quick-Drying Primer for Aluminum: MPI #95.
 - a. VOC Content: E Range of E1 **OR** E2 **OR** E3, **as directed**.

E. Wood Primers

1. Interior Latex-Based Wood Primer: MPI #39.
 - a. VOC Content: E Range of E1 **OR** E2 **OR** E3, **as directed**.
 - b. Environmental Performance Rating: EPR 1 **OR** EPR 2 **OR** EPR 3, **as directed**.

F. Latex Paints

1. Interior Latex (Flat): MPI #53 (Gloss Level 1).
 - a. VOC Content: E Range of E1 **OR** E2 **OR** E3, **as directed**.
 - b. Environmental Performance Rating: EPR 0.5 **OR** EPR 1.5 **OR** EPR 2.5, **as directed**.
2. Interior Latex (Low Sheen): MPI #44 (Gloss Level 2).
 - a. VOC Content: E Range of E1 **OR** E2 **OR** E3, **as directed**.
 - b. Environmental Performance Rating: EPR 1 **OR** EPR 2 **OR** EPR 3, **as directed**.
3. Interior Latex (Eggshell): MPI #52 (Gloss Level 3).
 - a. VOC Content: E Range of E1 **OR** E2 **OR** E3, **as directed**.
 - b. Environmental Performance Rating: EPR 1 **OR** EPR 2 **OR** EPR 3, **as directed**.
4. Interior Latex (Satin): MPI #43 (Gloss Level 4).
 - a. VOC Content: E Range of E1 **OR** E2 **OR** E3, **as directed**.
 - b. Environmental Performance Rating: EPR 1.5 **OR** EPR 2 **OR** EPR 2.5 **OR** EPR 3.5, **as directed**.
5. Interior Latex (Semigloss): MPI #54 (Gloss Level 5).
 - a. VOC Content: E Range of E1 **OR** E2 **OR** E3, **as directed**.
 - b. Environmental Performance Rating: EPR 2 **OR** EPR 3 **OR** EPR 4, **as directed**.
6. Interior Latex (Gloss): MPI #114 (Gloss Level 6, except minimum gloss of 65 units at 60 deg).
 - a. VOC Content: E Range of E1 **OR** E2 **OR** E3, **as directed**.
 - b. Environmental Performance Rating: EPR 2 **OR** EPR 3 **OR** EPR 4, **as directed**.
7. Institutional Low-Odor/VOC Latex (Flat): MPI #143 (Gloss Level 1).
 - a. VOC Content: E Range of E3.
 - b. Environmental Performance Rating: EPR 4 **OR** EPR 5.5, **as directed**.
8. Institutional Low-Odor/VOC Latex (Low Sheen): MPI #144 (Gloss Level 2).
 - a. VOC Content: E Range of E3.
 - b. Environmental Performance Rating: EPR 4.5.
9. Institutional Low-Odor/VOC Latex (Eggshell): MPI #145 (Gloss Level 3).
 - a. VOC Content: E Range of E3.
 - b. Environmental Performance Rating: EPR 4.5.
10. Institutional Low-Odor/VOC Latex (Semigloss): MPI #147 (Gloss Level 5).
 - a. VOC Content: E Range of E3.
 - b. Environmental Performance Rating: EPR 3 **OR** EPR 5.5, **as directed**.
11. High-Performance Architectural Latex (Low Sheen): MPI #138 (Gloss Level 2).
 - a. VOC Content: E Range of E1 **OR** E2 **OR** E3, **as directed**.
 - b. Environmental Performance Rating: EPR 4 **OR** EPR 5 **OR** EPR 6, **as directed**.
12. High-Performance Architectural Latex (Eggshell): MPI #139 (Gloss Level 3).
 - a. VOC Content: E Range of E2 **OR** E3, **as directed**.
 - b. Environmental Performance Rating: EPR 5 **OR** EPR 6, **as directed**.
13. High-Performance Architectural Latex (Satin): MPI #140 (Gloss Level 4).
 - a. VOC Content: E Range of E1 **OR** E3, **as directed**.
 - b. Environmental Performance Rating: EPR 4.5 **OR** EPR 6.5, **as directed**.
14. High-Performance Architectural Latex (Semigloss): MPI #141 (Gloss Level 5).
 - a. VOC Content: E Range of E1 **OR** E2 **OR** E3, **as directed**.
 - b. Environmental Performance Rating: EPR 5 **OR** EPR 6 **OR** EPR 7, **as directed**.
15. Exterior Latex (Flat): MPI #10 (Gloss Level 1).
 - a. VOC Content: E Range of E1 **OR** E2 **OR** E3, **as directed**.
16. Exterior Latex (Semigloss): MPI #11 (Gloss Level 5).

- a. VOC Content: E Range of E1 **OR** E2 **OR** E3, **as directed**.
- 17. Exterior Latex (Gloss): MPI #119 (Gloss Level 6, except minimum gloss of 65 units at 60 deg).
 - a. VOC Content: E Range of E1 **OR** E2 **OR** E3, **as directed**.
- G. Alkyd Paints
 - 1. Interior Alkyd (Flat): MPI #49 (Gloss Level 1).
 - a. VOC Content: E Range of E1 **OR** E2 **OR** E3, **as directed**.
 - 2. Interior Alkyd (Eggshell): MPI #51 (Gloss Level 3).
 - a. VOC Content: E Range of E1 **OR** E2, **as directed**.
 - 3. Interior Alkyd (Semigloss): MPI #47 (Gloss Level 5).
 - a. VOC Content: E Range of E1 **OR** E2, **as directed**.
 - b. Environmental Performance Rating: EPR 1 **OR** EPR 2 **OR** EPR 3, **as directed**.
 - 4. Interior Alkyd (Gloss): MPI #48 (Gloss Level 6).
 - a. VOC Content: E Range of E1 **OR** E2, **as directed**.
- H. Quick-Drying Enamels
 - 1. Quick-Drying Enamel (Semigloss): MPI #81 (Gloss Level 5).
 - a. VOC Content: E Range of E1 **OR** E2 **OR** E3, **as directed**.
 - 2. Quick-Drying Enamel (High Gloss): MPI #96 (Gloss Level 7).
 - a. VOC Content: E Range of E1 **OR** E2 **OR** E3, **as directed**.
- I. Textured Coating
 - 1. Latex Stucco and Masonry Textured Coating: MPI #42.
 - a. VOC Content: E Range of E2 **OR** E3, **as directed**.
- J. Dry Fog/Fall Coatings
 - 1. Latex Dry Fog/Fall: MPI #118.
 - a. VOC Content: E Range of E1 **OR** E2 **OR** E3, **as directed**.
 - b. Environmental Performance Rating: EPR 1 **OR** EPR 2 **OR** EPR 3, **as directed**.
 - 2. Waterborne Dry Fall: MPI #133.
 - a. VOC Content: E Range of E1 **OR** E2 **OR** E3, **as directed**.
 - b. Environmental Performance Rating: EPR 1 **OR** EPR 2 **OR** EPR 3, **as directed**.
 - 3. Interior Alkyd Dry Fog/Fall: MPI #55.
 - a. VOC Content: E Range of E1 **OR** E2 **OR** E3, **as directed**.
- K. Aluminum Paint
 - 1. Aluminum Paint: MPI #1.
 - a. VOC Content: E Range of E1 **OR** E2 **OR** E3, **as directed**.
- L. Floor Coatings
 - 1. Interior Concrete Floor Stain: MPI #58.
 - a. VOC Content: E Range of E1 **OR** E2 **OR** E3, **as directed**.
 - b. Environmental Performance Rating: EPR 2.
 - 2. Interior/Exterior Clear Concrete Floor Sealer (Water Based): MPI #99.
 - a. VOC Content: E Range of E1 **OR** E2 **OR** E3, **as directed**.
 - 3. Interior/Exterior Clear Concrete Floor Sealer (Solvent Based): MPI #104.
 - a. VOC Content: E Range of E1 **OR** E2, **as directed**.
 - 4. Interior/Exterior Latex Floor and Porch Paint (Low Gloss): MPI #60 (maximum Gloss Level 3).
 - a. VOC Content: E Range of E2 **OR** E3, **as directed**.
 - b. Environmental Performance Rating: EPR 3.
 - 5. Exterior/Interior Alkyd Floor Enamel (Gloss): MPI #27 (Gloss Level 6).
 - a. VOC Content: E Range of E1 **OR** E2, **as directed**.
 - b. Additives: Manufacturer's standard additive to increase skid resistance of painted surface.

1.3 EXECUTION

A. Preparation

1. Comply with manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual" applicable to substrates indicated.
2. Remove plates, machined surfaces, and similar items already in place that are not to be painted. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and painting.
 - a. After completing painting operations, use workers skilled in the trades involved to reinstall items that were removed. Remove surface-applied protection if any.
 - b. Do not paint over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.
3. Clean substrates of substances that could impair bond of paints, including dirt, oil, grease, and incompatible paints and encapsulants.
 - a. Remove incompatible primers and reprime substrate with compatible primers as required to produce paint systems indicated.
4. Concrete Substrates: Remove release agents, curing compounds, efflorescence, and chalk. Do not paint surfaces if moisture content or alkalinity of surfaces to be painted exceeds that permitted in manufacturer's written instructions.
5. Clay Masonry Substrates: Remove efflorescence and chalk. Do not paint surfaces if moisture content of surfaces or alkalinity of mortar joints to be painted exceed that permitted in manufacturer's written instructions.
6. Concrete Masonry Substrates: Remove efflorescence and chalk. Do not paint surfaces if moisture content or alkalinity of surfaces to be painted exceeds that permitted in manufacturer's written instructions.
7. Steel Substrates: Remove rust and loose mill scale. Clean using methods recommended in writing by paint manufacturer.
8. Galvanized-Metal Substrates: Remove grease and oil residue from galvanized sheet metal fabricated from coil stock by mechanical methods to produce clean, lightly etched surfaces that promote adhesion of subsequently applied paints.
9. Aluminum Substrates: Remove surface oxidation.
10. Wood Substrates:
 - a. Scrape and clean knots, and apply coat of knot sealer before applying primer.
 - b. Sand surfaces that will be exposed to view, and dust off.
 - c. Prime edges, ends, faces, undersides, and backsides of wood.
 - d. After priming, fill holes and imperfections in the finish surfaces with putty or plastic wood filler. Sand smooth when dried.
11. Gypsum Board Substrates: Do not begin paint application until finishing compound is dry and sanded smooth.
12. Plaster Substrates: Do not begin paint application until plaster is fully cured and dry.
13. Spray-Textured Ceiling Substrates: Do not begin paint application until surfaces are dry.
14. Cotton or Canvas Insulation Covering Substrates: Remove dust, dirt, and other foreign material that might impair bond of paints to substrates.

B. Application

1. Apply paints according to manufacturer's written instructions.
 - a. Use applicators and techniques suited for paint and substrate indicated.
 - b. Paint surfaces behind movable equipment and furniture same as similar exposed surfaces. Before final installation, paint surfaces behind permanently fixed equipment or furniture with prime coat only.
 - c. Paint front and backsides of access panels, removable or hinged covers, and similar hinged items to match exposed surfaces.
2. Tint each undercoat a lighter shade to facilitate identification of each coat if multiple coats of same material are to be applied. Tint undercoats to match color of topcoat, but provide sufficient difference in shade of undercoats to distinguish each separate coat.

3. If undercoats or other conditions show through topcoat, apply additional coats until cured film has a uniform paint finish, color, and appearance.
 4. Apply paints to produce surface films without cloudiness, spotting, holidays, laps, brush marks, roller tracking, runs, sags, ropiness, or other surface imperfections. Cut in sharp lines and color breaks.
 5. Painting Mechanical and Electrical Work: Paint items exposed in equipment rooms and occupied spaces including, but not limited to, the following:
 - a. Mechanical Work:
 - 1) Uninsulated metal piping.
 - 2) Uninsulated plastic piping.
 - 3) Pipe hangers and supports.
 - 4) Tanks that do not have factory-applied final finishes.
 - 5) Visible portions of internal surfaces of metal ducts, without liner, behind air inlets and outlets.
 - 6) Duct, equipment, and pipe insulation having cotton or canvas insulation covering or other paintable jacket material.
 - 7) Mechanical equipment that is indicated to have a factory-primed finish for field painting.
 - b. Electrical Work:
 - 1) Switchgear.
 - 2) Panelboards.
 - 3) Electrical equipment that is indicated to have a factory-primed finish for field painting.
- C. Field Quality Control
1. Testing of Paint Materials: The following procedure may be requested at any time and as often as the Owner deems necessary during the period when paints are being applied:
 - a. Engage the services of a qualified testing agency to sample paint materials being used. Samples of material delivered to Project site will be taken, identified, sealed, and certified in presence of Contractor.
 - b. Testing agency will perform tests for compliance with product requirements.
 - c. the Owner may direct Contractor to stop applying paints if test results show materials being used do not comply with product requirements. Contractor shall remove noncomplying-paint materials from Project site, pay for testing, and repaint surfaces painted with rejected materials. Contractor will be required to remove rejected materials from previously painted surfaces if, on repainting with complying materials, the two paints are incompatible.
- D. Cleaning And Protection
1. At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.
 2. After completing paint application, clean spattered surfaces. Remove spattered paints by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.
 3. Protect work of other trades against damage from paint application. Correct damage to work of other trades by cleaning, repairing, replacing, and refinishing, as approved by the Owner, and leave in an undamaged condition.
 4. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces.
- E. Interior Painting Schedule
1. Concrete Substrates, Nontraffic Surfaces:
 - a. Latex System: MPI INT 3.1E.
 - 1) Prime Coat: Interior latex matching topcoat.
 - 2) Intermediate Coat (for MPI Premium Grade system): Interior latex matching topcoat.
 - 3) Topcoat: Interior latex (flat) **OR** (low sheen) **OR** (eggshell) **OR** (satin) **OR** (semigloss) **OR** (gloss), **as directed**.
 - b. Latex Over Sealer System: MPI INT 3.1A.

- 1) Prime Coat: Interior latex primer/sealer.
- 2) Intermediate Coat (for MPI Premium Grade system): Interior latex matching topcoat.
- 3) Topcoat: Interior latex (flat) **OR** (low sheen) **OR** (eggshell) **OR** (satin) **OR** (semigloss) **OR** (gloss), **as directed**.
- c. Latex Over Latex Aggregate System: MPI INT 3.1B.
 - 1) Prime Coat: Latex stucco and masonry textured coating.
 - 2) Intermediate Coat (for MPI Premium Grade system): Exterior latex matching topcoat.
 - 3) Topcoat: Exterior latex (flat) **OR** (semigloss) **OR** (gloss), **as directed**.
- d. Alkyd System: MPI INT 3.1D.
 - 1) Prime Coat: Interior latex primer/sealer.
 - 2) Intermediate Coat (for MPI Premium Grade system): Interior alkyd matching topcoat.
 - 3) Topcoat: Interior alkyd (flat) **OR** (eggshell) **OR** (semigloss) **OR** (gloss), **as directed**.
- e. Institutional Low-Odor/VOC Latex System: MPI INT 3.1M.
 - 1) Prime Coat: Institutional low-odor/VOC interior latex matching topcoat.
 - 2) Intermediate Coat (for MPI Premium Grade system): Institutional low-odor/VOC interior latex matching topcoat.
 - 3) Topcoat: Institutional low-odor/VOC interior latex (flat) **OR** (low sheen) **OR** (eggshell) **OR** (semigloss), **as directed**.
- f. High-Performance Architectural Latex System: MPI INT 3.1C.
 - 1) Prime Coat: Interior latex primer/sealer.
 - 2) Intermediate Coat (for MPI Premium Grade system): High-performance architectural latex matching topcoat.
 - 3) Topcoat: High-performance architectural latex (low sheen) **OR** (eggshell) **OR** (satin) **OR** (semigloss), **as directed**.
2. Concrete Substrates, Traffic Surfaces:
 - a. Latex Floor Enamel System: MPI INT 3.2A.
 - 1) Prime Coat: Interior/exterior latex floor and porch paint (low gloss).
 - 2) Intermediate Coat (for MPI Premium Grade system): Interior/exterior latex floor and porch paint (low gloss).
 - 3) Topcoat: Interior/exterior latex floor and porch paint (low gloss).
 - b. Alkyd Floor Enamel System: MPI INT 3.2B.
 - 1) Prime Coat: Exterior/interior alkyd floor enamel (gloss).
 - 2) Intermediate Coat (for MPI Premium Grade system): Exterior/interior alkyd floor enamel (gloss).
 - 3) Topcoat: Exterior/interior alkyd floor enamel (gloss).
 - c. Concrete Stain System: MPI INT 3.2E.
 - 1) First Coat (for MPI Premium Grade system): Interior concrete floor stain.
 - 2) Topcoat: Interior concrete floor stain.
 - d. Clear Sealer System: MPI INT 3.2F.
 - 1) First Coat: Interior/exterior clear concrete floor sealer (solvent based).
 - 2) Topcoat: Interior/exterior clear concrete floor sealer (solvent based).
 - e. Water-Based Clear Sealer System: MPI INT 3.2G.
 - 1) First Coat: Interior/exterior clear concrete floor sealer (water based).
 - 2) Topcoat: Interior/exterior clear concrete floor sealer (water based).
3. Clay-Masonry Substrates:
 - a. Latex System: MPI INT 4.1A.
 - 1) Prime Coat: Interior latex matching topcoat.
 - 2) Intermediate Coat (for MPI Premium Grade system): Interior latex matching topcoat.
 - 3) Topcoat: Interior latex (flat) **OR** (low sheen) **OR** (eggshell) **OR** (satin) **OR** (semigloss) **OR** (gloss), **as directed**.
 - b. Alkyd System: MPI INT 4.1D.
 - 1) Prime Coat: Interior latex primer/sealer.

- 2) Intermediate Coat (for MPI Premium Grade system): Interior alkyd matching topcoat.
- 3) Topcoat: Interior alkyd (flat) **OR** (eggshell) **OR** (semigloss) **OR** (gloss), **as directed**.
- c. Latex Aggregate System: MPI INT 4.1B.
 - 1) Prime Coat: As recommended in writing by topcoat manufacturer.
 - 2) Intermediate Coat: As recommended in writing by topcoat manufacturer.
 - 3) Topcoat: Latex stucco and masonry textured coating.
- d. Institutional Low-Odor/VOC Latex System: MPI INT 4.1M.
 - 1) Prime Coat: Institutional low-odor/VOC interior latex matching topcoat.
 - 2) Intermediate Coat (for MPI Premium Grade system): Institutional low-odor/VOC interior latex matching topcoat.
 - 3) Topcoat: Institutional low-odor/VOC interior latex (flat) **OR** (low sheen) **OR** (eggshell) **OR** (semigloss), **as directed**.
- e. High-Performance Architectural Latex System: MPI INT 4.1L.
 - 1) Prime Coat: High-performance architectural latex matching topcoat.
 - 2) Intermediate Coat (for MPI Premium Grade system): High-performance architectural latex matching topcoat.
 - 3) Topcoat: High-performance architectural latex (low sheen) **OR** (eggshell) **OR** (satin) **OR** (semigloss), **as directed**.
4. CMU Substrates:
 - a. Latex System: MPI INT 4.2A.
 - 1) Prime Coat: Interior/exterior latex block filler.
 - 2) Intermediate Coat (for MPI Premium Grade system): Interior latex matching topcoat.
 - 3) Topcoat: Interior latex (flat) **OR** (low sheen) **OR** (eggshell) **OR** (satin) **OR** (semigloss) **OR** (gloss), **as directed**.
 - b. Alkyd System: MPI INT 4.2C.
 - 1) Prime Coat: Interior/exterior latex block filler.
 - 2) Intermediate Coat (for MPI Premium Grade system): Interior alkyd matching topcoat.
 - 3) Topcoat: Interior alkyd (flat) **OR** (eggshell) **OR** (semigloss) **OR** (gloss), **as directed**.
 - c. Alkyd Over Latex Sealer System: MPI INT 4.2N.
 - 1) Prime Coat: Interior/exterior latex block filler.
 - 2) Sealer Coat: Interior latex primer/sealer.
 - 3) Intermediate Coat (for MPI Premium Grade system): Interior alkyd matching topcoat.
 - 4) Topcoat: Interior alkyd (flat) **OR** (eggshell) **OR** (semigloss) **OR** (gloss), **as directed**.
 - d. Institutional Low-Odor/VOC Latex System: MPI INT 4.2E.
 - 1) Prime Coat: Interior/exterior latex block filler.
 - 2) Intermediate Coat (for MPI Premium Grade system): Institutional low-odor/VOC interior latex matching topcoat.
 - 3) Topcoat: Institutional low-odor/VOC interior latex (flat) **OR** (low sheen) **OR** (eggshell) **OR** (semigloss), **as directed**.
 - e. High-Performance Architectural Latex System: MPI INT 4.2D.
 - 1) Prime Coat: Interior/exterior latex block filler.
 - 2) Intermediate Coat (for MPI Premium Grade system): High-performance architectural latex matching topcoat.
 - 3) Topcoat: High-performance architectural latex (low sheen) **OR** (eggshell) **OR** (satin) **OR** (semigloss), **as directed**.
5. Steel Substrates:
 - a. Quick-Drying Enamel System: MPI INT 5.1A.
 - 1) Prime Coat: Quick-drying alkyd metal primer.
 - 2) Intermediate Coat: Quick-drying enamel matching topcoat.
 - 3) Topcoat: Quick-drying enamel (semigloss) **OR** (high gloss), **as directed**.
 - b. Water-Based Dry-Fall System: MPI INT 5.1C.
 - 1) Prime Coat: Alkyd anticorrosive **OR** Quick-drying alkyd, **as directed**, metal primer.
 - 2) Topcoat: Latex dry fog/fall **OR** Waterborne dry fall, **as directed**.

- c. Alkyd Dry-Fall System: MPI INT 5.1D.
 - 1) Prime Coat: Alkyd anticorrosive **OR** Quick-drying alkyd, **as directed**, metal primer.
 - 2) Topcoat: Interior alkyd dry fog/fall.
- d. Latex Over Alkyd Primer System: MPI INT 5.1Q.
 - 1) Prime Coat: Alkyd anticorrosive **OR** Quick-drying alkyd, **as directed**, metal primer.
 - 2) Intermediate Coat (for MPI Premium Grade system): Interior latex matching topcoat.
 - 3) Topcoat: Interior latex (flat) **OR** (low sheen) **OR** (eggshell) **OR** (satin) **OR** (semigloss) **OR** (gloss), **as directed**.
- e. Alkyd System: MPI INT 5.1E.
 - 1) Prime Coat: Alkyd anticorrosive **OR** Quick-drying alkyd, **as directed**, metal primer.
 - 2) Intermediate Coat (for MPI Premium Grade system): Interior alkyd matching topcoat.
 - 3) Topcoat: Interior alkyd (flat) **OR** (eggshell) **OR** (semigloss) **OR** (gloss), **as directed**.
- f. Aluminum Paint System: MPI INT 5.1M.
 - 1) Prime Coat: Alkyd anticorrosive **OR** Quick-drying alkyd, **as directed**, metal primer.
 - 2) Intermediate Coat (for MPI Premium Grade system): Aluminum paint.
 - 3) Topcoat: Aluminum paint.
- g. Institutional Low-Odor/VOC Latex System: MPI INT 5.1S.
 - 1) Prime Coat: Rust-inhibitive primer (water based).
 - 2) Intermediate Coat (for MPI Premium Grade system): Institutional low-odor/VOC interior latex matching topcoat.
 - 3) Topcoat: Institutional low-odor/VOC interior latex (flat) **OR** (low sheen) **OR** (eggshell) **OR** (semigloss), **as directed**.
- h. High-Performance Architectural Latex System: MPI INT 5.1R.
 - 1) Prime Coat: Alkyd anticorrosive **OR** Quick-drying alkyd, **as directed**, metal primer.
 - 2) Intermediate Coat (for MPI Premium Grade system): High-performance architectural latex matching topcoat.
 - 3) Topcoat: High-performance architectural latex (low sheen) **OR** (eggshell) **OR** (satin) **OR** (semigloss), **as directed**.
- 6. Galvanized-Metal Substrates:
 - a. Water-Based Dry-Fall System: MPI INT 5.3H.
 - 1) Prime Coat: Waterborne dry fall.
 - 2) Topcoat: Waterborne dry fall.
 - b. Alkyd Dry-Fall System: MPI INT 5.3F.
 - 1) Prime Coat: Cementitious galvanized-metal primer.
 - 2) Topcoat: Interior alkyd dry fog/fall.
 - c. Latex System: MPI INT 5.3A.
 - 1) Prime Coat: Cementitious galvanized-metal primer.
 - 2) Intermediate Coat: Interior latex matching topcoat.
 - 3) Topcoat: Interior latex (flat) **OR** (low sheen) **OR** (eggshell) **OR** (satin) **OR** (semigloss) **OR** (gloss), **as directed**.
 - d. Latex Over Waterborne Primer System: MPI INT 5.3J.
 - 1) Prime Coat: Waterborne galvanized-metal primer.
 - 2) Intermediate Coat (for MPI Premium Grade system): Interior latex matching topcoat.
 - 3) Topcoat: Interior latex (flat) **OR** (low sheen) **OR** (eggshell) **OR** (satin) **OR** (semigloss) **OR** (gloss), **as directed**.
 - e. Alkyd System: MPI INT 5.3C.
 - 1) Prime Coat: Cementitious galvanized-metal primer.
 - 2) Intermediate Coat: Interior alkyd matching topcoat.
 - 3) Topcoat: Interior alkyd (flat) **OR** (eggshell) **OR** (semigloss) **OR** (gloss), **as directed**.
 - f. Aluminum Paint System: MPI INT 5.3G.
 - 1) Prime Coat: Cementitious galvanized-metal primer.
 - 2) Intermediate Coat (for MPI Premium Grade system): Aluminum paint.
 - 3) Topcoat: Aluminum paint.
 - g. Institutional Low-Odor/VOC Latex System: MPI INT 5.3N.

- 1) Prime Coat: Waterborne galvanized-metal primer.
- 2) Intermediate Coat (for MPI Premium Grade system): Institutional low-odor/VOC interior latex matching topcoat.
- 3) Topcoat: Institutional low-odor/VOC interior latex (flat) **OR** (low sheen) **OR** (eggshell) **OR** (semigloss), **as directed**.
- h. High-Performance Architectural Latex System: MPI INT 5.3M.
 - 1) Prime Coat: Waterborne galvanized-metal primer.
 - 2) Intermediate Coat (for MPI Premium Grade system): High-performance architectural latex matching topcoat.
 - 3) Topcoat: High-performance architectural latex (low sheen) **OR** (eggshell) **OR** (satin) **OR** (semigloss), **as directed**.
7. Aluminum (Not Anodized or Otherwise Coated) Substrates:
 - a. Latex System: MPI INT 5.4H.
 - 1) Prime Coat: Quick-drying primer for aluminum.
 - 2) Intermediate Coat (for MPI Premium Grade system): Interior latex matching topcoat.
 - 3) Topcoat: Interior latex (flat) **OR** (low sheen) **OR** (eggshell) **OR** (satin) **OR** (semigloss) **OR** (gloss), **as directed**.
 - b. Alkyd Over Vinyl Wash Primer System: MPI INT 5.4A.
 - 1) Prime Coat: Vinyl wash primer.
 - 2) Intermediate Coat (for MPI Premium Grade system): Interior alkyd matching topcoat.
 - 3) Topcoat: Interior alkyd (flat) **OR** (eggshell) **OR** (semigloss) **OR** (gloss), **as directed**.
 - c. Alkyd Over Quick-Drying Primer System: MPI INT 5.4J.
 - 1) Prime Coat: Quick-drying primer for aluminum.
 - 2) Intermediate Coat (for MPI Premium Grade system): Interior alkyd matching topcoat.
 - 3) Topcoat: Interior alkyd (flat) **OR** (eggshell) **OR** (semigloss) **OR** (gloss), **as directed**.
 - d. Aluminum Paint System: MPI INT 5.4D.
 - 1) Prime Coat: Vinyl wash primer.
 - 2) Intermediate Coat (for MPI Premium Grade system): Aluminum paint.
 - 3) Topcoat: Aluminum paint.
 - e. Institutional Low-Odor/VOC Latex System: MPI INT 5.4G.
 - 1) Prime Coat: Quick-drying primer for aluminum.
 - 2) Intermediate Coat (for MPI Premium Grade system): Institutional low-odor/VOC interior latex matching topcoat.
 - 3) Topcoat: Institutional low-odor/VOC interior latex (flat) **OR** (low sheen) **OR** (eggshell) **OR** (semigloss), **as directed**.
 - f. High-Performance Architectural Latex System: MPI INT 5.4F.
 - 1) Prime Coat: Quick-drying primer for aluminum.
 - 2) Intermediate Coat (for MPI Premium Grade system): High-performance architectural latex matching topcoat.
 - 3) Topcoat: High-performance architectural latex (low sheen) **OR** (eggshell) **OR** (satin) **OR** (semigloss), **as directed**.
8. Glue-Laminated Beam and Column Substrates:
 - a. Latex System: MPI INT 6.1M.
 - 1) Prime Coat: Interior latex-based wood primer.
 - 2) Intermediate Coat: Interior latex matching topcoat.
 - 3) Topcoat: Interior latex (flat) **OR** (low sheen) **OR** (eggshell) **OR** (satin) **OR** (semigloss) **OR** (gloss), **as directed**.
 - b. Latex Over Alkyd Primer System: MPI INT 6.1A.
 - 1) Prime Coat: Interior alkyd primer/sealer.
 - 2) Intermediate Coat (for MPI Premium Grade system): Interior latex matching topcoat.
 - 3) Topcoat: Interior latex (flat) **OR** (low sheen) **OR** (eggshell) **OR** (satin) **OR** (semigloss) **OR** (gloss), **as directed**.
 - c. Alkyd System: MPI INT 6.1B.
 - 1) Prime Coat: Interior alkyd primer/sealer.

- 2) Intermediate Coat (for MPI Premium Grade system): Interior alkyd matching topcoat.
- 3) Topcoat: Interior alkyd (flat) **OR** (eggshell) **OR** (semigloss) **OR** (gloss), **as directed**.
- d. Institutional Low-Odor/VOC Latex System: MPI INT 6.1Q.
 - 1) Prime Coat: Interior latex-based wood primer.
 - 2) Intermediate Coat (for MPI Premium Grade system): Institutional low-odor/VOC interior latex matching topcoat.
 - 3) Topcoat: Institutional low-odor/VOC interior latex (flat) **OR** (low sheen) **OR** (eggshell) **OR** (semigloss), **as directed**.
- e. High-Performance Architectural Latex System: MPI INT 6.1N.
 - 1) Prime Coat: Interior latex-based wood primer.
 - 2) Intermediate Coat: High-performance architectural latex matching topcoat.
 - 3) Topcoat: High-performance architectural latex (low sheen) **OR** (eggshell) **OR** (satin) **OR** (semigloss), **as directed**.
9. Dressed Lumber Substrates: Including architectural woodwork and doors.
 - a. Latex System: MPI INT 6.3T.
 - 1) Prime Coat: Interior latex-based wood primer.
 - 2) Intermediate Coat: Interior latex matching topcoat.
 - 3) Topcoat: Interior latex (semigloss) **OR** (gloss), **as directed**.
 - b. Latex Over Alkyd Primer System: MPI INT 6.3U.
 - 1) Prime Coat: Interior alkyd primer/sealer.
 - 2) Intermediate Coat (for MPI Premium Grade system): Interior latex matching topcoat.
 - 3) Topcoat: Interior latex (semigloss) **OR** (gloss), **as directed**.
 - c. Alkyd System: MPI INT 6.3B.
 - 1) Prime Coat: Interior alkyd primer/sealer.
 - 2) Intermediate Coat (for MPI Premium Grade system): Interior alkyd matching topcoat.
 - 3) Topcoat: Interior alkyd (eggshell) **OR** (semigloss) **OR** (gloss), **as directed**.
 - d. Institutional Low-Odor/VOC Latex System: MPI INT 6.3V.
 - 1) Prime Coat: Interior latex-based wood primer.
 - 2) Intermediate Coat (for MPI Premium Grade system): Institutional low-odor/VOC interior latex matching topcoat.
 - 3) Topcoat: Institutional low-odor/VOC interior latex (flat) **OR** (low sheen) **OR** (eggshell) **OR** (semigloss), **as directed**.
 - e. High-Performance Architectural Latex System: MPI INT 6.3A.
 - 1) Prime Coat: Interior latex-based wood primer.
 - 2) Intermediate Coat: High-performance architectural latex matching topcoat.
 - 3) Topcoat: High-performance architectural latex (low sheen) **OR** (eggshell) **OR** (satin) **OR** (semigloss), **as directed**.
10. Wood Panel Substrates: Including painted plywood, medium-density fiberboard, and hardboard.
 - a. Latex System: MPI INT 6.4R.
 - 1) Prime Coat: Interior latex-based wood primer.
 - 2) Intermediate Coat: Interior latex matching topcoat.
 - 3) Topcoat: Interior latex (semigloss) **OR** (gloss), **as directed**.
 - b. Latex Over Alkyd Primer System: MPI INT 6.4A.
 - 1) Prime Coat: Interior alkyd primer/sealer.
 - 2) Intermediate Coat (for MPI Premium Grade system): Interior latex matching topcoat.
 - 3) Topcoat: Interior latex (flat) **OR** (low sheen) **OR** (eggshell) **OR** (satin) **OR** (semigloss) **OR** (gloss), **as directed**.
 - c. Alkyd System: MPI INT 6.4B.
 - 1) Prime Coat: Interior alkyd primer/sealer.
 - 2) Intermediate Coat (for MPI Premium Grade system): Interior alkyd matching topcoat.
 - 3) Topcoat: Interior alkyd (flat) **OR** (eggshell) **OR** (semigloss) **OR** (gloss), **as directed**.
 - d. Institutional Low-Odor/VOC Latex System: MPI INT 6.4T.

- 1) Prime Coat: Interior latex-based wood primer.
- 2) Intermediate Coat : Institutional low-odor/VOC interior latex matching topcoat.
- 3) Topcoat: Institutional low-odor/VOC interior latex (flat) **OR** (low sheen) **OR** (eggshell) **OR** (semigloss), **as directed**.
- e. High-Performance Architectural Latex System: MPI INT 6.4S.
 - 1) Prime Coat: Interior latex-based wood primer.
 - 2) Intermediate Coat: High-performance architectural latex matching topcoat.
 - 3) Topcoat: High-performance architectural latex (low sheen) **OR** (eggshell) **OR** (satin) **OR** (semigloss), **as directed**.
11. Dimension Lumber Substrates, Nontraffic Surfaces: Including exposed joists and exposed beams.
 - a. Latex System: MPI INT 6.2D.
 - 1) Prime Coat: Interior latex-based wood primer.
 - 2) Intermediate Coat: Interior latex matching topcoat.
 - 3) Topcoat: Interior latex (flat) **OR** (low sheen) **OR** (eggshell) **OR** (satin) **OR** (semigloss) **OR** (gloss), **as directed**.
 - b. Latex Over Alkyd Primer System: MPI INT 6.2A.
 - 1) Prime Coat: Interior alkyd primer/sealer.
 - 2) Intermediate Coat : Interior latex matching topcoat.
 - 3) Topcoat: Interior latex (flat) **OR** (low sheen) **OR** (eggshell) **OR** (satin) **OR** (semigloss) **OR** (gloss), **as directed**.
 - c. Alkyd System: MPI INT 6.2C.
 - 1) Prime Coat: Interior alkyd primer/sealer.
 - 2) Intermediate Coat (for MPI Premium Grade system): Interior alkyd matching topcoat.
 - 3) Topcoat: Interior alkyd (flat) **OR** (eggshell) **OR** (semigloss) **OR** (gloss), **as directed**.
 - d. Institutional Low-Odor/VOC Latex System: MPI INT 6.2L.
 - 1) Prime Coat: Interior latex-based wood primer.
 - 2) Intermediate Coat (for MPI Premium Grade system): Institutional low-odor/VOC interior latex matching topcoat.
 - 3) Topcoat: Institutional low-odor/VOC interior latex (flat) **OR** (low sheen) **OR** (eggshell) **OR** (semigloss), **as directed**.
 - e. High-Performance Architectural Latex System: MPI INT 6.2B.
 - 1) Prime Coat: Interior alkyd primer/sealer.
 - 2) Intermediate Coat (for MPI Premium Grade system): High-performance architectural latex matching topcoat.
 - 3) Topcoat: High-performance architectural latex (low sheen) **OR** (eggshell) **OR** (satin) **OR** (semigloss), **as directed**.
12. Wood Substrates, Traffic Surfaces:
 - a. Latex Floor Paint System: MPI INT 6.5G.
 - 1) Prime Coat: Interior alkyd primer/sealer.
 - 2) Intermediate Coat: Interior/exterior latex floor and porch paint (low gloss).
 - 3) Topcoat: Interior/exterior latex floor and porch paint (low gloss).
 - b. Alkyd Floor Enamel System: MPI INT 6.5A.
 - 1) Prime Coat: Exterior/interior alkyd floor enamel (gloss).
 - 2) Intermediate Coat: Exterior/interior alkyd floor enamel (gloss).
 - 3) Topcoat: Exterior/interior alkyd floor enamel (gloss).
13. Gypsum Board Substrates:
 - a. Latex System: MPI INT 9.2A.
 - 1) Prime Coat: Interior latex primer/sealer (for MPI Premium Grade system) **OR** matching topcoat, **as directed**.
 - 2) Intermediate Coat (for MPI Premium Grade system): Interior latex matching topcoat.
 - 3) Topcoat: Interior latex (flat) **OR** (low sheen) **OR** (eggshell) **OR** (satin) **OR** (semigloss) **OR** (gloss), **as directed**.
 - b. Alkyd Over Latex Primer System: MPI INT 9.2C.
 - 1) Prime Coat: Interior latex primer/sealer.

- 2) Intermediate Coat (for MPI Premium Grade system): Interior alkyd matching topcoat.
- 3) Topcoat: Interior alkyd (flat) **OR** (eggshell) **OR** (semigloss) **OR** (gloss), **as directed**.
- c. Institutional Low-Odor/VOC Latex System: MPI INT 9.2M.
 - 1) Prime Coat: Interior latex primer/sealer.
 - 2) Intermediate Coat (for MPI Premium Grade system): Institutional low-odor/VOC interior latex matching topcoat.
 - 3) Topcoat: Institutional low-odor/VOC interior latex (flat) **OR** (low sheen) **OR** (eggshell) **OR** (semigloss), **as directed**.
- d. High-Performance Architectural Latex System: MPI INT 9.2B.
 - 1) Prime Coat: Interior latex primer/sealer.
 - 2) Intermediate Coat (for MPI Premium Grade system): High-performance architectural latex matching topcoat.
 - 3) Topcoat: High-performance architectural latex (low sheen) **OR** (eggshell) **OR** (satin) **OR** (semigloss), **as directed**.
14. Plaster Substrates:
 - a. Latex System: MPI INT 9.2A.
 - 1) Prime Coat: Interior latex primer/sealer (for MPI Premium Grade system) **OR** matching topcoat, **as directed**.
 - 2) Intermediate Coat (for MPI Premium Grade system): Interior latex matching topcoat.
 - 3) Topcoat: Interior latex (flat) **OR** (low sheen) **OR** (eggshell) **OR** (satin) **OR** (semigloss) **OR** (gloss), **as directed**.
 - b. Latex Over Alkyd Primer System: MPI INT 9.2K.
 - 1) Prime Coat: Interior alkyd primer/sealer.
 - 2) Intermediate Coat: Interior latex matching topcoat.
 - 3) Topcoat: Interior latex (flat) **OR** (low sheen) **OR** (eggshell) **OR** (satin) **OR** (semigloss) **OR** (gloss), **as directed**.
 - c. Alkyd Over Latex Primer System: MPI INT 9.2C.
 - 1) Prime Coat: Interior latex primer/sealer.
 - 2) Intermediate Coat (for MPI Premium Grade system): Interior alkyd matching topcoat.
 - 3) Topcoat: Interior alkyd (flat) **OR** (eggshell) **OR** (semigloss) **OR** (gloss), **as directed**.
 - d. Institutional Low-Odor/VOC Latex System: MPI INT 9.2M.
 - 1) Prime Coat: Interior latex primer/sealer.
 - 2) Intermediate Coat (for MPI Premium Grade system): Institutional low-odor/VOC interior latex matching topcoat.
 - 3) Topcoat: Institutional low-odor/VOC interior latex (flat) **OR** (low sheen) **OR** (eggshell) **OR** (semigloss), **as directed**.
 - e. High-Performance Architectural Latex System: MPI INT 9.2B.
 - 1) Prime Coat: Interior latex primer/sealer.
 - 2) Intermediate Coat (for MPI Premium Grade system): High-performance architectural latex matching topcoat.
 - 3) Topcoat: High-performance architectural latex (low sheen) **OR** (eggshell) **OR** (satin) **OR** (semigloss), **as directed**.
15. Spray-Textured Ceiling Substrates:
 - a. Latex (Flat) System: MPI INT 9.1A, spray applied.
 - 1) Prime Coat: Interior latex primer/sealer **OR** (flat), **as directed**.
 - 2) Topcoat: Interior latex (flat).
 - b. Latex System: MPI INT 9.1E, spray applied.
 - 1) Prime Coat: Interior latex matching topcoat.
 - 2) Intermediate Coat: Interior latex matching topcoat.
 - 3) Topcoat: Interior latex (flat) **OR** (low sheen) **OR** (eggshell) **OR** (satin) **OR** (semigloss), **as directed**.
 - c. Latex Over Alkyd Primer System: MPI INT 9.1B.
 - 1) Prime Coat: Interior alkyd primer/sealer.

- 2) Topcoat: Interior latex (flat) **OR** (low sheen) **OR** (eggshell) **OR** (satin) **OR** (semigloss) **OR** (gloss), **as directed**.
- d. Alkyd (Flat) System: MPI INT 9.1C.
 - 1) Prime Coat: Interior alkyd (flat).
 - 2) Topcoat: Interior alkyd (flat).
- e. Alkyd System: MPI INT 9.1D.
 - 1) Prime Coat: Interior alkyd primer/sealer.
 - 2) Intermediate Coat (for MPI Premium Grade system): Interior alkyd matching topcoat.
 - 3) Topcoat: Interior alkyd (eggshell) **OR** (semigloss) **OR** (gloss), **as directed**.
- 16. Cotton or Canvas Insulation-Covering Substrates: Including pipe and duct coverings.
 - a. Latex System: MPI INT 10.1A.
 - 1) Prime Coat: Interior latex primer/sealer (for MPI Premium Grade system) **OR** matching topcoat, **as directed**.
 - 2) Intermediate Coat (for MPI Premium Grade system): Interior latex matching topcoat.
 - 3) Topcoat: Interior latex (flat) **OR** (low sheen) **OR** (eggshell) **OR** (satin) **OR** (semigloss) **OR** (gloss), **as directed**.
 - b. Alkyd Over Latex Primer System: MPI INT 10.1B.
 - 1) Prime Coat: Interior latex primer/sealer.
 - 2) Intermediate Coat (for MPI Premium Grade system): Interior alkyd matching topcoat.
 - 3) Topcoat: Interior alkyd (flat) **OR** (eggshell) **OR** (semigloss) **OR** (gloss), **as directed**.
 - c. Aluminum Paint System: MPI INT 10.1C.
 - 1) Prime Coat: Interior latex primer/sealer.
 - 2) Intermediate Coat (for MPI Premium Grade system): Aluminum paint.
 - 3) Topcoat: Aluminum paint.
 - d. Institutional Low-Odor/VOC Latex System: MPI INT 10.1D.
 - 1) Prime Coat: Interior latex primer/sealer.
 - 2) Intermediate Coat (for MPI Premium Grade system): Institutional low-odor/VOC interior latex matching topcoat.
 - 3) Topcoat: Institutional low-odor/VOC interior latex (flat) **OR** (low sheen) **OR** (eggshell) **OR** (semigloss), **as directed**.

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SECTION 09 91 23 00a - MULTICOLORED INTERIOR COATINGS

1.1 GENERAL

A. Description Of Work

1. This specification covers the furnishing and installation of materials for multicolored interior coatings. Products shall be as follows or as directed by the Owner. Installation procedures shall be in accordance with the product manufacturer's recommendations. Demolition and removal of materials shall be as required to support the work.

B. Summary

1. This Section includes surface preparation and field application of multicolor interior coating systems applied on the following substrates:
 - a. Vertical concrete.
 - b. Cementitious composition board.
 - c. Clay masonry units.
 - d. Concrete masonry units (CMU).
 - e. Wood.
 - f. Fiberglass moldings and trim.
 - g. Plastic moldings and trim.
 - h. Plaster, Gypsum veneer plaster, and Gypsum board.

C. Submittals

1. Product Data: For each type of product indicated.
2. Samples: For each finish-coat product and for each color and texture required.
3. LEED Submittal:
 - a. Product Data for Credit EQ 4.2: For coatings, including printed statement of VOC content and chemical components.

D. Quality Assurance

1. Fire-Test-Response Characteristics: Provide coatings with flame-spread and smoked-developed indexes of 25 or less and 450 or less, respectively, as determined by testing identical products per ASTM E 84 by testing and inspecting agency acceptable to authorities having jurisdiction.
2. Master Painters Institute (MPI) Standards: Comply with recommendations in "MPI Architectural Painting Specification Manual" **OR** "MPI Maintenance Repainting Manual," **as directed**, applicable to products and coating systems indicated.
3. Mockups: Apply mockup of each coating system indicated to verify preliminary selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for materials and execution.
 - a. Architect will select one surface to represent surfaces and conditions for application of each coating system and type of substrate.
 - 1) Wall Surfaces: Provide samples of at least **100 sq. ft. (9 sq. m)**.
 - 2) Other Items: Architect will designate items or areas required.
 - b. Apply mockup after permanent lighting and other environmental services have been activated.
 - c. Final approval of color and pattern selections will be based on mockup.
 - 1) If preliminary color and pattern selections are not approved, apply additional mockups of colors and patterns selected by Architect at no added cost to Owner.
 - d. Repair Mockup: After approval of color and pattern selections, apply representative repairs to **100 sq. in. (65 sq. cm)** of mockup to establish quality standards for coating system repairs.
 - e. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.

- f. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

E. Delivery, Storage, And Handling

1. Store materials not in use in tightly covered containers in well-ventilated areas with ambient temperatures continuously maintained at not less than 45 deg F (7 deg C).
 - a. Maintain containers in clean condition, free of foreign materials and residue.
 - b. Remove rags and waste from storage areas daily.

1.2 PRODUCTS

A. Multicolor Coating Systems, General

1. Material Compatibility: Provide materials for use within each coating system that are compatible with one another and substrates indicated under conditions of service and application, as demonstrated by manufacturer based on testing and field experience.
2. VOC Content of Interior Paints and Coatings: Provide products that comply with the following limits for VOC content when calculated according to 40 CFR 59, Subpart D (EPA Method 24):
 - a. Flat Paints, Coatings, and Primers: VOC content of not more than 50 g/L.
 - b. Nonflat Paints, Coatings, and Primers: VOC content of not more than 150 g/L.
 - c. Clear Wood Finishes, Varnishes: VOC not more than 350 g/L.
 - d. Shellacs, Clear: VOC not more than 730 g/L.
 - e. Shellacs, Pigmented: VOC not more than 550 g/L.
 - f. Flat Topcoat Paints: VOC content of not more than 50 g/L.
 - g. Nonflat Topcoat Paints: VOC content of not more than 150 g/L.
 - h. Clear Wood Finishes, Varnishes: VOC not more than 350 g/L.
 - i. Shellacs, Clear: VOC not more than 730 g/L.
 - j. Shellacs, Pigmented: VOC not more than 550 g/L.
 - k. Primers, Sealers, and Undercoaters: VOC content of not more than 200 g/L.
3. Chemical Components of Interior Paints and Coatings: Provide topcoat paints that comply with the following chemical restrictions; these requirements do not apply to paints and coatings that are applied in a fabrication or finishing shop:
 - a. Aromatic Compounds: Paints and coatings shall not contain more than 1.0 percent by weight of total aromatic compounds (hydrocarbon compounds containing 1 or more benzene rings).
 - b. Restricted Components: Paints and coatings shall not contain any of the following:
 - 1) Acrolein.
 - 2) Acrylonitrile.
 - 3) Antimony.
 - 4) Benzene.
 - 5) Butyl benzyl phthalate.
 - 6) Cadmium.
 - 7) Di (2-ethylhexyl) phthalate.
 - 8) Di-n-butyl phthalate.
 - 9) Di-n-octyl phthalate.
 - 10) 1,2-dichlorobenzene.
 - 11) Diethyl phthalate.
 - 12) Dimethyl phthalate.
 - 13) Ethylbenzene.
 - 14) Formaldehyde.
 - 15) Hexavalent chromium.
 - 16) Isophorone.
 - 17) Lead.
 - 18) Mercury.
 - 19) Methyl ethyl ketone.

- 20) Methyl isobutyl ketone.
 - 21) Methylene chloride.
 - 22) Naphthalene.
 - 23) Toluene (methylbenzene).
 - 24) 1,1,1-trichloroethane.
 - 25) Vinyl chloride.
4. Colors and Patterns: Match samples **OR** As selected from manufacturer's full range **OR** As indicated in color schedule, **as directed**.
- B. Fillers And Primers
1. General: Undercoatings recommended in writing for use in coating systems by manufacturer of multicolor interior coating on substrates and under conditions indicated.
 2. Latex Block Filler: Waterborne, high-solids, emulsion-type, pigmented coating product recommended in writing for use in coating system indicated by manufacturer of multicolor interior coating, with bridging and filling properties, and formulated for filling surfaces of CMU for subsequent applications of finish coatings.
 - a. VOC Content: Minimum E Range of E2 **OR** E3, **as directed**, according to requirements for MPI #4.
 3. Wood Filler Paste: Solvent-based, high-solids, clear paste product recommended in writing for use in coating system indicated by manufacturer of multicolor interior coating, for use on open-grained or damaged woods and that fills hardwood pores with minimal surface residues and without showing cracking or shrinkage. When dry, sanding filler produces a smooth surface without clogging or gumming sandpaper.
 - a. VOC Content: Minimum E Range of E1 **OR** E2 **OR** E3, **as directed**, according to requirements for MPI #91.
 4. Wood-Knot Sealer: White shellac or other sealer recommended in writing for this purpose by manufacturer of multicolor interior coating.
 5. Primer/Sealer for Multicolor Systems: Acrylic or acrylic/polyvinyl acetate (PVA) co-polymer emulsion-type, pigmented primer/sealer product recommended in writing for use in coating system indicated by manufacturer of multicolor interior coating.
 - a. VOC Content: Minimum E Range of E2 **OR** E3, **as directed**, according to requirements for MPI #125.
 6. Interior Alkyd Primer/Sealer: Solvent-based, pigmented primer/sealer.
 - a. VOC Content: Minimum E Range of E1 **OR** E2, **as directed**, according to requirements for MPI #45.
 7. Water-Based Bonding Primer: Water-based, emulsion-type, pigmented primer product recommended in writing for use in coating system indicated by manufacturer of multicolor interior coating, and formulated to promote adhesion of subsequent coatings.
 - a. VOC Content: Minimum E Range of E1 **OR** E2 **OR** E3, **as directed**, according to requirements for MPI #17.
 8. Solvent-Based Bonding Primer: Solvent-based, pigmented product recommended in writing for use in coating system indicated by manufacturer of multicolor interior coating, and formulated to promote adhesion of subsequent coatings to substrate.
 - a. VOC Content: Minimum E Range of E1 **OR** E2 **OR** E3, **as directed**, according to requirements for MPI #69.
- C. Multicolor Coatings
1. Multicolor Coatings: Complying with MPI #112 and listed in "MPI Approved Products List."
 - a. VOC Content: Minimum E Range of E1 **OR** E3, **as directed**.
 2. Clear Topcoat: Product of multicolor coating manufacturer complying with MPI #121 and listed in "MPI Approved Products List."
 - a. VOC Content: Minimum E Range of E1 **OR** E2, **as directed**.

1.3 EXECUTION

A. Preparation

1. Comply with manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual" applicable to substrates indicated.
2. Remove plates, machined surfaces, and similar items already in place that are not to be coated. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and coating.
 - a. After completing coating operations, reinstall items that were removed; use workers skilled in the trades involved.
3. Clean substrates of substances that could impair bond of coatings, including dirt, oil, grease, and incompatible primers, paints, and encapsulants.
4. Concrete Substrates: Remove release agents, curing compounds, efflorescence, and chalk. Do not coat surfaces if moisture content or alkalinity of surfaces to be coated exceeds that permitted in manufacturer's written instructions.
5. Clay Masonry Substrates: Remove efflorescence and chalk. Do not coat surfaces if moisture content or alkalinity of surfaces to be coated exceeds that permitted in manufacturer's written instructions.
6. Concrete Masonry Substrates: Remove efflorescence and chalk. Do not coat surfaces if moisture content or alkalinity of surfaces to be coated exceeds that permitted in manufacturer's written instructions.
7. Wood Substrates:
 - a. Scrape and clean small, dry, seasoned knots, and apply a thin coat of knot sealer before applying primer.
 - b. Sand surfaces that will be exposed to view and dust off.
 - c. Prime edges, ends, faces, undersides, and back sides of wood.
 - d. After priming, fill holes and imperfections in the finish surfaces with putty or plastic wood filler. Sand smooth when dried.

B. Application

1. Apply coatings according to manufacturer's written instructions using applicators and techniques suited for coating and substrate indicated.
2. Coat surfaces behind movable equipment and furniture same as similar exposed surfaces. Before final installation, coat surfaces behind permanently fixed equipment or furniture with prime coat only.
3. Coat back sides of access panels, removable or hinged covers, and similar hinged items to match exposed surfaces.
4. Apply coating systems to produce uniformly textured, colored, and patterned finished-surface films without substrates, undercoats, marks, or stains showing through. Produce sharp, even glass lines and color breaks.

C. Cleaning And Protection

1. At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.
2. After completing coating application, clean spattered surfaces. Remove spattered coatings by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.
3. Protect work of other trades against damage from coating operation. Correct damage by cleaning, repairing, replacing, and recoating, as approved by the Owner, and leave in an undamaged condition.
4. At completion of construction activities of other trades, touch up and restore damaged or defaced coated surfaces.

D. Multicolor Interior Coating Schedule

1. Vertical Concrete Substrates: System below corresponds to MPI INT 3.1H
 - a. Prime Coat: Primer/sealer for multicolor systems.

- b. Multicolor Base Coat: Multicolor coating, MPI #112.
 - c. Multicolor Pattern Coat: Multicolor coating, MPI #112.
 - d. Topcoat (for a Premium Grade system): Clear topcoat, MPI #121.
2. Cementitious Composition Board Substrates: System below corresponds to MPI INT 3.3F
 - a. Prime Coat: Primer/sealer for multicolor systems.
 - b. Multicolor Base Coat: Multicolor coating, MPI #112.
 - c. Multicolor Pattern Coat: Multicolor coating, MPI #112.
 - d. Topcoat (for a Premium Grade system): Clear topcoat, MPI #121.
3. Clay Masonry Units Substrates: System below corresponds to MPI INT 4.1H
 - a. Prime Coat: Primer/sealer for multicolor systems tinted to match multicolor basecoat.
 - b. Multicolor Base Coat: Multicolor coating, MPI #112.
 - c. Multicolor Pattern Coat: Multicolor coating, MPI #112.
 - d. Topcoat (for a Premium Grade system): Clear topcoat, MPI #121.
4. CMU Substrates: System below corresponds to MPI INT 4.2H
 - a. Block Filler: Latex block filler.
 - b. Prime Coat: Primer/sealer for multicolor systems.
 - c. Multicolor Base Coat: Multicolor coating, MPI #112.
 - d. Multicolor Pattern Coat: Multicolor coating, MPI #112.
 - e. Topcoat (for a Premium Grade system): Clear topcoat, MPI #121.
5. Wood Substrates: System below corresponds to MPI INT 6.2E, MPI INT 6.3N, and MPI INT 6.4L
 - a. Fill Coat: Wood filler paste (Fill coat is optional component and is for use on open-grained woods where a smooth, glasslike finish is desired).
 - b. Prime Coat: Interior alkyd primer/sealer tinted to match multicolor base coat {for dressed lumber (finished carpentry)}.
 - c. Multicolor Base Coat: Multicolor coating, MPI #112.
 - d. Multicolor Pattern Coat: Multicolor coating, MPI #112.
 - e. Topcoat (for a Premium Grade system): Clear topcoat, MPI #121.
6. Fiberglass Molding and Trim Substrates: System below corresponds to MPI INT 6.7G
 - a. Prime Coat: Water-based **OR** Solvent-based, **as directed**, bonding primer.
 - b. Multicolor Base Coat: Multicolor coating, MPI #112.
 - c. Multicolor Pattern Coat: Multicolor coating, MPI #112.
 - d. Topcoat (for a Premium Grade system): Clear topcoat, MPI #121.
7. Plastic Molding and Trim Substrates: System below corresponds to MPI INT 6.8D
 - a. Prime Coat: Solvent-based bonding primer.
 - b. Multicolor Base Coat: Multicolor coating, MPI #112.
 - c. Multicolor Pattern Coat: Multicolor coating, MPI #112.
 - d. Topcoat (for a Premium Grade system): Clear topcoat, MPI #121.
8. Plaster **OR** Gypsum Veneer Plaster **OR** Gypsum Board, **as directed**, Substrates: System below corresponds to MPI INT 9.2G
 - a. Prime Coat: Primer/sealer for multicolor systems.
 - b. Multicolor Base Coat: Multicolor coating, MPI #112.
 - c. Multicolor Pattern Coat: Multicolor coating, MPI #112.
 - d. Topcoat (for a Premium Grade system): Clear topcoat, MPI #121.

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Task	Specification	Specification Description
09 91 23 00	09 91 13 00	Exterior Painting
09 91 33 00	09 91 13 00a	Wood Stains and Transparent Finishes
09 91 33 00	09 91 13 00b	High-Temperature-Resistant Coatings

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SECTION 09 93 23 13 - FLOOR TREATMENT REFINISHING WOOD FLOORS

1.1 GENERAL

A. Description Of Work

1. This specification covers the furnishing and installation of materials for refinishing wood floors. Products shall match existing materials and/or shall be as follows or as directed by the Owner. Installation procedures shall be in accordance with the product manufacturer's recommendations. Demolition and removal of materials shall be as required to support the work.

B. Submittals

1. Product Data: For each type of product indicated.

C. Quality Assurance

1. Build mockup of typical flooring area as shown on Drawings including base and shoe moldings.
 - a. To set quality standards for sanding and application of field finishes, prepare finish mockup of floor area as shown on Drawings.
 - b. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
 - c. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.2 PRODUCTS

- A. Cleaning Compound: A liquid chemical cleaner containing non-ionic and anionic type detergents, non-reactive to wood flooring. Compound shall have no free metal alkalies, no artificial coloring and no fatty acids. Compound shall be UL listed as "slip-resistant."
- B. Varnish Remover: Non-flammable paint and varnish remover.
- C. Stain: Penetrating type non-fading wood stain.
- D. Wood Filler: Paste type wood filler, pigmented if necessary to match sample, complying with Fed. Spec. TT-F-336.
- E. Floor Sealer: Penetrating type, pliable, wood-hardening finish/sealer.
- F. Floor Varnish: Alkyd resin varnish, specially compounded for floor finish, Fed. Spec. TT-V-109.
- G. Urethane Finish: Specially compounded for wood floor finish, moisture curing type, for multiple-coat application.
- H. Floor Wax: Liquid, solvent-type, slip-resistant, CID A-A-1550, Type II.

1.3 EXECUTION

A. Preparation:

1. Cleaning: Scrub thoroughly with cleaning compound and warm water. Rinse with clean water, mop dry, and buff with polishing machine.
2. Varnish Removal: Apply paint and varnish remover as required.

3. Sanding: Traverse floors two times with an electric-powered sanding machine. A rotary disc sander may be used for the final cut, but first cut shall be made with a drum-type machine. The first cut may be made crosswise of the grain or at a 45-degree angle. Make second cut in direction of grain. Use No. 1/2 sandpaper for first traverse and No. 0 for second traverse. Use an electric edger or hand sander for sanding areas near walls, in corners, and small closets.

B. Installation:

1. Apply Wood Paste Filler, followed by wiping cross-grain to work into pores and cracks.
2. Apply Stain if needed to match selected finish.
3. Apply Sealer (2 coats) complying with Fed. Spec. TT-S-176. Use Class I for white oak and red oak floors and Class II for beech, birch, and hard maple floors.
4. Apply Floor Varnish, (3 coats) buffing after each coat. First coat may be thinned as a sealer.
5. Apply Urethane Finish. Apply as many coats as needed to build a dry film thickness of 1.0 mil.
6. When Floors are Dry, apply two coats of wax complying with Fed. Spec. P-W-155; concentration 12 percent. Spread the wax at the rate of 1,500 square feet per gallon and polish the floors with a weighted floor brush or an electric polisher.
7. Protection: Upon completion of work, cover all traffic areas immediately with nonstaining kraft paper or polyethylene, taped along edges, and maintain floor protection until acceptance.

END OF SECTION 09 93 23 13



Task	Specification	Specification Description
09 93 23 13	09 91 13 00a	Wood Stains and Transparent Finishes
09 93 23 53	09 93 23 13	Floor Treatment Refinishing Wood Floors
09 93 23 53	09 91 13 00a	Wood Stains and Transparent Finishes

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SECTION 09 96 00 00 - HIGH-PERFORMANCE COATINGS

1.1 GENERAL

A. Description Of Work

1. This specification covers the furnishing and installation of materials for high performance coatings. Products shall be as follows or as directed by the Owner. Installation procedures shall be in accordance with the product manufacturer's recommendations. Demolition and removal of materials shall be as required to support the work.

B. Summary

1. This Section includes surface preparation and application of high-performance coating systems on the following substrates:
 - a. Exterior Substrates:
 - 1) Concrete, vertical and horizontal surfaces.
 - 2) Clay masonry.
 - 3) Concrete masonry units (CMU).
 - 4) Steel.
 - 5) Galvanized metal.
 - 6) Aluminum (not anodized or otherwise coated).
 - 7) Wood.
 - b. Interior Substrates:
 - 1) Concrete, vertical and horizontal surfaces.
 - 2) Clay masonry.
 - 3) Concrete masonry units (CMU).
 - 4) Steel.
 - 5) Galvanized metal.
 - 6) Aluminum (not anodized or otherwise coated).
 - 7) Wood.
 - 8) Gypsum board.

C. Submittals

1. Product Data: For each type of product indicated.
2. Samples: For each type of finish-coat product indicated.
3. Product List: For each product indicated. Cross-reference products to coating system and locations of application areas. Use same designations indicated on Drawings and in schedules.
4. LEED Submittals:
 - a. Product Data for Credit EQ 4.2: For coatings, including printed statement of VOC content and chemical components.

D. Quality Assurance

1. Master Painters Institute (MPI) Standards:
 - a. Products: Complying with MPI standards indicated and listed in "MPI Approved Products List."
 - b. Preparation and Workmanship: Comply with requirements in "MPI Architectural Painting Specification Manual" **OR** "MPI Maintenance Repainting Manual," **as directed**, for products and coating systems indicated.
2. Mockups: Apply mockups of each coating system indicated to verify preliminary selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
 - a. Architect will select one surface to represent surfaces and conditions for application of each coating system specified in Part 3.
 - 1) Wall and Ceiling Surfaces: Provide samples of at least **100 sq. ft. (9 sq. m).**
 - 2) Other Items: Architect will designate items or areas required.

- b. Final approval of color selections will be based on mockups.
 - 1) If preliminary color selections are not approved, apply additional mockups of additional colors selected by Architect at no added cost to Owner.
- c. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
- d. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

E. Delivery, Storage, And Handling

- 1. Store materials not in use in tightly covered containers in well-ventilated areas with ambient temperatures continuously maintained at not less than 45 deg F (7 deg C).
 - a. Maintain containers in clean condition, free of foreign materials and residue.
 - b. Remove rags and waste from storage areas daily.

F. Project Conditions

- 1. Apply coatings only when temperature of surfaces to be coated and surrounding air temperatures are between 50 and 95 deg F (10 and 35 deg C).
- 2. Do not apply coatings in snow, rain, fog, or mist; when relative humidity exceeds 85 percent; at temperatures less than 5 deg F (3 deg C) above the dew point; or to damp or wet surfaces.

1.2 PRODUCTS

A. High-Performance Coatings, General

- 1. Material Compatibility:
 - a. Provide materials for use within each coating system that are compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
 - b. Provide products of same manufacturer for each coat in a coating system.
- 2. VOC Content of Field-Applied Interior Paints and Coatings: Provide products that comply with the following limits for VOC content when calculated according to 40 CFR 59, Subpart D (EPA Method 24):
 - a. Flat Paints, Coatings, and Primers: VOC content of not more than 50 g/L.
 - b. Nonflat Paints, Coatings, and Primers: VOC content of not more than 150 g/L.
 - c. Anticorrosive and Anti-Rust Paints Applied to Ferrous Metals: VOC content of not more than 250 g/L.
 - d. Clear Wood Finishes, Varnishes: VOC not more than 350 g/L.
 - e. Clear Wood Finishes, Lacquers: VOC not more than 550 g/L.
 - f. Floor Coatings: VOC not more than 100 g/L.
 - g. Shellacs, Clear: VOC not more than 730 g/L.
 - h. Shellacs, Pigmented: VOC not more than 550 g/L.
 - i. Stains: VOC content of not more than 250 g/L.
 - j. Flat Interior Topcoat Paints: VOC content of not more than 50 g/L.
 - k. Nonflat Interior Topcoat Paints: VOC content of not more than 150 g/L.
 - l. Anti-Corrosive and Anti-Rust Paints Applied to Ferrous Metals: VOC not more than 250 g/L.
 - m. Clear Wood Finishes, Varnishes: VOC not more than 350 g/L.
 - n. Clear Wood Finishes, Lacquers: VOC not more than 550 g/L.
 - o. Floor Coatings: VOC not more than 100 g/L.
 - p. Shellacs, Clear: VOC not more than 730 g/L.
 - q. Shellacs, Pigmented: VOC not more than 550 g/L.
 - r. Stains: VOC not more than 250 g/L.
 - s. Primers, Sealers, and Undercoaters: VOC content of not more than 200 g/L.
 - t. Zinc-Rich Industrial Maintenance Primers: VOC content of not more than 340 g/L.

- u. Pre-Treatment Wash Primers: VOC content of not more than 420 g/L.
 3. Chemical Components of Field-Applied Interior Paints and Coatings: Provide topcoat paints and anti-corrosive and anti-rust paints applied to ferrous metals that comply with the following chemical restrictions; these requirements do not apply to paints and coatings that are applied in a fabrication or finishing shop:
 - a. Aromatic Compounds: Paints and coatings shall not contain more than 1.0 percent by weight of total aromatic compounds (hydrocarbon compounds containing 1 or more benzene rings).
 - b. Restricted Components: Paints and coatings shall not contain any of the following:
 - 1) Acrolein.
 - 2) Acrylonitrile.
 - 3) Antimony.
 - 4) Benzene.
 - 5) Butyl benzyl phthalate.
 - 6) Cadmium.
 - 7) Di (2-ethylhexyl) phthalate.
 - 8) Di-n-butyl phthalate.
 - 9) Di-n-octyl phthalate.
 - 10) 1,2-dichlorobenzene.
 - 11) Diethyl phthalate.
 - 12) Dimethyl phthalate.
 - 13) Ethylbenzene.
 - 14) Formaldehyde.
 - 15) Hexavalent chromium.
 - 16) Isophorone.
 - 17) Lead.
 - 18) Mercury.
 - 19) Methyl ethyl ketone.
 - 20) Methyl isobutyl ketone.
 - 21) Methylene chloride.
 - 22) Naphthalene.
 - 23) Toluene (methylbenzene).
 - 24) 1,1,1-trichloroethane.
 - 25) Vinyl chloride.
 4. Colors: As selected from manufacturer's full range **OR** Match samples **OR** As indicated in color schedule, **as directed**.
- B. Block Fillers
1. Interior/Exterior Latex Block Filler: MPI#4.
 - a. VOC Content: Minimum E Range of E2 **OR** E3, **as directed**.
 2. Epoxy Block Filler: MPI #116.
 - a. VOC Content: Minimum E Range of E1 **OR** E2 **OR** E3, **as directed**.
- C. Interior Primers/Sealers
1. Interior Latex Primer/Sealer: MPI #50.
 - a. Environmental Characteristics:
 - 1) VOC Content:
 - a) Minimum E Range of E2 **OR** E3, **as directed**.
 - b) Meets or exceeds LEED requirements for VOC content.
 - 2) Environmental Performance Rating (EPR): Minimum EPR 2 **OR** 3, **as directed**.
 2. Interior Alkyd Primer/Sealer: MPI #45.
 - a. VOC Content: Minimum E Range of E1 **OR** E2, **as directed**.
 3. Interior Latex-Based Wood Primer: MPI #39.
 - a. Environmental Characteristics:
 - 1) VOC Content:
 - a) Minimum E Range of E1 **OR** E2 **OR** E3, **as directed**.

- b) Meets or exceeds LEED requirements for VOC content.
 - 2) Environmental Performance Rating (EPR): Minimum EPR 1 **OR 2 OR 3, as directed.**
- 4. Wood-Knot Sealer: White shellac or other sealer recommended in writing by manufacturer for this purpose.

D. Metal Primers

- 1. Inorganic Zinc Primer: MPI #19.
 - a. VOC Content: Minimum E Range of 0 **OR E1 OR E2 OR E3, as directed.**
- 2. Epoxy Zinc Primer: MPI #20.
 - a. VOC Content: Minimum E Range of E1 **OR E2 OR E3, as directed.**
- 3. Rust-Inhibitive Primer (Water Based): MPI #107.
 - a. Environmental Characteristics:
 - 1) VOC Content:
 - a) Minimum E Range of E1 **OR E2 OR E3, as directed.**
 - b) Meets or exceeds LEED requirements for VOC content.
 - 2) Environmental Performance Rating (EPR): Minimum EPR 1 **OR 2 OR 3, as directed.**
- 4. Cold-Curing Epoxy Primer: MPI #101.
 - a. VOC Content: Minimum E Range of E1 **OR E3, as directed.**
- 5. Alkyd Anticorrosive Metal Primer: MPI #79.
 - a. VOC Content: Minimum E Range of E1 **OR E2, as directed.**
- 6. Quick-Dry Alkyd Metal Primer: MPI #76.
 - a. VOC Content: Minimum E Range of E1 **OR E2 OR E3, as directed.**
- 7. Cementitious Galvanized-Metal Primer: MPI #26.
 - a. VOC Content: Minimum E Range of E1 **OR E2 OR E3, as directed.**
- 8. Waterborne Galvanized-Metal Primer: MPI #134.
 - a. Environmental Characteristics:
 - 1) VOC Content:
 - a) Minimum E Range of E1 **OR E2 OR E3, as directed.**
 - b) Meets or exceeds LEED requirements for VOC content.
 - 2) Environmental Performance Rating (EPR): Minimum EPR 1 **OR 2 OR 3, as directed.**
- 9. Quick-Drying Primer for Aluminum: MPI #95.
 - a. VOC Content: Minimum E Range of E1 **OR E2 OR E3, as directed.**
- 10. Vinyl Wash Primer: MPI #80.
 - a. VOC Content: Minimum E Range of E2 **OR E3, as directed.**

E. Water-Based, Light-Industrial Coatings

- 1. Gloss, Water-Based, Light-Industrial Coating: MPI #110-G6.
 - a. Environmental Characteristics:
 - 1) VOC Content: Minimum E Range of E2.
 - 2) Environmental Performance Rating (EPR): Minimum EPR 2.
- 2. Semigloss, Water-Based, Light-Industrial Coating: MPI #110-G5.
 - a. Environmental Characteristics:
 - 1) VOC Content:
 - a) Minimum E Range of E2 **OR E3, as directed.**
 - b) Meets or exceeds LEED requirements for VOC content.
 - 2) Environmental Performance Rating (EPR): Minimum EPR 2 **OR 3, as directed.**
- 3. Eggshell, Water-Based, Light-Industrial Coating: MPI #110-G3.
 - a. Environmental Characteristics:
 - 1) VOC Content:
 - a) Minimum E Range of E2 **OR E3, as directed.**
 - b) Meets or exceeds LEED requirements for VOC content.
 - 2) Environmental Performance Rating (EPR): Minimum EPR 2 **OR 3, as directed.**

F. Epoxy Coatings

1. Epoxy, Cold-Cured, Gloss: MPI #77.
 - a. VOC Content: Minimum E Range of E1 **OR** E2 **OR** E3, **as directed**.
2. Water-Based Epoxy (Interior and Exterior): MPI #115.
 - a. VOC Content: Minimum E Range of E1 **OR** E2 **OR** E3, **as directed**.
3. High-Build Epoxy Marine Coating, Low Gloss: MPI #108.
 - a. VOC Content: Minimum E Range of E1 **OR** E2 **OR** E3, **as directed**.
4. Epoxy Deck Coating: MPI #82.
 - a. VOC Content: Minimum E Range of E1 **OR** E2 **OR** E3, **as directed**.
5. Water-Based Epoxy Floor Paint: MPI #93.
 - a. Environmental Characteristics:
 - 1) VOC Content:
 - a) Minimum E Range of E1 **OR** E2 **OR** E3, **as directed**.
 - b) Meets or exceeds LEED requirements for VOC content.
 - 2) Environmental Performance Rating (EPR): Minimum EPR 1 **OR** 2 **OR** 3, **as directed**.

G. Polyurethane Coatings

1. Polyurethane, Two-Component, Pigmented, Gloss: MPI #72.
 - a. VOC Content: Minimum E Range of E1 **OR** E2 **OR** E3, **as directed**.
2. Two-Component, Aliphatic Polyurethane, Clear: MPI #78.
 - a. VOC Content: Minimum E Range of E1 **OR** E2 **OR** E3, **as directed**.
3. Polyurethane, Moisture Cured, Clear, Gloss: MPI #31.
 - a. VOC Content: Minimum E Range of E1 **OR** E2 **OR** E3, **as directed**.
4. Polyurethane, Moisture Cured, Clear, Flat: MPI #71.
 - a. VOC Content: Minimum E Range of E2.

H. Interior High-Performance Architectural Latex Coatings

1. High-Performance Architectural Latex, Velvet Finish: MPI #138, Gloss Level 2.
 - a. Environmental Characteristics:
 - 1) VOC Content:
 - a) Minimum E Range of E1 **OR** E2 **OR** E3, **as directed**.
 - b) Meets or exceeds LEED requirements for VOC content.
 - 2) Environmental Performance Rating (EPR): Minimum EPR 4 **OR** 5 **OR** 6, **as directed**.
2. High-Performance Architectural Latex, Eggshell Finish: MPI #139, Gloss Level 3.
 - a. Environmental Characteristics:
 - 1) VOC Content:
 - a) Minimum E Range of E2 **OR** E3, **as directed**.
 - b) Meets or exceeds LEED requirements for VOC content.
 - 2) Environmental Performance Rating (EPR): Minimum EPR 5 **OR** 6, **as directed**.
3. High-Performance Architectural Latex, Satin Finish: MPI #140, Gloss Level 4.
 - a. Environmental Characteristics:
 - 1) VOC Content:
 - a) Minimum E Range of E1 **OR** E3, **as directed**.
 - b) Meets or exceeds LEED requirements for VOC content.
 - 2) Environmental Performance Rating (EPR): Minimum EPR 4.5 **OR** 6.5, **as directed**.
4. High-Performance Architectural Latex, Semigloss Finish: MPI #141, Gloss Level 5.
 - a. Environmental Characteristics:
 - 1) VOC Content:
 - a) Minimum E Range of E1 **OR** E2 **OR** E3, **as directed**.
 - b) Meets or exceeds LEED requirements for VOC content.
 - 2) Environmental Performance Rating (EPR): Minimum EPR 5 **OR** 6 **OR** 7, **as directed**.

I. Wood Stains

1. Exterior Semitransparent Stain (Solvent Based): MPI #13.
 - a. VOC Content: Minimum E Range of E1 **OR** E2, **as directed**.
2. Interior Wood Stain, Semitransparent (Solvent Based): MPI #90.
 - a. VOC Content: Minimum E Range of E1 **OR** E2, **as directed**.

1.3 EXECUTION

A. Preparation

1. Comply with manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual" applicable to substrates indicated.
2. Remove plates, machined surfaces, and similar items already in place that are not to be coated. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and coating.
 - a. After completing coating operations, reinstall items that were removed; use workers skilled in the trades involved.
3. Clean substrates of substances that could impair bond of coatings, including dirt, oil, grease, and incompatible paints and encapsulants.
 - a. Remove incompatible primers and reprime substrate with compatible primers as required to produce coating systems indicated.
4. Concrete Substrates: Remove release agents, curing compounds, efflorescence, and chalk. Do not coat surfaces if moisture content or alkalinity of surfaces to be coated exceeds that permitted in manufacturer's written instructions.
 - a. Clean surfaces with pressurized water. Use pressure range of **1500 to 4000 psi (10 350 to 27 580 kPa)** at **6 to 12 inches (150 to 300 mm)** **OR 4000 to 10,000 psi (27 580 to 68 950 kPa)**, **as directed**.
OR
Abrasive blast clean surfaces to comply with SSPC-SP 7/NACE No. 4, "Brush-Off Blast Cleaning."
5. Clay Masonry Substrates: Remove efflorescence and chalk. Do not coat surfaces if moisture content or alkalinity of surfaces to be coated exceeds that permitted in manufacturer's written instructions.
 - a. Clean surfaces with pressurized water. Use pressure range of **100 to 600 psi (690 to 4140 kPa)** **OR 1500 to 4000 psi (10 350 to 27 580 kPa)**, **as directed**, at **6 to 12 inches (150 to 300 mm)**.
6. CMU Substrates: Remove efflorescence and chalk. Do not coat surfaces if moisture content or alkalinity of surfaces to be coated exceeds that permitted in manufacturer's written instructions.
7. Steel Substrates (for field applied primers): Remove rust and loose mill scale.
 - a. Clean using methods recommended in writing by coating manufacturer.

Blast clean according to SSPC-SP 5/NACE No. 1, "White Metal Blast Cleaning **OR** SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning **OR** SSPC-SP 7/NACE No. 4, "Brush-Off Blast Cleaning **OR** SSPC-SP 10/NACE No. 2, "Near-White Blast Cleaning," **as directed**.
8. Galvanized-Metal Substrates: Remove grease and oil residue from galvanized sheet metal fabricated from coil stock by mechanical methods to produce clean, lightly etched surfaces that promote adhesion of subsequently applied coatings.
9. Aluminum Substrates: Remove surface oxidation.
10. Wood Substrates:
 - a. Scrape and clean small, dry, seasoned knots, and apply a thin coat of knot sealer before applying primer.
 - b. Sand surfaces that will be exposed to view and dust off.
 - c. Prime edges, ends, faces, undersides, and back sides of wood.
 - d. After priming, fill holes and imperfections in the finish surfaces with putty or plastic wood filler. Sand smooth when dried.

B. Application

1. Apply high-performance coatings according to manufacturer's written instructions.
 - a. Use applicators and techniques suited for coating and substrate indicated.
 - b. Coat surfaces behind movable equipment and furniture same as similar exposed surfaces. Before final installation, coat surfaces behind permanently fixed equipment or furniture with prime coat only.
 - c. Coat back sides of access panels, removable or hinged covers, and similar hinged items to match exposed surfaces.
2. Tint each undercoat a lighter shade to facilitate identification of each coat if multiple coats of the same material are to be applied. Tint undercoats to match color of finish coat, but provide sufficient difference in shade of undercoats to distinguish each separate coat.
3. If undercoats or other conditions show through final coat, apply additional coats until cured film has a uniform coating finish, color, and appearance.
4. Apply coatings to produce surface films without cloudiness, spotting, holidays, laps, brush marks, runs, sags, ropiness, or other surface imperfections. Produce sharp glass lines and color breaks.

C. Field Quality Control

1. The following procedure may be requested at any time and as often as the Owner deems necessary during the period when coatings are being applied:
 - a. Engage the services of a qualified testing agency to sample coating material being used. Samples of material delivered to Project site will be taken, identified, sealed, and certified in presence of Contractor.
 - b. Testing agency will perform tests for compliance with specified requirements.
 - c. the Owner may direct Contractor to stop applying coatings if test results show materials being used do not comply with specified requirements. Contractor shall remove noncomplying coating materials from Project site, pay for testing, and recoat surfaces coated with rejected materials. Contractor will be required to remove rejected materials from previously coated surfaces if, on recoating with complying materials, the two coatings are incompatible.

D. Cleaning And Protection

1. At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.
2. After completing coating application, clean spattered surfaces. Remove spattered coatings by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.
3. Protect work of other trades against damage from coating operation. Correct damage by cleaning, repairing, replacing, and recoating, as approved by the Owner, and leave in an undamaged condition.
4. At completion of construction activities of other trades, touch up and restore damaged or defaced coated surfaces.

E. Exterior High-Performance Coating Schedule

1. Coating systems in this Article are based on "MPI Architectural Painting Specification Manual." For renovation projects, consult "MPI Maintenance Repainting Manual" and revise coating systems accordingly.
2. Concrete Substrates, Vertical Surfaces:
 - a. Water-Based, Light-Industrial Coating System (System below corresponds to MPI EXT 3.1C):
 - 1) Prime Coat: Water-based, light-industrial coating, MPI #110, gloss matching topcoat.
 - 2) Intermediate Coat: Not required **OR** Water-based, light-industrial coating, MPI #110, gloss matching topcoat, **as directed**.
 - 3) Topcoat: Water-based, light-industrial coating, MPI #110-G6, gloss **OR** 5, semigloss **OR** 3, eggshell, **as directed**.
 - b. Epoxy Coating System (System below corresponds to MPI EXT 3.1D):
 - 1) Prime Coat: Epoxy, cold-cured, gloss, MPI #77.

- 2) Intermediate Coat: Not required **OR** Epoxy, cold-cured, gloss, MPI #77, **as directed**.
- 3) Topcoat: Epoxy, cold-cured, gloss, MPI #77.
- c. Water-Based Epoxy Coating System (System below corresponds to MPI EXT 3.1E):
 - 1) Prime Coat: Water-based epoxy (interior and exterior), MPI #115.
 - 2) Intermediate Coat: Not required **OR** Water-based epoxy (interior and exterior), MPI #115, **as directed**.
 - 3) Topcoat: Water-based epoxy (interior and exterior), MPI #115.
3. Concrete Substrates, Horizontal Surfaces (System below corresponds to MPI EXT 3.2C):
 - a. Epoxy Slip-Resistant Deck Coating System:
 - 1) Topcoat: Epoxy deck coating, MPI #82.
4. Clay-Masonry Substrates (System below corresponds to MPI EXT 4.1C):
 - a. Water-Based, Light-Industrial Coating System:
 - 1) Prime Coat: Water-based, light-industrial coating, MPI #110, gloss matching topcoat.
 - 2) Intermediate Coat: Not required **OR** Water-based, light-industrial coating, MPI #110, gloss matching topcoat, **as directed**.
 - 3) Topcoat: Water-based, light-industrial coating, MPI #110-G6, gloss **OR** 5, semigloss **OR** 3, eggshell, **as directed**.
 - b. Epoxy Coating System (System below corresponds to MPI EXT 4.1D) (MPI recommends this system for smooth brick.):
 - 1) Prime Coat: Epoxy, cold-cured, gloss, MPI #77.
 - 2) Intermediate Coat : Not required **OR** Epoxy, cold-cured, gloss, MPI #77, **as directed**.
 - 3) Topcoat: Epoxy, cold-cured, gloss, MPI #77.
 - c. Water-Based Epoxy Coating System (System below corresponds to MPI EXT 4.1E) (MPI recommends this system for smooth brick.):
 - 1) Prime Coat: Water-based epoxy (interior and exterior), MPI #115.
 - 2) Intermediate Coat: Not required **OR** Water-based epoxy (interior and exterior), MPI #115, **as directed**.
 - 3) Topcoat: Water-based epoxy (interior and exterior), MPI #115.
 - d. Polyurethane, Pigmented, Over Epoxy Coating System (System below corresponds to MPI EXT 4.1J):
 - 1) Prime Coat: Epoxy, cold-cured, gloss, MPI #77.
 - 2) Intermediate Coat: Epoxy, cold-cured, gloss, MPI #77.
 - 3) Topcoat: Polyurethane, two-component, pigmented, gloss, MPI #72.
5. CMU Substrates:
 - a. Water-Based, Light-Industrial Coating System (System below corresponds to MPI EXT 4.2C):
 - 1) Prime Coat: Interior/exterior latex block filler, MPI #4.
 - 2) Intermediate Coat: Not required **OR** Water-based, light-industrial coating, MPI #110, gloss matching topcoat, **as directed**.
 - 3) Topcoat: Water-based, light-industrial coating, MPI #110-G6, gloss **OR** 5, semigloss **OR** 3, eggshell, **as directed**.
 - b. Epoxy Coating System (System below corresponds to MPI EXT 4.2E):
 - 1) Block Filler: Epoxy block filler, MPI #116.
 - 2) Intermediate Coat: Not required **OR** Epoxy, cold-cured, gloss, MPI #77, **as directed**.
 - 3) Topcoat: Epoxy, cold-cured, gloss, MPI #77.
 - c. Water-Based Epoxy Coating System (System below corresponds to MPI EXT 4.2F):
 - 1) Block Filler: Epoxy block filler, MPI #116.
 - 2) Intermediate Coat: Not required **OR** Water-based epoxy (interior and exterior), MPI #115, **as directed**.
 - 3) Topcoat: Water-based epoxy (interior and exterior), MPI #115.

- d. Polyurethane, Pigmented, Over High-Build Epoxy Coating System (System below corresponds to MPI EXT 4.2G):
 - 1) Block Filler: Epoxy block filler, MPI #116.
 - 2) Intermediate Coat: High-build epoxy marine coating, low gloss, MPI #108.
 - 3) Topcoat: Polyurethane, two-component, pigmented, gloss, MPI #72.
6. Steel Substrates:
 - a. Water-Based, Light-Industrial Coating System (System below corresponds to MPI EXT 5.1B, MPI EXT 5.1C, MPI EXT 5.1M and MPI EXT 5.1N, depending on primer selected):
 - 1) Prime Coat: Inorganic zinc primer, MPI #19 **OR** Alkyd anticorrosive metal primer, MPI #79 **OR** Rust-inhibitive primer, (water based), MPI #107 **OR** Cold-curing epoxy primer, MPI #101, **as directed**, primer.
 - 2) Intermediate Coat: Water-based, light-industrial coating, MPI #110, gloss matching topcoat (intermediate coat is required for coating systems except MPI Custom Grade system using inorganic zinc primer).
 - 3) Topcoat: Water-based, light-industrial coating, MPI #110-G6, gloss **OR** 5, semigloss **OR** 3, eggshell, **as directed**.
 - b. High-Build Epoxy Coating System (System below corresponds to MPI EXT 5.1F):
 - 1) Prime Coat: Cold-curing epoxy primer, MPI #101.
 - 2) Intermediate Coat: High-build epoxy marine coating, low gloss, MPI #108.
 - 3) Topcoat: Epoxy, cold-cured, gloss, MPI #77.
 - c. Water-Based Epoxy Coating System (System below corresponds to MPI EXT 5.1E):
 - 1) Prime Coat: Rust-inhibitive primer, (water based), MPI #107.
 - 2) Intermediate Coat: Water-based epoxy (interior and exterior), MPI #115.
 - 3) Topcoat: Water-based epoxy (interior and exterior), MPI #115.
 - d. Polyurethane, Pigmented, Over Epoxy Coating System (System below corresponds to MPI EXT 5.1H):
 - 1) Prime Coat: Cold-curing epoxy primer, MPI #101.
 - 2) Intermediate Coat: Epoxy, cold-cured, gloss, MPI #77.
 - 3) First Topcoat: Polyurethane, two-component, pigmented, gloss, MPI #72.
 - 4) Second Topcoat (for Premium Grade system): Polyurethane, two-component, pigmented, gloss, MPI #72.
 - e. Polyurethane, Pigmented, Over Epoxy Coating System (System below corresponds to MPI EXT 5.1P)
 - 1) Prime Coat: Epoxy zinc primer, MPI#20.
 - 2) Intermediate Coat: Epoxy, cold-cured, gloss, MPI #77.
 - 3) First Topcoat: Polyurethane, two-component, pigmented, gloss, MPI #72.
 - 4) Second Topcoat: Polyurethane, two-component, pigmented, gloss, MPI #72.
 - f. Polyurethane, Pigmented, Over High-Build Epoxy Coating System (System below corresponds to MPI EXT 5.1G):
 - 1) Prime Coat: Epoxy zinc primer, MPI#20.
 - 2) Intermediate Coat: High-build epoxy marine coating, low gloss, MPI #108.
 - 3) First Topcoat: Polyurethane, two-component, pigmented, gloss, MPI #72.
 - 4) Second Topcoat (for Premium Grade system): Polyurethane, two-component, pigmented, gloss, MPI #72.
 - g. Polyurethane, Pigmented, Over High-Build Epoxy Coating System (System below corresponds to MPI EXT 5.1J):
 - 1) Prime Coat: Cold-curing epoxy primer, MPI #101.
 - 2) Intermediate Coat: High-build epoxy marine coating, low gloss, MPI #108.
 - 3) First Topcoat: Polyurethane, two-component, pigmented, gloss, MPI #72.
 - 4) Second Topcoat: Polyurethane, two-component, pigmented, gloss, MPI #72.
 - h. Polyurethane, Pigmented, Over High-Build Epoxy Coating System (System below corresponds to MPI EXT 5.1L):
 - 1) Prime Coat: Inorganic zinc primer, MPI #19.
 - 2) Intermediate Coat: High-build epoxy marine coating, low gloss, MPI #108.
 - 3) First Topcoat: Polyurethane, two-component, pigmented, gloss, MPI #72.

- 4) Second Topcoat: Polyurethane, two-component, pigmented, gloss, MPI #72.
7. Galvanized-Metal Substrates:
 - a. Water-Based, Light-Industrial Coating System (System below corresponds to MPI EXT 5.3G and MPI EXT 5.3J, depending on primer selected):
 - 1) Prime Coat: Cementitious galvanized-metal primer, MPI #26 **OR** Waterborne galvanized-metal primer, MPI #134, **as directed**.
 - 2) Intermediate Coat (for Premium Grade system): Not required **OR** Water-based, light-industrial coating, MPI #110, gloss matching topcoat, **as directed**.
 - 3) Topcoat: Water-based, light-industrial coating, MPI #110-G6, gloss **OR** 5, semigloss **OR** 3, eggshell, **as directed**.
 - b. Epoxy Coating System (System below corresponds to MPI EXT 5.3C) (MPI recommends this system for high-contact and -traffic areas.):
 - 1) Prime Coat: Cold-curing epoxy primer, MPI #101.
 - 2) Intermediate Coat (for Premium Grade system): Not required **OR** Epoxy, cold-cured, gloss, MPI #77, **as directed**.
 - 3) Topcoat: Epoxy, cold-cured, gloss, MPI #77.
 - c. Polyurethane, Pigmented Coating System (System below corresponds to MPI EXT 5.3D) (MPI recommends these systems for high-contact and -traffic areas.):
 - 1) Prime Coat: Vinyl wash primer, MPI #80.
 - 2) Intermediate Coat: Not required **OR** Cold-curing epoxy primer, MPI #101, **as directed**.
 - 3) First Topcoat: Polyurethane, two-component, pigmented, gloss, MPI #72.
 - 4) Second Topcoat: Polyurethane, two-component, pigmented, gloss, MPI #72.
 - d. Polyurethane, Pigmented Coating System (System below corresponds to MPI EXT 5.3L):
 - 1) Prime Coat: Cold-curing epoxy primer, MPI #101.
 - 2) Intermediate Coat: Not required **OR** Polyurethane, two-component, pigmented, gloss, MPI #72, **as directed**.
 - 3) First Topcoat: Polyurethane, two-component, pigmented, gloss, MPI #72.
 - 4) Second Topcoat: Polyurethane, two-component, pigmented, gloss, MPI #72.
8. Aluminum (Not Anodized or Otherwise Coated) Substrates:
 - a. Water-Based, Light-Industrial Coating System (System below corresponds to MPI EXT 5.4G):
 - 1) Prime Coat: Quick-drying primer for aluminum, MPI #95.
 - 2) Intermediate Coat: Not required **OR** Water-based, light-industrial coating, MPI #110, gloss matching topcoat, **as directed**.
 - 3) Topcoat: Water-based, light-industrial coating, MPI #110-G6, gloss **OR** 5, semigloss **OR** 3, eggshell, **as directed**.
 - b. Epoxy Coating System (System below corresponds to MPI EXT 5.4E):
 - 1) Prime Coat: Vinyl wash primer, MPI #80.
 - 2) Intermediate Coat (for Premium Grade system): Epoxy, cold-cured, gloss, MPI #77.
 - 3) Topcoat: Epoxy, cold-cured, gloss, MPI #77.
 - c. Polyurethane, Pigmented Coating System (System below corresponds to MPI EXT 5.4B) (MPI recommends these systems for high-contact and -traffic areas.):
 - 1) Prime Coat: Vinyl wash primer, MPI #80.
 - 2) Intermediate Coat: Cold-curing epoxy primer, MPI #101.
 - 3) First Topcoat: Polyurethane, two-component, pigmented, gloss, MPI #72.
 - 4) Second Topcoat (for Premium Grade system): Polyurethane, two-component, pigmented, gloss, MPI #72.
9. Wood Substrates:
 - a. Pigmented Polyurethane Coating System (System below corresponds to MPI EXT 6.1J, MPI EXT 6.2J, and MPI EXT 6.3H):
 - 1) Prime Coat: Polyurethane, two-component, pigmented, gloss, MPI #72.
 - 2) Intermediate Coat: Polyurethane, two-component, pigmented, gloss, MPI #72.
 - 3) Topcoat: Polyurethane, two-component, pigmented, gloss, MPI #72.

- b. Polyurethane, Clear, Two-Component Coating System (System below corresponds to MPI EXT 6.1E for use on glue-laminated beams and columns):
 - 1) Stain Coat: Exterior semitransparent stain (solvent based), MPI #13.
 - 2) Intermediate Coat: Two-component, aliphatic polyurethane, clear, MPI #78.
 - 3) First Topcoat: Two-component, aliphatic polyurethane, clear, MPI #78.
 - 4) Second Topcoat (for Premium Grade systems): Two-component, aliphatic polyurethane, clear, MPI #78.
- F. Interior High-Performance Coating Schedule
 1. Coating systems in this Article are based on "MPI Architectural Painting Specification Manual." For renovation projects, consult "MPI Maintenance Repainting Manual" and revise coating systems accordingly.
 2. Concrete Substrates, Vertical Surfaces (System below corresponds to MPI INT 3.1C):
 - a. High-Performance Architectural Latex Coating System:
 - 1) Prime Coat: Interior latex primer/sealer, MPI #50.
 - 2) Intermediate Coat: Not required **OR** High-performance architectural latex matching topcoat, **as directed**.
 - 3) Topcoat: High-performance architectural latex, velvet finish, MPI #138, Gloss Level 2 **OR** eggshell finish, MPI #139, Gloss Level 3 **OR** satin finish, MPI #140, Gloss Level 4 **OR** semigloss finish, MPI #141, Gloss Level 5, **as directed**.
 - b. Water-Based, Light-Industrial Coating System (System below corresponds to MPI INT 3.1L):
 - 1) Prime Coat: Water-based, light-industrial coating, MPI #110, gloss matching topcoat.
 - 2) Intermediate Coat: Not required **OR** Water-based, light-industrial coating, MPI #110, gloss matching topcoat, **as directed**.
 - 3) Topcoat: Water-based, light-industrial coating, MPI #110-G6, gloss **OR** 5, semigloss **OR** 3, eggshell, **as directed**.
 - c. Epoxy Coating System (System below corresponds to MPI INT 3.1F.) (MPI recommends this system for smooth concrete.):
 - 1) Prime Coat: Epoxy, cold-cured, gloss, MPI #77.
 - 2) Intermediate Coat: Not required **OR** Epoxy, cold-cured, gloss, MPI #77, **as directed**.
 - 3) Topcoat: Epoxy, cold-cured, gloss, MPI #77.
 - d. Water-Based Epoxy Coating System (System below corresponds to MPI INT 3.1G) (MPI recommends this system for smooth concrete.):
 - 1) Prime Coat: Water-based epoxy (interior and exterior), MPI #115.
 - 2) Intermediate Coat: Not required **OR** Water-based epoxy (interior and exterior), MPI #115, **as directed**.
 - 3) Topcoat: Water-based epoxy (interior and exterior), MPI #115.
 3. Concrete Substrates, Horizontal Surfaces.
 - a. Epoxy Coating System (System below corresponds to MPI INT 3.2C):
 - 1) Prime Coat: Epoxy, cold-cured, gloss, MPI #77.
 - 2) Intermediate Coat: Not required **OR** Epoxy, cold-cured, gloss, MPI #77, **as directed**.
 - 3) Topcoat: Epoxy, cold-cured, gloss, MPI #77.
 - b. Water-Based Epoxy Floor Paint Coating System (System below corresponds to MPI INT 3.2L).
 - 1) Prime Coat: Water-based epoxy floor paint, MPI #93.
 - 2) Intermediate Coat: Not required **OR** Water-based epoxy floor paint, MPI #93, **as directed**.
 - 3) Topcoat: Water-based epoxy floor paint, MPI #93.
 - c. Polyurethane, Pigmented Coating System (System below corresponds to MPI INT 3.2D):
 - 1) Prime Coat: Epoxy, cold-cured, gloss, MPI #77.
 - 2) Intermediate Coat: Not required **OR** Polyurethane, two-component, pigmented, gloss, MPI #72, **as directed**.

- 3) Topcoat: Polyurethane, two-component, pigmented, gloss, MPI #72.
- d. Polyurethane, Clear, Two-Component Coating System (System below corresponds to MPI INT 3.2K):
 - 1) Prime Coat: Two-component, aliphatic polyurethane, clear, MPI #78.
 - 2) Intermediate Coat: Not required **OR** Two-component, aliphatic polyurethane, clear, MPI #78, **as directed**.
 - 3) Topcoat: Two-component, aliphatic polyurethane, clear, MPI #78.
4. Clay-Masonry Substrates:
 - a. High-Performance Architectural Latex Coating System (System below corresponds to MPI INT 4.1L):
 - 1) Prime Coat: High-performance architectural latex matching topcoat.
 - 2) Intermediate Coat: Not required **OR** High-performance architectural latex matching topcoat, **as directed**.
 - 3) Topcoat: High-performance architectural latex, velvet finish, MPI #138, Gloss Level 2 **OR** eggshell finish, MPI #139, Gloss Level 3 **OR** satin finish, MPI #140, Gloss Level 4 **OR** semigloss finish, MPI #141, Gloss Level 5, **as directed**.
 - b. Water-Based, Light-Industrial Coating System (System below corresponds to MPI INT 4.1C):
 - 1) Prime Coat: Water-based, light-industrial coating, MPI #110, gloss matching topcoat.
 - 2) Intermediate Coat: Not required **OR** Water-based, light-industrial coating, MPI #110, gloss matching topcoat, **as directed**.
 - 3) Topcoat: Water-based, light-industrial coating, MPI #110-G6, gloss **OR** 5, semigloss **OR** 3, eggshell, **as directed**.
 - c. Epoxy Coating System (System below corresponds to MPI INT 4.1F) (MPI recommends this system for smooth brick.):
 - 1) Prime Coat: Epoxy, cold-cured, gloss, MPI #77.
 - 2) Intermediate Coat: Not required **OR** Epoxy, cold-cured, gloss, MPI #77, **as directed**.
 - 3) Topcoat: Epoxy, cold-cured, gloss, MPI #77.
 - d. Water-Based Epoxy Coating System (System below corresponds to MPI INT 4.1G) (MPI recommends this system for smooth brick.):
 - 1) Prime Coat: Water-based epoxy (interior and exterior), MPI #115.
 - 2) Intermediate Coat: Not required **OR** Water-based epoxy (interior and exterior), MPI #115, **as directed**.
 - 3) Topcoat: Water-based epoxy (interior and exterior), MPI #115.
 - e. Polyurethane, Clear, Two-Component Coating System (System below corresponds to MPI INT 4.1K):
 - 1) Prime Coat: Two-component, aliphatic polyurethane, clear, MPI #78.
 - 2) Intermediate Coat: Not required **OR** Two-component, aliphatic polyurethane, clear, MPI #78, **as directed**.
 - 3) Topcoat: Two-component, aliphatic polyurethane, clear, MPI #78.
5. CMU Substrates:
 - a. High-Performance Architectural Latex Coating System (System below corresponds to MPI INT 4.2D):
 - 1) Prime Coat: Interior/exterior latex block filler, MPI #4.
 - 2) Intermediate Coat: Not required **OR** High-performance architectural latex matching topcoat, **as directed**.
 - 3) Topcoat: High-performance architectural latex, velvet finish, MPI #138, Gloss Level 2 **OR** eggshell finish, MPI #139, Gloss Level 3 **OR** satin finish, MPI #140, Gloss Level 4 **OR** semigloss finish, MPI #141, Gloss Level 5, **as directed**.
 - b. Water-Based, Light-Industrial Coating System (System below corresponds to MPI INT 4.2K):
 - 1) Prime Coat: Interior/exterior latex block filler, MPI #4.

- 2) Intermediate Coat: Not required **OR** Water-based, light-industrial coating, MPI #110, gloss matching topcoat, **as directed**.
- 3) Topcoat: Water-based, light-industrial coating, MPI #110-G6, gloss **OR** 5, semigloss **OR** 3, eggshell, **as directed**.
- c. Epoxy Coating System (System below corresponds to MPI INT 4.2F and MPI INT 4.2G, depending on primer selected) (MPI recommends these systems for dry environments.):
 - 1) Prime Coat: Interior/exterior latex block filler, MPI #4 **OR** Epoxy block filler, MPI #116, **as directed**.
 - 2) Intermediate Coat: Not required **OR** Epoxy, cold-cured, gloss, MPI #77, **as directed**.
 - 3) Topcoat: Epoxy, cold-cured, gloss, MPI #77.
- d. Water-Based Epoxy Coating System (System below corresponds to MPI INT 4.2J) (MPI recommends this system for wet environments.):
 - 1) Prime Coat: Interior/exterior latex block filler, MPI #4.
 - 2) Intermediate Coat: Not required **OR** Water-based epoxy (interior and exterior), MPI #115, **as directed**.
 - 3) Topcoat: Water-based epoxy (interior and exterior), MPI #115.
6. Steel Substrates:
 - a. High-Performance Architectural Latex Coating System (System below corresponds to MPI INT 5.1R):
 - 1) Prime Coat: Alkyd anticorrosive metal primer, MPI #79 **OR** Quick-dry alkyd metal primer, MPI #76, **as directed**.
 - 2) Intermediate Coat: Not required **OR** High-performance architectural latex matching topcoat, **as directed**.
 - 3) Topcoat: High-performance architectural latex, velvet finish, MPI #138, Gloss Level 2 **OR** eggshell finish, MPI #139, Gloss Level 3 **OR** satin finish, MPI #140, Gloss Level 4 **OR** semigloss finish, MPI #141, Gloss Level 5, **as directed**.
 - b. Water-Based, Light-Industrial Coating System (System below corresponds to MPI INT 5.1B and MPI INT 5.1N, depending on primer selected.):
 - 1) Prime Coat: Rust-inhibitive primer (water based), MPI #107 **OR** Cold-curing epoxy primer, MPI #101, **as directed**.
 - 2) Intermediate Coat: Not required **OR** Water-based, light-industrial coating, MPI #110, gloss matching topcoat, **as directed**.
 - 3) Topcoat: Water-based, light-industrial coating, MPI #110-G6, gloss **OR** 5, semigloss **OR** 3, eggshell, **as directed**.
 - c. High-Build Epoxy Coating System - Premium Grade (System below corresponds to MPI INT 5.1P):
 - 1) Prime Coat: Epoxy zinc primer, MPI#20.
 - 2) Intermediate Coat: High-build epoxy marine coating, low gloss, MPI #108.
 - 3) Topcoat: Epoxy, cold-cured, gloss, MPI #77.
 - d. High-Build Epoxy Coating System – Custom Grade (System below corresponds to MPI INT 5.1P):
 - 1) Prime Coat: Epoxy zinc primer, MPI#20.
 - 2) Topcoat: High-build epoxy marine coating, low gloss, MPI #108.
 - e. Epoxy Coating System (System below corresponds to MPI INT 5.1L):
 - 1) Prime Coat: Cold-curing epoxy primer, MPI #101.
 - 2) Intermediate Coat: Not required **OR** Epoxy, cold-cured, gloss, MPI #77, **as directed**.
 - 3) Topcoat: Epoxy, cold-cured, gloss, MPI #77.
 - f. Water-Based Epoxy Coating System (System below corresponds to MPI INT 5.1K):
 - 1) Prime Coat: Rust-inhibitive primer (water based), MPI #107.
 - 2) Intermediate Coat: Water-based epoxy (interior and exterior), MPI #115.
 - 3) Topcoat: Water-based epoxy (interior and exterior), MPI #115.
 - g. Polyurethane, Pigmented Coating System (System below corresponds to MPI INT 5.1F):
 - 1) Prime Coat: Cold-curing epoxy primer, MPI #101.

- 2) Intermediate Coat: Not required **OR** Polyurethane, two-component, pigmented, gloss, MPI #72, **as directed**.
- 3) Topcoat: Polyurethane, two-component, pigmented, gloss, MPI #72.
- h. Polyurethane, Pigmented Coating System (System below corresponds to MPI INT 5.1H):
 - 1) Prime Coat: Inorganic zinc primer, MPI #19.
 - 2) Intermediate Coat: Epoxy, cold-cured, gloss, MPI #77.
 - 3) Topcoat: Polyurethane, two-component, pigmented, gloss, MPI #72.
- i. Polyurethane, Pigmented Coating System (System below corresponds to MPI INT 5.1J):
 - 1) Prime Coat: Epoxy zinc primer, MPI #20.
 - 2) Intermediate Coat: Epoxy, cold-cured, gloss, MPI #77.
 - 3) Topcoat: Polyurethane, two-component, pigmented, gloss, MPI #72.
- j. Polyurethane, Pigmented, Over High-Build Epoxy Coating System (System below corresponds to MPI INT 5.1G):
 - 1) Prime Coat: Cold-curing epoxy primer, MPI #101.
 - 2) Intermediate Coat: High-build epoxy marine coating, low gloss, MPI #108.
 - 3) Topcoat: Polyurethane, two-component, pigmented, gloss, MPI #72.
7. Galvanized-Metal Substrates:
 - a. High-Performance Architectural Latex Coating System (System below corresponds to MPI INT 5.3M):
 - 1) Prime Coat: Waterborne galvanized-metal primer, MPI #134.
 - 2) Intermediate Coat: Not required **OR** High-performance architectural latex matching topcoat, **as directed**.
 - 3) Topcoat: High-performance architectural latex, velvet finish, MPI #138, Gloss Level 2 **OR** eggshell finish, MPI #139, Gloss Level 3 **OR** satin finish, MPI #140, Gloss Level 4 **OR** semigloss finish, MPI #141, Gloss Level 5, **as directed**.
 - b. Water-Based, Light-Industrial Coating System (System below corresponds to MPI INT 5.3B and MPI INT 5.3K, depending on primer selected.):
 - 1) Prime Coat: Cementitious galvanized-metal primer, MPI #26 **OR** Waterborne galvanized-metal primer, MPI #134, **as directed**.
 - 2) Intermediate Coat: Not required **OR** Water-based, light-industrial coating, MPI #110, gloss matching topcoat, **as directed**.
 - 3) Topcoat: Water-based, light-industrial coating, MPI #110-G6, gloss **OR** 5, semigloss **OR** 3, eggshell, **as directed**.
 - c. Epoxy Coating System (System below corresponds to MPI INT 5.3D):
 - 1) Prime Coat: Cold-curing epoxy primer, MPI #101.
 - 2) Intermediate Coat: Not required **OR** Epoxy, cold-cured, gloss, MPI #77, **as directed**.
 - 3) Topcoat: Epoxy, cold-cured, gloss, MPI #77.
8. Aluminum (Not Anodized or Otherwise Coated) Substrates (System below corresponds to MPI INT 5.4F):
 - a. High-Performance Architectural Latex Coating System:
 - 1) Prime Coat: Quick-drying primer for aluminum, MPI #95.
 - 2) Intermediate Coat: Not required **OR** High-performance architectural latex, matching topcoat, **as directed**.
 - 3) Topcoat: High-performance architectural latex, velvet finish, MPI #138, Gloss Level 2 **OR** eggshell finish, MPI #139, Gloss Level 3 **OR** satin finish, MPI #140, Gloss Level 4 **OR** semigloss finish, MPI #141, Gloss Level 5, **as directed**.
 - b. Water-Based, Light-Industrial Coating System (System below corresponds to MPI INT 5.4E):
 - 1) Prime Coat: Quick-drying primer for aluminum, MPI #95.
 - 2) Intermediate Coat: Not required **OR** Water-based, light-industrial coating, MPI #110, gloss matching topcoat, **as directed**.
 - 3) Topcoat: Water-based, light-industrial coating, MPI #110-G6, gloss **OR** 5, semigloss **OR** 3, eggshell, **as directed**.
 - c. Epoxy Coating System (System below corresponds to MPI INT 5.4B):

- 1) Prime Coat: Vinyl wash primer, MPI #80.
- 2) Intermediate Coat: Not required **OR** Epoxy, cold-cured, gloss, MPI #77, **as directed**.
- 3) Topcoat: Epoxy, cold-cured, gloss, MPI #77.
- d. Polyurethane, Pigmented Coating System (System below corresponds to MPI INT 5.4C):
 - 1) Prime Coat: Vinyl wash primer, MPI #80.
 - 2) Intermediate Coat: Epoxy, cold-cured, gloss, MPI #77.
 - 3) Topcoat: Polyurethane, two-component, pigmented, gloss, MPI #72.
9. Wood Substrates:
 - a. High-Performance Architectural Latex Coating System (System below corresponds to MPI INT 6.1N, MPI INT 6.3A, and MPI INT 6.4S):
 - 1) Prime Coat: Interior latex-based wood primer, MPI #39.
 - 2) Intermediate Coat: High-performance architectural latex matching topcoat.
 - 3) Topcoat: High-performance architectural latex, velvet finish, MPI #138, Gloss Level 2 **OR** eggshell finish, MPI #139, Gloss Level 3 **OR** satin finish, MPI #140, Gloss Level 4 **OR** semigloss finish, MPI #141, Gloss Level 5, **as directed**.
 - b. Water-Based, Light-Industrial Coating System (System below corresponds to MPI INT 6.3P and MPI INT 6.4N):
 - 1) Prime Coat: Interior alkyd primer/sealer, MPI #45.
 - 2) Intermediate Coat: Water-based, light-industrial coating, MPI #110, gloss matching topcoat.
 - 3) Topcoat: Water-based, light-industrial coating, MPI #110-G6, gloss **OR** 5, semigloss **OR** 3, eggshell, **as directed**.
 - c. Epoxy Coating System (System below corresponds to MPI INT 6.1L and MPI INT 6.3L):
 - 1) Prime Coat: Epoxy, cold-cured, gloss, MPI #77.
 - 2) Intermediate Coat: Not required **OR** Epoxy, cold-cured, gloss, MPI #77, **as directed**.
 - 3) Topcoat: Epoxy, cold-cured, gloss, MPI #77.
 - d. Pigmented Polyurethane Coating System (System below corresponds to MPI INT 6.1E):
 - 1) Prime Coat: Polyurethane, two-component, pigmented, gloss, MPI #72.
 - 2) Intermediate Coat: Polyurethane, two-component, pigmented, gloss, MPI #72.
 - 3) Topcoat: Polyurethane, two-component, pigmented, gloss, MPI #72.
 - e. Polyurethane, Clear, Moisture-Cured Coating System (System below corresponds to MPI INT 6.1S, MPI INT 6.2N, MPI INT 6.3Y, and MPI INT 6.4V):
 - 1) Stain Coat: Interior wood stain, semitransparent (solvent based), MPI #90.
 - 2) Intermediate Coat: Polyurethane, moisture cured, clear, flat, MPI #71 **OR** Polyurethane, moisture cured, clear, gloss, MPI #31, **as directed**.
 - 3) First Topcoat: Polyurethane, moisture cured, clear, flat, MPI #71 **OR** Polyurethane, moisture cured, clear, gloss, MPI #31, **as directed**.
 - 4) Second Topcoat: Not required **OR** Polyurethane, moisture cured, clear, flat, MPI #71 **OR** Polyurethane, moisture cured, clear, gloss, MPI #31, **as directed**.
 - f. Polyurethane, Clear, Moisture-Cured Coating System (System below corresponds to MPI INT 6.3X):
 - 1) Intermediate Coat: Polyurethane, moisture cured, clear, flat, MPI #71 **OR** Polyurethane, moisture cured, clear, gloss, MPI #31, **as directed**.
 - 2) First Topcoat: Polyurethane, moisture cured, clear, flat, MPI #71 **OR** Polyurethane, moisture cured, clear, gloss, MPI #31, **as directed**.
 - 3) Second Topcoat: Not required **OR** Polyurethane, moisture cured, clear, flat, MPI #71 **OR** Polyurethane, moisture cured, clear, gloss, MPI #31, **as directed**.
 - g. Polyurethane, Clear, Two-Component Coating System (System below corresponds to MPI INT 6.3Z):
 - 1) Stain Coat: Exterior semitransparent stain (solvent based), MPI #13.
 - 2) Intermediate Coat: Not required **OR** Two-component, aliphatic polyurethane, clear, MPI #78, **as directed**.
 - 3) Topcoat: Two-component, aliphatic polyurethane, clear, MPI #78.
10. Gypsum Board Substrates:

- a. High-Performance Architectural Latex Coating System (System below corresponds to MPI INT 9.2B):
 - 1) Prime Coat: Interior latex primer/sealer, MPI #50.
 - 2) Intermediate Coat: High-performance architectural latex matching topcoat.
 - 3) Topcoat: High-performance architectural latex, velvet finish, MPI #138, Gloss Level 2 **OR** eggshell finish, MPI #139, Gloss Level 3 **OR** satin finish, MPI #140, Gloss Level 4 **OR** semigloss finish, MPI #141, Gloss Level 5, **as directed**.
- b. Water-Based, Light-Industrial Coating System (System below corresponds to MPI INT 9.2L):
 - 1) Prime Coat: Interior latex primer/sealer, MPI #50.
 - 2) Intermediate Coat: Water-based, light-industrial coating, MPI #110, gloss matching topcoat.
 - 3) Topcoat: Water-based, light-industrial coating, MPI #110-G6, gloss **OR** 5, semigloss **OR** 3, eggshell, **as directed**.
- c. Epoxy Coating System (System below corresponds to MPI INT 9.2E):
 - 1) Prime Coat: Interior latex primer/sealer, MPI #50.
 - 2) Intermediate Coat: Not required **OR** Epoxy, cold-cured, gloss, MPI #77, **as directed**.
 - 3) Topcoat: Epoxy, cold-cured, gloss, MPI #77.
- d. Water-Based Epoxy Coating System (System below corresponds to MPI INT 9.2F):
 - 1) Prime Coat: Interior latex primer/sealer, MPI #50.
 - 2) Intermediate Coat: Not required **OR** Water-based epoxy (interior and exterior), MPI #115, **as directed**.
 - 3) Topcoat: Water-based epoxy (interior and exterior), MPI #115.

END OF SECTION 09 96 00 00



Task	Specification	Specification Description
09 96 53 00	09 91 13 00	Exterior Painting

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SECTION 09 96 56 00 - FIBERGLASS REINFORCED EPOXY COATING

1.1 GENERAL

A. Description Of Work

1. This specification covers the furnishing and installation of materials for fiberglass reinforced epoxy coating. Products shall be as follows or as directed by the Owner. Installation procedures shall be in accordance with the product manufacturer's recommendations. Demolition and removal of materials shall be as required to support the work.

B. Submittals

1. Product Data: For each coating system specified.

C. Material Storage

1. Store materials in a temperature controlled environment (50°F - 90°F) and out of direct sunlight.
2. Keep resins, hardeners, and solvents separated from each other and away from sources of ignition. One year shelf life is expected for products stored between 50°F - 90°F.

1.2 PRODUCTS

A. Materials

1. Multi-Layer, High Build Wall and Ceiling Surfacing System
 - a. Primer
 - 1) Water-based epoxy base coating.
 - b. Base Coat
 - 1) High performance epoxy coating.
 - c. Fiberglass Mesh Reinforcement
 - 1) Bound fiberglass cloth, 5.6 oz.
 - d. Saturant
 - 1) High performance epoxy coating.
 - e. Level Coat
 - 1) High performance epoxy coating.
 - f. Chemical Resistant Finish Coat
 - 1) 100% solids polyurethane.

1.3 EXECUTION

A. Primer

1. Mixing and Application: Water Based Epoxy Wall Coating should only be used on unpainted, porous surfaces. If the surface is painted with latex or an epoxy coating, clean and abrade the surface then apply the primer.
2. Premix resin and hardener separately, using a low speed drill and Jiffy mixer. Mix for three minutes and until uniform, exercising caution not to whip air into the materials.
3. Add 2 parts resin to 1 part hardener, mix with low speed drill and Jiffy mixer for three minutes and until uniform. Apply material using a 1/4" short nap roller at a spread rate of 300-350 sq. ft. per gallon to yield 5 mils WFT.
4. Allow to cure for a minimum of 3 hours depending upon air movement. Lightly "pole sand" smooth rough edges of the flake before applying base coat.

B. Base Coat

1. Mixing and Application

- a. Premix resin and hardener separately, using a low speed drill and Jiffy mixer. Mix for three minutes and until uniform, exercising caution not to introduce air into the material.
 - b. Add 3 parts resin to 1 part hardener by volume. Mix with low speed drill and Jiffy mixer for three minutes and until uniform. To insure proper system cure and performance, strictly follow mix ratio recommendations.
 - c. Base coat may be applied via spray, roller or brush. Apply using a 1/4" nap roller at a spread rate of 200-250 sq. ft. per gallon to yield 6-8 mils WFT evenly with no runs. Coverage will vary depending upon porosity of the substrate and surface texture.
- C. Fiberglass Reinforcement
 1. Apply 5.6 oz. bound fiberglass cloth for walls and 4 oz. for ceilings directly into wet resin. Do not allow material to cure or recoating will be necessary.
 2. Hang fiberglass cloth directly to the wall similar to hanging wallpaper so seams are uniform and even. Overlap each strip using a double cut method. Remove the trimmed material behind the front strip.
 3. After hand affixing to wall, use a broad knife to remove air pockets, wrinkles or any irregularities.
- D. Saturant Coat
 1. Mixing and Application
 - a. Premix resin and hardener separately, using a low speed drill and Jiffy mixer. Mix for three minutes and until uniform, exercising caution not to introduce air into the material.
 - b. Add 3 parts 3548PA (resin) to 1 part 3548B (hardener) by volume. Mix with low speed drill and Jiffy mixer for three minutes and until uniform. To insure proper system cure and performance, strictly follow mix ratio recommendations.
 - c. Saturant coat may be applied via spray, roller or brush. Apply at a spread rate of 250-400 sq. ft. per gallon to yield 4-6 mils WFT evenly with no runs. Allow to cure overnight (minimum 10 hours) before lightly sanding seams, bumps and other imperfections with 60-80 grit sandpaper caused by the saturant coat.
- E. Level Coat
 1. Mixing and Application
 - a. Apply leveling coat as described in previous step.
 - b. Allow to cure overnight.
 - c. An additional level coat may be applied.
 - d. Sand any imperfections prior to applying finish coat.
- F. Finish Coat
 1. Mixing and Application
 - a. Premix resin using a low speed drill and Jiffy mixer. Mix for three minutes and until uniform, exercising caution not to introduce air into the material.
 - b. Add 1 part resin to 1 part hardener by volume. Mix with low speed drill and Jiffy mixer for three minutes and until uniform. To insure proper system cure and performance, strictly follow mix ratio recommendations.
 - c. Finish coat may be applied via spray, roller or brush. Apply using a 1/4" nap non-shedding, urethane enamel roller at a spread rate of 250-400 sq. ft. per gallon to yield 4-6 WFT mils evenly with no runs. If second coat is required, the surface must be abraded with 80-120 grit paper or screen and tack wiped prior to second application.
 - d. Allow to cure 48 hours for water exposure and 7 days for chemical exposure. In cool and/or high humidity conditions, a surface film may form which can be washed with soap and water.

END OF SECTION 09 96 56 00



Task	Specification	Specification Description
09 96 56 00	09 96 00 00	High-Performance Coatings

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SECTION 09 96 66 00 - CEMENTITIOUS COATINGS

1.1 GENERAL

A. Description Of Work

1. This specification covers the furnishing and installation of materials for cementitious coatings. Products shall be as follows or as directed by the Owner. Installation procedures shall be in accordance with the product manufacturer's recommendations. Demolition and removal of materials shall be as required to support the work.

B. Summary

1. Section includes surface preparation and application of cementitious coating systems on the following substrates:
 - a. Exterior and Interior concrete.
 - b. Exterior and Interior concrete masonry units.
 - c. Exterior and Interior brick.

C. Submittals

1. Product Data: For each type of product indicated.
2. LEED Submittal:
 - a. Product Data for Credit EQ 4.2: For paints and coatings, including printed statement of VOC content and chemical components.
3. Samples: In each color and gloss of finish coat indicated.
 - a. Submit Samples on rigid backing **OR** actual substrate, **as directed**, not less than **4 by 8 inches (100 by 200 mm)**, with mortar joint in center, **as directed**.
 - b. Step coats on Samples to show each coat required for system.
 - c. Label each coat of each Sample.
4. Material Certificates: For each cementitious coating, from manufacturer.
5. Product Test Reports: Based on evaluation of comprehensive tests performed by manufacturer and witnessed by a qualified testing agency or by a qualified testing agency, for each product formulation.

D. Quality Assurance

1. Source Limitations: Obtain cementitious coating materials from single source from single manufacturer.
2. Mockups: Apply benchmark samples of coating system indicated and each color and finish selected to verify preliminary selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
 - a. Architect will select one actual substrate of each type to represent surfaces and conditions for application of coating.
 - 1) Wall Surfaces: Prepare samples of at least **100 sq. ft. (9.3 sq. m)**.
 - b. Apply benchmark samples after permanent lighting and other environmental services have been activated.
 - c. Final approval of color selections will be based on benchmark samples.
 - 1) If preliminary color selections are not approved, apply additional benchmark samples of additional colors selected by Architect at no added cost to Owner.

E. Delivery, Storage, And Handling

1. Deliver materials to Project site in manufacturer's original, new, unopened packages and containers bearing manufacturer's name and label, and the following information:
 - a. Product name or title of material.
 - b. Manufacturer's stock number and date of manufacture.
 - c. Contents by volume, for pigment and vehicle constituents.
 - d. Application instructions.

- e. Color name and number.
- f. Handling instructions and precautions.
- 2. Store materials not in use in tightly covered containers in a well-ventilated area at a minimum ambient temperature of **45 deg F (7 deg C)**. Maintain containers used in storage of coatings in a clean condition, free of foreign materials and residue.
 - a. Protect cementitious coating materials from freezing. Keep materials dry and storage area neat and orderly. Remove waste daily. Take necessary measures to ensure that workers and work areas are protected from health hazards resulting from handling, mixing, and applying the coating.

F. Project Conditions

- 1. Apply coatings only when temperature of surfaces to be painted and ambient air temperatures are between **50 and 95 deg F (10 and 35 deg C)**.
- 2. Do not apply coatings when relative humidity exceeds 85 percent; at temperatures less than **5 deg F (3 deg C)** above the dew point; or to damp or wet surfaces.

1.2 PRODUCTS

A. Cementitious Coatings

- 1. Polymer-Modified Cementitious Coating: Containing portland cement, polymer, and hydrated lime or aggregates.
- 2. Performance Requirements: Comply with the following:
 - a. Compressive Strength: Not less than **3500 psi (24.1 MPa)** at 28 days according to ASTM C 109/C 109M.
 - b. Tensile Strength: Not less than **350 psi (2.41 MPa)** at 28 days according to ASTM C 109/C 109M.
 - c. Flexural Strength: as directed by the Owner.
 - d. Adhesion: as directed by the Owner.
 - e. Permeance: as directed by the Owner.
 - f. Accelerated Weathering: as directed by the Owner.
 - g. UV Resistance: as directed by the Owner.
 - h. Salt-Spray Resistance: as directed by the Owner.
- 3. Other Materials: Provide crack fillers, block fillers, and related materials that are compatible with cementitious finish-coat materials and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
- 4. Chemical Components of Field-Applied Interior Paints and Coatings: Provide products that comply with the following limits for VOC content, exclusive of colorants added to a tint base, when calculated according to 40 CFR 59, Subpart D (EPA Method 24) and the following chemical restrictions:
 - a. Flat Paints and Coatings: VOC content of not more than 50 g/L.
 - b. Nonflat Paints and Coatings: VOC content of not more than 150 g/L.
- 5. Chemical Components of Interior Paints and Coatings: Provide topcoat paints that comply with the following chemical restrictions:
 - a. Aromatic Compounds: Paints and coatings shall not contain more than 1.0 percent by weight of total aromatic compounds (hydrocarbon compounds containing one or more benzene rings).
 - b. Restricted Components: Paints and coatings shall not contain any of the following:
 - 1) Acrolein.
 - 2) Acrylonitrile.
 - 3) Antimony.
 - 4) Benzene.
 - 5) Butyl benzyl phthalate.
 - 6) Cadmium.
 - 7) Di (2-ethylhexyl) phthalate.

- 8) Di-n-butyl phthalate.
 - 9) Di-n-octyl phthalate.
 - 10) 1,2-dichlorobenzene.
 - 11) Diethyl phthalate.
 - 12) Dimethyl phthalate.
 - 13) Ethylbenzene.
 - 14) Formaldehyde.
 - 15) Hexavalent chromium.
 - 16) Isophorone.
 - 17) Lead.
 - 18) Mercury.
 - 19) Methyl ethyl ketone.
 - 20) Methyl isobutyl ketone.
 - 21) Methylene chloride.
 - 22) Naphthalene.
 - 23) Toluene (methylbenzene).
 - 24) 1,1,1-trichloroethane.
 - 25) Vinyl chloride.
6. Colors: As selected from manufacturer's full range **OR** As indicated in a color schedule, **as directed**.

1.3 EXECUTION

A. Examination

1. Examine substrates and conditions, with Applicator present, for compliance with requirements and other conditions affecting performance of the Work.
2. Verify suitability of substrates, including surface conditions and compatibility.
3. Begin coating application only after unsatisfactory conditions have been corrected and surfaces are dry.
 - a. Beginning coating application constitutes Contractor's acceptance of substrates and conditions.

B. Preparation

1. Comply with manufacturer's written instructions for mixing and preparing materials and as applicable to substrates indicated.
2. Remove plates, machined surfaces, and similar items already in place that are not to be coated. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and coating.
 - a. After completing coating operations, use workers skilled in the trades involved to reinstall items that were removed. Remove surface-applied protection if any.
3. Clean substrates of substances that could impair bond of coatings, including dirt, oil, grease, incompatible coatings, and loose substrate materials.
4. Cementitious and Masonry Surfaces: Remove release agents, curing compounds, efflorescence, and chalk. Do not paint surfaces if moisture content or alkalinity of surfaces to be painted exceeds that permitted in manufacturer's written instructions.
5. Crack Repair: Fill cracks according to manufacturer's written instructions before coating surfaces.
 - a. Cracks Larger Than **1/32 Inch (0.8 mm)**: Cut out static cracks, voids, or honeycombing larger than **1/32 inch (0.8 mm)** and patch with materials recommended in writing by coating manufacturer. Identify dynamic cracks and treat according to manufacturer's written instructions before beginning application.

C. Application

1. Apply coatings according to manufacturer's written instructions. Use applicators and techniques suited for coating and substrate indicated.

- a. Dampen substrate of surfaces to receive cementitious coatings one hour before beginning application to prevent surface drag. Immediately before applying coatings, redampen substrate. Substrates shall be saturated surface dry at time of application.
- b. Brushes: Use tampico or masonry brushes best suited for material being applied.
- c. Spray Equipment: Use spray equipment recommended in writing by manufacturer for material and texture required.
2. Apply each material at not less than manufacturer's recommended spreading rate. Provide total cured material thickness indicated or as recommended in writing by manufacturer.
3. Brush Application: Brush-out and work brush coats into surfaces in an even film, filling all pores and voids at rate recommended in writing by manufacturer to achieve cured material thickness indicated. Finish coat with smooth, horizontal strokes.
4. Spray Application: Apply each coat according to manufacturer's written instructions to provide the equivalent hiding of brush-applied coats. Follow spray application with a general light brooming of coated surface to impart a slight texture.

D. Field Quality Control

1. Testing of Coating Materials: Contractor shall invoke the following procedure at any time and as often as necessary during the period when coating operations are being conducted:
 - a. Engage the services of a qualified testing agency to sample coating materials being used. Samples of material delivered to Project site will be taken, identified, sealed, and certified in presence of Contractor.
 - b. Testing agency will perform tests for compliance with the following product requirements.
 - 1) Quantitative material analysis.
 - 2) Compressive strength.
 - 3) Tensile strength.
 - 4) Flexural strength.
 - 5) Permeance.
 - 6) Accelerated weathering.
 - c. the Owner may direct Contractor to stop coating application if test results show materials being used do not comply with requirements. Contractor shall remove noncomplying materials from Project site, pay for testing, and recoat surfaces coated with rejected materials. Contractor will be required to remove rejected materials from previously coated surfaces if, on recoating with complying materials, the two coatings are incompatible.

E. Cleaning And Protection

1. At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.
2. After completing coating application, clean spattered surfaces. Remove spattered coatings by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.
3. Protect work of other trades against damage from coating application. Correct damage to work of other trades by cleaning, repairing, replacing, and refinishing, as approved by the Owner, and leave in an undamaged condition.
4. At completion of construction activities of other trades, touch up and restore damaged or defaced coated surfaces.

F. Coating Schedule

1. General: Apply additional coats when undercoats or other conditions show through final coat until cured film is of uniform coating finish, color, and appearance.
2. Above-Grade Concrete and Masonry: Two finish coats with total cured thickness not less than **40 mils (1.0 mm)**.
 - a. First Coat: Apply polymer-modified cementitious coating material at the rate of **2 lb/sq. yd. (1 kg/sq. m)** to achieve a total cured thickness of **25 mils (0.6 mm)**.
 - b. Second Coat: Apply polymer-modified cementitious coating material at the rate of **1 lb/sq. yd. (0.5 kg/sq. m)** to achieve a total cured thickness of **15 mils (0.4 mm)**.

3. Surfaces Previously Coated with Polymer-Modified Cementitious Coating: One finish coat with a total cured thickness of not less than **15 mils (0.4 mm)**.
 - a. Apply polymer-modified cementitious coating material at the rate of **1 lb/sq. yd. (0.5 kg/sq. m)** to achieve a total cured thickness of **15 mils (0.4 mm)**.

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Task	Specification	Specification Description
09 97 13 23	09 96 00 00	High-Performance Coatings
09 97 13 24	09 96 00 00	High-Performance Coatings
09 97 26 13	09 96 00 00	High-Performance Coatings
09 97 35 00	09 91 23 00	Interior Painting
09 97 63 00	09 96 00 00	High-Performance Coatings

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SECTION 10 01 50 11 - METAL LOCKERS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Knocked-down corridor lockers.
2. Welded corridor lockers.
3. Knocked-down athletic lockers.
4. Welded athletic lockers.
5. Knocked-down, open-front athletic lockers.
6. Welded, open-front athletic lockers.
7. Locks.
8. Locker benches.

B. Related Requirements:

1. Section 105113.13 "Coin-Operated Metal Lockers" for coin-operated lockers used in public facilities for temporary storage of personal belongings.

1.2 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at **[Project site]** **<Insert location>**.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each type of metal locker **[and bench]**.

B. Sustainable Design Submittals:

1. <Double click to insert sustainable design text for recycled content.>
2. <Double click to insert sustainable design text for EPDs and HPDs.>
3. <Double click to insert sustainable design text for composite wood.>

C. Shop Drawings: For metal lockers.

1. Include plans, elevations, sections, and attachment details.
2. Show locker trim and accessories.
3. Include locker identification system and numbering sequence.

D. Samples: For each color specified, in manufacturer's standard size.

E. Samples for Initial Selection: Manufacturer's color charts showing the full range of colors available.

F. Samples for Verification: For the following products, in manufacturer's standard size:



1. Lockers and equipment.
2. Locker benches.

G. Product Schedule: For lockers.[**Use same designations indicated on Drawings.**]

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.
- B. Sample Warranty: For special warranty.

1.5 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For adjusting, repairing, and replacing locker doors and latching mechanisms to include in maintenance manuals.

1.6 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 1. The following metal locker hardware items equal to **[10]** **<Insert number>** percent of amount installed for each type and finish installed, but no fewer than **[five]** **<Insert number>** units:
 - a. Locks.
 - b. Blank identification plates.
 - c. Hooks.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Do not deliver metal lockers until spaces to receive them are clean, dry, and ready for their installation.
- B. Deliver **[master and control keys]** **[combination control charts]** to Owner by registered mail or overnight package service[.], **addressed as follows:**
 1. **<Insert name and address of Owner's representative>**.

1.8 FIELD CONDITIONS

- A. Field Measurements: Verify actual dimensions of recessed openings by field measurements before fabrication.

1.9 COORDINATION

- A. Coordinate sizes and locations of **[concrete]** **[concrete masonry]** **[wood]** bases for metal lockers.

- B. Coordinate sizes and locations of framing, blocking, furring, reinforcements, and other related units of work specified in other Sections to ensure that metal lockers can be supported and installed as indicated.

1.10 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace components of metal lockers that fail in materials or workmanship, excluding finish, within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Structural failures.
 - b. Faulty operation of latches and other door hardware.
 - 2. Damage from deliberate destruction and vandalism is excluded.
 - 3. Warranty Period for Knocked-Down Metal Lockers: **[Two]** **<Insert number>** years from date of Substantial Completion.
 - 4. Warranty Period for Welded Metal Lockers: **[Lifetime]** **[10 years]** **<Insert years>** from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Source Limitations: Obtain metal lockers[, **locker benches**,] and accessories from single source from single locker manufacturer.
 - 1. Obtain locks from single lock manufacturer.

2.2 PERFORMANCE REQUIREMENTS

- A. Accessibility Standard: For lockers[**and locker benches**] indicated to be accessible, comply with applicable provisions in [the USDOJ's "2010 ADA Standards for Accessible Design"] [the ABA standards of the Federal agency having jurisdiction] [and] [ICC A117.1] **<Insert requirement>**.

2.3 KNOCKED-DOWN CORRIDOR LOCKERS **<Insert designation>**

- A. **<Double click here to find, evaluate, and insert list of manufacturers and products.>**
- B. Doors: One piece; fabricated from **[0.060-inch (1.52-mm)] [0.075-inch (1.90-mm)]** nominal-thickness steel sheet; formed into channel shape with double bend at vertical edges and with right-angle single bend at horizontal edges.
 - 1. Doors less than **12 inches (305 mm)** wide may be fabricated from **0.048-inch (1.21-mm)** nominal-thickness steel sheet.
 - 2. Doors for box lockers less than **15 inches (381 mm)** wide may be fabricated from **0.048-inch (1.21-mm)** nominal-thickness steel sheet.
 - 3. Reinforcement: Manufacturer's standard reinforcing angles, channels, or stiffeners for doors more than **15 inches (381 mm)** wide; welded to inner face of doors.

4. Stiffeners: Manufacturer's standard full-height stiffener fabricated from 0.048-inch (1.21-mm) nominal-thickness steel sheet; welded to inner face of doors.
 5. Sound-Dampening Panels: Manufacturer's standard, designed to stiffen doors and reduce sound levels when doors are closed, of die-formed metal with full perimeter flange and sound-dampening material; welded to inner face of doors.
 6. Door Style: **[Unperforated panel.] [Vented panel as follows:]**
 - a. Louvered Vents: No fewer than **[six louver openings at top and bottom for single-tier] [three louver openings at top and bottom for double-tier] [two louver openings at top and bottom, or three louver openings at top or bottom, for triple-tier] <Insert configuration>** lockers.
 - b. Security Vents: Manufacturer's standard, stamped horizontal or vertical.
 - c. Perforated Vents: **[Manufacturer's standard shape and configuration] <Insert shape and configuration>**.
 - d. Concealed Vents: Slotted perforations in top and bottom horizontal door return flanges.
- C. Body: Assembled by riveting or bolting body components together. Fabricate from unperforated steel sheet with thicknesses as follows:
1. Tops, Bottoms, and Intermediate Dividers: 0.024-inch (0.61-mm) nominal thickness, with single bend at sides.
 2. Backs and Sides: 0.024-inch (0.61-mm) nominal thickness, with full-height, double-flanged connections.
 3. Shelves: 0.024-inch (0.61-mm) nominal thickness, with double bend at front and single bend at sides and back.
- D. Frames: Channel formed; fabricated from 0.060-inch (1.52-mm) nominal-thickness steel sheet; lapped and factory welded at corners; with top and bottom main frames factory welded into vertical main frames. Form continuous, integral, full-height door strikes on vertical main frames.
1. Cross Frames between Tiers: Channel formed and fabricated from same material as main frames; welded to vertical main frames.
 2. Frame Vents: Fabricate face frames with vents.
- E. Hinges: Welded to door and attached to door frame with no fewer than two factory-installed rivets per hinge that are completely concealed and tamper resistant when door is closed; fabricated to swing 180 degrees; **self-closing**.
1. Knuckle Hinges: Steel, full loop, five or seven knuckles, tight pin; minimum 2 inches (51 mm) high. Provide no fewer than three hinges for each door more than 42 inches (1067 mm) high.
 2. Continuous Hinges: Manufacturer's standard, steel, full height.
 3. Hinges: Manufacturer's standard, steel, continuous or knuckle type.
- F. Projecting Door Handle and Latch: Finger-lift latch control designed for use with either built-in combination locks or padlocks; positive automatic latching, chromium plated; pry and vandal resistant.
1. Latch Hooks: Equip doors 48 inches (1219 mm) and higher with three latch hooks and doors less than 48 inches (1219 mm) high with two latch hooks; fabricated from 0.105-inch (2.66-mm) nominal-thickness steel sheet; welded or riveted to full-height door strikes; with resilient silencer on each latch hook.
 2. Latching Mechanism: Manufacturer's standard, rattle-free latching mechanism and moving components isolated to prevent metal-to-metal contact, and incorporating a prelocking device that allows locker door to be locked while door is open and then closed without unlocking or damaging lock or latching mechanism.

- G. Recessed Door Handle and Latch: Stainless steel cup with integral door pull, recessed so locking device does not protrude beyond door face; pry and vandal resistant.
1. Multipoint Latching: Finger-lift latch control designed for use with built-in combination locks, built-in key locks, or padlocks; positive automatic latching and prelocking.
 - a. Latch Hooks: Equip doors **48 inches (1219 mm)** and higher with three latch hooks and doors less than **48 inches (1219 mm)** high with two latch hooks; fabricated from **0.105-inch (2.66-mm)** nominal-thickness steel sheet; welded or riveted to full-height door strikes; with resilient silencer on each latch hook.
 - b. Latching Mechanism: Manufacturer's standard, rattle-free latching mechanism and moving components isolated to prevent metal-to-metal contact, and incorporating a prelocking device that allows locker door to be locked while door is open and then closed without unlocking or damaging lock or latching mechanism.
 2. Single-Point Latching: Nonmoving latch hook **[designed to engage bolt of built-in combination or cylinder lock] [with steel padlock loop that projects through recessed cup and is finished to match metal locker body]**.
 - a. Latch Hook: Equip each door with one latch hook, fabricated from **0.105-inch (2.66-mm)** nominal-thickness steel sheet; welded midway up full-height door strike; with resilient silencer.
- H. Door Handle and Latch for **[Box] [16-Person]** Lockers: Stainless steel strike plate with integral pull; with steel padlock loop that projects through metal locker door.
- I. Locks: **[Combination padlocks] [Built-in combination locks] [Cylinder locks] [Built-in, card-operated locks] [Digital keypad locks] [Built-in, coin-operated locks]**.
- J. Identification Plates: Manufacturer's standard, etched, embossed, or stamped **[aluminum] [plastic]** plates, with numbers and letters at least **3/8 inch (9 mm)** high.
- K. Hooks: Manufacturer's standard ball-pointed hooks, aluminum or steel; zinc plated.
- L. Coat Rods: **[1-inch- (25-mm-) diameter steel tube or rod, chrome finished] [1-inch- (25-mm-) diameter steel tube or rod, nickel plated] [3/4-inch- (19-mm-) diameter steel tube or rod, chrome finished] [3/4-inch- (19-mm-) diameter steel tube or rod, nickel plated] [Manufacturer's standard]**.
- M. Legs: **[6 inches (152 mm)] <Insert dimension>** high; formed by extending vertical frame members, or fabricated from **0.075-inch (1.90-mm)** nominal-thickness steel sheet; welded to bottom of locker.
 1. Closed Front and End Bases: Fabricated from **0.036-inch (0.91-mm)** nominal-thickness steel sheet.
- N. Continuous Zee Base: Fabricated from **[0.060-inch (1.52-mm)] [0.075-inch (1.90-mm)] [manufacturer's standard thickness, but not less than 0.060-inch (1.52-mm)]** nominal-thickness steel sheet.
 1. Height: **[4 inches (102 mm)] <Insert dimension>**.
- O. Continuous Sloping Tops: Fabricated from **[0.036-inch (0.91-mm)] [0.048-inch (1.21-mm)] [manufacturer's standard thickness, but not less than 0.036-inch (0.91-mm)]** nominal-thickness steel sheet.
 1. Closures: **[Vertical] [Hipped]**-end type.
 2. Sloping-top corner fillers, mitered.

- P. Individual Sloping Tops: Fabricated from **0.024-inch (0.61-mm)** nominal-thickness steel sheet.
- Q. Recess Trim: Fabricated from **0.048-inch (1.21-mm)** nominal-thickness steel sheet.
- R. Filler Panels: Fabricated from **[0.036-inch (0.91-mm)] [0.048-inch (1.21-mm)] [manufacturer's standard thickness, but not less than 0.036-inch (0.91-mm)]** nominal-thickness steel sheet.
- S. Boxed End Panels: Fabricated from **0.060-inch (1.52-mm)** nominal-thickness steel sheet.
- T. Finished End Panels: Fabricated from **0.024-inch (0.61-mm)** nominal-thickness steel sheet to cover unused penetrations and fasteners, except for perimeter fasteners, at exposed ends of nonrecessed metal lockers; finished to match lockers.
- U. Center Dividers: Fabricated from **0.024-inch (0.61-mm)** nominal-thickness steel sheet.
- V. Materials:
 - 1. Cold-Rolled Steel Sheet: ASTM A1008/A1008M, Commercial Steel (CS), Type B, suitable for exposed applications.
 - 2. Metallic-Coated Steel Sheet: ASTM A653/A653M, Commercial Steel (CS), Type B; with **A60 (ZF180)** zinc-iron, alloy (galvannealed) coating designation.
 - 3. <Double click to insert sustainable design text for recycled content.>
- W. Finish: Baked enamel or powder coat.
 - 1. Color: **[As indicated by manufacturer's designations] [Match Architect's sample] [As selected by Architect from manufacturer's full range] [Two colors, with door one color and frame and body another color; as selected by Architect from manufacturer's full range] <Insert color>.**

2.4 WELDED CORRIDOR LOCKERS <Insert designation>

- A. <Double click here to find, evaluate, and insert list of manufacturers and products.>
- B. Doors: One piece; fabricated from **0.075-inch (1.90-mm)** nominal-thickness steel sheet; formed into channel shape with double bend at vertical edges and with right-angle single bend at horizontal edges.
 - 1. Reinforcement: Manufacturer's standard reinforcing angles, channels, or stiffeners for doors more than **15 inches (381 mm)** wide; welded to inner face of doors.
 - 2. Door Style: **[Unperforated panel.] [Vented panel as follows:]**
 - a. Louvered Vents: No fewer than **[six louver openings at top and bottom for single-tier] [three louver openings at top and bottom for double-tier] [two louver openings at top and bottom, or three louver openings at top or bottom, for triple-tier] <Insert configuration>** lockers.
 - b. Security Vents: Manufacturer's standard, stamped horizontal or vertical.
 - c. Perforated Vents: **[Manufacturer's standard shape and configuration] <Insert shape and configuration>.**
- C. Body: Assembled by welding body components together. Fabricate from unperforated steel sheet with thicknesses as follows:
 - 1. Tops, Bottoms, and Sides: **0.060-inch (1.52-mm)** nominal thickness.

2. Backs: 0.048-inch (1.21-mm) nominal thickness.
 3. Shelves: 0.060-inch (1.52-mm) nominal thickness, with double bend at front and single bend at sides and back.
- D. Frames: Channel formed; fabricated from 0.060-inch (1.52-mm) nominal-thickness steel sheet; lapped and factory welded at corners; with top and bottom main frames factory welded into vertical main frames. Form continuous, integral, full-height door strikes on vertical main frames.
1. Cross Frames between Tiers: Channel formed and fabricated from same material as main frames; welded to vertical main frames.
- E. Hinges: Welded to door and attached to door frame with no fewer than two factory-installed rivets per hinge that are completely concealed and tamper resistant when door is closed; fabricated to swing 180 degrees; **self-closing**.
1. Knuckle Hinges: Steel, full loop, five or seven knuckles, tight pin; minimum 2 inches (51 mm) high. Provide no fewer than three hinges for each door more than 42 inches (1067 mm) high.
 2. Continuous Hinges: Manufacturer's standard, steel, full height.
 3. Hinges: Manufacturer's standard, steel, continuous or knuckle type.
- F. Projecting Door Handle and Latch: Finger-lift latch control designed for use with either built-in combination locks or padlocks; positive automatic latching, chromium plated; pry and vandal resistant.
1. Latch Hooks: Equip doors 48 inches (1219 mm) and higher with three latch hooks and doors less than 48 inches (1219 mm) high with two latch hooks; fabricated from 0.105-inch (2.66-mm) nominal-thickness steel sheet; welded or riveted to full-height door strikes; with resilient silencer on each latch hook.
 2. Latching Mechanism: Manufacturer's standard, rattle-free latching mechanism and moving components isolated to prevent metal-to-metal contact, and incorporating a prelocking device that allows locker door to be locked while door is open and then closed without unlocking or damaging lock or latching mechanism.
- G. Recessed Door Handle and Latch: Stainless steel cup with integral door pull, recessed so locking device does not protrude beyond door face; pry and vandal resistant.
1. Multipoint Latching: Finger-lift latch control designed for use with built-in combination locks or padlocks; positive automatic latching and prelocking.
 - a. Latch Hooks: Equip doors 48 inches (1219 mm) and higher with three latch hooks and doors less than 48 inches (1219 mm) high with two latch hooks; fabricated from 0.120-inch (3.04-mm) nominal-thickness steel sheet; welded to full-height door strikes; with resilient silencer on each latch hook.
 - b. Latching Mechanism: Manufacturer's standard, rattle-free latching mechanism and moving components isolated to prevent metal-to-metal contact, and incorporating a prelocking device that allows locker door to be locked while door is open and then closed without unlocking or damaging lock or latching mechanism.
 2. Single-Point Latching: Nonmoving latch hook **[designed to engage bolt of built-in combination or cylinder lock] [with steel padlock loop that projects through recessed cup and is finished to match metal locker body]**.
 - a. Latch Hook: Equip each door with one latch hook, fabricated from 0.120-inch (3.04-mm) nominal-thickness steel sheet; welded midway up full-height door strike; with resilient silencer.

- H. Door Handle and Latch for **[Box]** **[16-Person]** Lockers: Stainless steel strike plate with integral pull; with steel padlock loop that projects through metal locker door.
- I. Locks: **[Combination padlocks]** **[Built-in combination locks]** **[Cylinder locks]** **[Built-in, card-operated locks]** **[Digital keypad locks]** **[Built-in, coin-operated locks]**.
- J. Identification Plates: Manufacturer's standard, etched, embossed, or stamped **[aluminum]** **[plastic]** plates, with numbers and letters at least **3/8 inch (9 mm)** high.
- K. Hooks: Manufacturer's standard ball-pointed, aluminum or steel; zinc plated.
- L. Coat Rods: **[1-inch- (25-mm-) diameter steel, chrome finished]** **[1-inch- (25-mm-) diameter steel, nickel plated]** **[3/4-inch- (19-mm-) diameter steel, chrome finished]** **[3/4-inch- (19-mm-) diameter steel, nickel plated]** **[Manufacturer's standard]**.
- M. Legs: **[6 inches (152 mm)]** **<Insert dimension>** high; formed by extending vertical frame members, or fabricated from **0.075-inch (1.90-mm)** nominal-thickness steel sheet; welded to bottom of locker.
1. Closed Front and End Bases: Fabricated from **0.036-inch (0.91-mm)** nominal-thickness steel sheet.
- N. Continuous Zee Base: Fabricated from, **[0.060-inch (1.52-mm)]** **[0.075-inch (1.90-mm)]** **[manufacturer's standard thickness, but not less than 0.060-inch (1.52-mm)]** nominal-thickness steel sheet.
1. Height: **[4 inches (102 mm)]** **<Insert dimension>**.
- O. Continuous Sloping Tops: Fabricated from **0.048-inch (1.21-mm)** nominal-thickness steel sheet, with a pitch of approximately 20 degrees.
1. Closures: **[Vertical]** **[Hipped]**-end type.
- P. Recess Trim: Fabricated from **0.048-inch (1.21-mm)** nominal-thickness steel sheet.
- Q. Filler Panels: Fabricated from **0.048-inch (1.21-mm)** nominal-thickness steel sheet.
- R. Boxed End Panels: Fabricated from **0.048-inch (1.21-mm)** nominal-thickness steel sheet.
- S. Finished End Panels: Fabricated from **0.024-inch (0.61-mm)** nominal-thickness steel sheet to cover unused penetrations and fasteners, except for perimeter fasteners, at exposed ends of nonrecessed metal lockers; finished to match lockers.
- T. Materials:
1. Cold-Rolled Steel Sheet: ASTM A1008/A1008M, Commercial Steel (CS), Type B, suitable for exposed applications.
 2. Metallic-Coated Steel Sheet: ASTM A653/A653M, Commercial Steel (CS), Type B; with **A60 (ZF180)** zinc-iron, alloy (galvannealed) coating designation.
 3. [<Double click to insert sustainable design text for recycled content.>](#)
- U. Finish: Baked enamel or powder coat.
1. Color: **[As indicated by manufacturer's designations]** **[Match Architect's sample]** **[As selected by Architect from manufacturer's full range]** **[Two colors, with door one color and**

frame and body another color; as selected by Architect from manufacturer's full range] <Insert color>.

2.5 KNOCKED-DOWN ATHLETIC LOCKERS <Insert designation>

- A. [<Double click here to find, evaluate, and insert list of manufacturers and products.>](#)
- B. Perforated Doors: One piece; fabricated from **0.075-inch (1.90-mm)** nominal-thickness steel sheet with manufacturer's standard diamond perforations; formed into channel shape with double bend at **[vertical edges and with right-angle single bend at horizontal edges]** **[and]** **[latch point (bottom) and right-angle single bend at remaining edges for box lockers]**.
1. Reinforcement: Manufacturer's standard reinforcing angles, channels, or stiffeners for doors more than **15 inches (381 mm)** wide; welded to inner face of doors.
- C. Expanded-Metal Doors: Fabricated from **0.090-inch (2.28-mm)** nominal-thickness expanded metal; welded to **0.105-inch (2.66-mm)** nominal-thickness steel angle frame; with **0.090-inch (2.28-mm)** nominal-thickness, steel sheet lock panel backed by **0.060-inch (1.52-mm)** nominal-thickness, steel sheet retainer welded to door frame.
- D. Body: Assembled by riveting or bolting body components together. Fabricate from unperforated steel sheet with thicknesses as follows:
1. Tops and Bottoms: **0.060-inch (1.52-mm)** nominal thickness, with single bend at edges.
 2. Backs: **0.048-inch (1.21-mm)** nominal thickness.
 3. Shelves: **0.060-inch (1.52-mm)** nominal thickness, with double bend at front and single bend at sides and back.
- E. Unperforated Sides: Fabricated from **[0.048-inch (1.21-mm)] [0.060-inch (1.52-mm)]** nominal-thickness steel sheet.
- F. Perforated Sides: Fabricated from **0.060-inch (1.52-mm)** nominal-thickness steel sheet with manufacturer's standard diamond perforations.
- G. Expanded-Metal Sides: Fabricated from **0.090-inch (2.28-mm)** nominal-thickness expanded metal; welded to **0.105-inch (2.66-mm)** nominal-thickness steel angles or **0.060-inch (1.52-mm)** nominal-thickness steel channel frames.
- H. Frames: Channel formed; fabricated from **0.060-inch (1.52-mm)** nominal-thickness steel sheet or **0.097-inch (2.45-mm)** nominal-thickness steel angles; lapped and factory welded at corners; with top and bottom main frames factory welded into vertical main frames. Form continuous, integral, full-height door strikes on vertical main frames.
1. Cross Frames for **[Double-Tier] [Triple-Tier]** Lockers: Channel formed and fabricated from same material as main frames; welded to vertical main frames.
- I. Reinforced Bottoms: Structural channels, formed from **[0.060-inch (1.52-mm)] [0.075-inch (1.90-mm)]** nominal-thickness steel sheet; welded to front and rear of side-panel frames.
- J. Hinges: Welded to door and attached to door frame with no fewer than two factory-installed rivets per hinge that are completely concealed and tamper resistant when door is closed; fabricated to swing 180 degrees; **self-closing**.
1. Knuckle Hinges: Steel, full loop, five or seven knuckles, tight pin; minimum **2 inches (51 mm)** high. Provide no fewer than three hinges for each door more than **42 inches (1067 mm)** high.

2. Continuous Hinges: Manufacturer's standard, steel; side or top mounted as required by locker configuration.
 3. Hinges: Manufacturer's standard, steel, continuous or knuckle type.
- K. Recessed Door Handle and Latch: Stainless steel cup with integral door pull, recessed so locking device does not protrude beyond door face; pry and vandal resistant.
1. Multipoint Latching: Finger-lift latch control designed for use with built-in combination locks, built-in cylinder locks, or padlocks; positive automatic latching and prelocking.
 - a. Latch Hooks: Equip doors **48 inches (1219 mm)** and higher with three latch hooks and doors less than **48 inches (1219 mm)** high with two latch hooks; fabricated from **0.120-inch (3.04-mm)** nominal-thickness steel sheet; welded to full-height door strikes; with resilient silencer on each latch hook.
 - b. Latching Mechanism: Manufacturer's standard, rattle-free latching mechanism and moving components isolated to prevent metal-to-metal contact, and incorporating a prelocking device that allows locker door to be locked while door is open and then closed without unlocking or damaging lock or latching mechanism.
 2. Single-Point Latching: Nonmoving latch hook **[designed to engage bolt of built-in combination or cylinder lock] [with steel padlock loop that projects through recessed cup and is finished to match metal locker body]**.
 - a. Latch Hook: Equip each door with one latch hook, fabricated from **0.120-inch (3.04-mm)** nominal-thickness steel sheet; welded midway up full-height door strike; with resilient silencer.
- L. Projecting Turn-Handle and Latch: Steel handle welded to manufacturer's standard, three-point, cremone-type latching mechanism consisting of steel rods or bars that engage locker frame at top and bottom of door, and center latch that engages strike jamb; with steel padlock loop.
- M. Door Handle and Latch for Box Lockers: Stainless steel strike plate with integral pull; with steel padlock loop that projects through metal locker door.
- N. Locks: **[Combination padlocks] [Built-in combination locks] [Cylinder locks] [Built-in, card-operated locks] [Digital keypad locks] [Built-in, coin-operated locks]**.
- O. Identification Plates: Manufacturer's standard, etched, embossed, or stamped **[aluminum] [plastic]** plates, with numbers and letters at least **3/8 inch (9 mm)** high.
- P. Hooks: Manufacturer's standard ball-pointed, aluminum or steel; zinc plated.
- Q. Coat Rods: **[1-inch- (25-mm-) diameter steel, chrome finished] [1-inch- (25-mm-) diameter steel, nickel plated] [3/4-inch- (19-mm-) diameter steel, chrome finished] [3/4-inch- (19-mm-) diameter steel, nickel plated] [Manufacturer's standard]**.
- R. Legs: **[6 inches (152 mm)] <Insert dimension>** high; formed by extending vertical frame members, or fabricated from **0.075-inch (1.90-mm)** nominal-thickness steel sheet; welded to bottom of locker.
1. Closed Front and End Bases: Fabricated from **0.048-inch (1.21-mm)** nominal-thickness steel sheet.
- S. Continuous Zee Base: **4 inches (102 mm)** high; fabricated from **0.075-inch (1.90-mm)** nominal-thickness steel sheet.

- T. Continuous Sloping Tops: Fabricated from 0.048-inch (1.21-mm) nominal-thickness steel sheet, with a pitch of approximately 20 degrees.
 - 1. Closures: **[Vertical] [Hipped]**-end type.
- U. Recess Trim: Fabricated from 0.048-inch (1.21-mm) nominal-thickness steel sheet.
- V. Filler Panels: Fabricated from 0.048-inch (1.21-mm) nominal-thickness steel sheet.
- W. Boxed End Panels: Fabricated from 0.060-inch (1.52-mm) nominal-thickness steel sheet.
- X. Finished End Panels: Fabricated from 0.024-inch (0.61-mm) nominal-thickness steel sheet to cover unused penetrations and fasteners, except for perimeter fasteners, at exposed ends of nonrecessed metal lockers; finished to match lockers.
- Y. Materials:
 - 1. Cold-Rolled Steel Sheet: ASTM A1008/A1008M, Commercial Steel (CS), Type B, suitable for exposed applications.
 - 2. Metallic-Coated Steel Sheet: ASTM A653/A653M, Commercial Steel (CS), Type B; with A60 (ZF180) zinc-iron, alloy (galvannealed) coating designation.
 - 3. Expanded Metal: ASTM F1267, Type II (flattened), Class I (uncoated), 3/4-inch (19-mm) steel mesh, with at least 70 percent open area.
 - 4. [<Double click to insert sustainable design text for recycled content.>](#)
- Z. Finish: Baked enamel or powder coat.
 - 1. Color: **[As indicated by manufacturer's designations] [Match Architect's sample] [As selected by Architect from manufacturer's full range] [Two colors, with door one color and frame and body another color; as selected by Architect from manufacturer's full range] <Insert color>.**

2.6 WELDED ATHLETIC LOCKERS <Insert designation>

- A. [<Double click here to find, evaluate, and insert list of manufacturers and products.>](#)
- B. Perforated Doors: One piece; fabricated from 0.075-inch (1.90-mm) nominal-thickness steel sheet with manufacturer's standard diamond perforations; formed into channel shape with double bend at **[vertical edges and with right-angle single bend at horizontal edges] [and] [latch point (bottom) and right-angle single bend at remaining edges for box lockers]**.
 - 1. Reinforcement: Manufacturer's standard reinforcing angles, channels, or stiffeners for doors more than 15 inches (381 mm) wide; welded to inner face of doors.
- C. Expanded-Metal Doors: Fabricated from 0.090-inch (2.28-mm) nominal-thickness expanded metal; welded to 0.105-inch (2.66-mm) nominal-thickness steel angle frame; with 0.090-inch (2.28-mm) nominal-thickness, steel sheet lock panel backed by 0.060-inch (1.52-mm) nominal-thickness, steel sheet retainer welded to door frame.
- D. Body: Assembled by welding body components together. Fabricate from unperforated steel sheet with thicknesses as follows:
 - 1. Tops and Bottoms: 0.060-inch (1.52-mm) nominal thickness, with single bend at edges.
 - 2. Backs: 0.048-inch (1.21-mm) nominal thickness.

3. Shelves: **0.060-inch (1.52-mm)** nominal thickness, with double bend at front and single bend at sides and back.
- E. Unperforated Sides: Fabricated from [**0.048-inch (1.21-mm)**] [**0.060-inch (1.52-mm)**] nominal-thickness steel sheet.
- F. Perforated Sides: Fabricated from **0.060-inch (1.52-mm)** nominal-thickness steel sheet with manufacturer's standard diamond perforations.
- G. Expanded-Metal Sides: Fabricated from **0.090-inch (2.28-mm)** nominal-thickness expanded metal; welded to **0.105-inch (2.66-mm)** nominal-thickness steel angles or **0.060-inch (1.52-mm)** nominal-thickness steel channel frames.
- H. Frames: Channel formed; fabricated from **0.060-inch (1.52-mm)** nominal-thickness steel sheet or **0.097-inch (2.45-mm)** nominal-thickness steel angles; lapped and factory welded at corners; with top and bottom main frames factory welded into vertical main frames. Form continuous, integral, full-height door strikes on vertical main frames.
 1. Cross Frames for [**Double-Tier**] [**Triple-Tier**] Lockers: Channel formed and fabricated from same material as main frames; welded to vertical main frames.
- I. Reinforced Bottoms: Structural channels, formed from [**0.060-inch (1.52-mm)**] [**0.075-inch (1.90-mm)**] nominal-thickness steel sheet; welded to front and rear of side-panel frames.
- J. Hinges: Welded to door and attached to door frame with no fewer than two factory-installed rivets per hinge that are completely concealed and tamper resistant when door is closed; fabricated to swing 180 degrees[; **self-closing**].
 1. Knuckle Hinges: Steel, full loop, five or seven knuckles, tight pin; minimum **2 inches (51 mm)** high. Provide no fewer than three hinges for each door more than **42 inches (1067 mm)** high.
 2. Continuous Hinges: Manufacturer's standard, steel; side or top mounted as required by locker configuration.
 3. Hinges: Manufacturer's standard, steel, continuous or knuckle type.
- K. Recessed Door Handle and Latch: Stainless steel cup with integral door pull, recessed so locking device does not protrude beyond door face; pry and vandal resistant.
 1. Multipoint Latching: Finger-lift latch control designed for use with built-in combination locks, built-in cylinder locks, or padlocks; positive automatic latching and prelocking.
 - a. Latch Hooks: Equip doors **48 inches (1219 mm)** and higher with three latch hooks and doors less than **48 inches (1219 mm)** high with two latch hooks; fabricated from **0.120-inch (3.04-mm)** nominal-thickness steel sheet; welded to full-height door strikes; with resilient silencer on each latch hook.
 - b. Latching Mechanism: Manufacturer's standard, rattle-free latching mechanism and moving components isolated to prevent metal-to-metal contact, and incorporating a prelocking device that allows locker door to be locked while door is open and then closed without unlocking or damaging lock or latching mechanism.
 2. Single-Point Latching: Nonmoving latch hook [**designed to engage bolt of built-in combination or cylinder lock**] [**with steel padlock loop that projects through recessed cup and is finished to match metal locker body**].

- a. Latch Hook: Equip each door with one latch hook, fabricated from 0.120-inch (3.04-mm) nominal-thickness steel sheet; welded midway up full-height door strike; with resilient silencer.
- L. Projecting Turn-Handle and Latch: Steel handle welded to manufacturer's standard, three-point, cremone-type latching mechanism consisting of steel rods or bars that engage locker frame at top and bottom of door, and center latch that engages strike jamb; with steel padlock loop.
- M. Door Handle and Latch for Box Lockers: Stainless steel strike plate with integral pull; with steel padlock loop that projects through metal locker door.
- N. Locks: **[Combination padlocks]** **[Built-in combination locks]** **[Cylinder locks]** **[Built-in, card-operated locks]** **[Digital keypad locks]** **[Built-in, coin-operated locks]**.
- O. Identification Plates: Manufacturer's standard, etched, embossed, or stamped **[aluminum]** **[plastic]** plates, with numbers and letters at least 3/8 inch (9 mm) high.
- P. Hooks: Manufacturer's standard ball-pointed, aluminum or steel; zinc plated.
- Q. Coat Rods: **[1-inch- (25-mm-) diameter steel, chrome finished]** **[1-inch- (25-mm-) diameter steel, nickel plated]** **[3/4-inch- (19-mm-) diameter steel, chrome finished]** **[3/4-inch- (19-mm-) diameter steel, nickel plated]** **[Manufacturer's standard]**.
- R. Legs: **[6 inches (152 mm)]** **<Insert dimension>** high; formed by extending vertical frame members, or fabricated from 0.075-inch (1.90-mm) nominal-thickness steel sheet; welded to bottom of locker.
 1. Closed Front and End Bases: Fabricated from 0.048-inch (1.21-mm) nominal-thickness steel sheet.
- S. Continuous Zee Base: 4 inches (102 mm) high; fabricated from 0.075-inch (1.90-mm) nominal-thickness steel sheet.
- T. Continuous Sloping Tops: Fabricated from 0.048-inch (1.21-mm) nominal-thickness steel sheet, with a pitch of approximately 20 degrees.
 1. Closures: **[Vertical]** **[Hipped]**-end type.
- U. Recess Trim: Fabricated from 0.048-inch (1.21-mm) nominal-thickness steel sheet.
- V. Filler Panels: Fabricated from 0.048-inch (1.21-mm) nominal-thickness steel sheet.
- W. Boxed End Panels: Fabricated from 0.060-inch (1.52-mm) nominal-thickness steel sheet.
- X. Finished End Panels: Fabricated from 0.024-inch (0.61-mm) nominal-thickness steel sheet to cover unused penetrations and fasteners, except for perimeter fasteners, at exposed ends of nonrecessed metal lockers; finished to match lockers.
- Y. Materials:
 1. Cold-Rolled Steel Sheet: ASTM A1008/A1008M, Commercial Steel (CS), Type B, suitable for exposed applications.
 2. Metallic-Coated Steel Sheet: ASTM A653/A653M, Commercial Steel (CS), Type B; with **A60 (ZF180)** zinc-iron, alloy (galvannealed) coating designation.
 3. Expanded Metal: ASTM F1267, Type II (flattened), Class I (uncoated), 3/4-inch (19-mm) steel mesh, with at least 70 percent open area.

4. [<Double click to insert sustainable design text for recycled content.>](#)

Z. Finish: Baked enamel or powder coat.

1. Color: [As indicated by manufacturer's designations] [Match Architect's sample] [As selected by Architect from manufacturer's full range] [Two colors, with door one color and frame and body another color; as selected by Architect from manufacturer's full range] <Insert color>.

2.7 KNOCKED-DOWN, OPEN-FRONT ATHLETIC LOCKERS <Insert designation>

A. [<Double click here to find, evaluate, and insert list of manufacturers and products.>](#)

B. Locker Arrangement: Open front, with [seat/shelf] [seat/footlocker] [upper shelf] [upper shelf with security box] [and] [full-width security compartment] [configuration as indicated on Drawings].

C. Body: Assembled by riveting or bolting body components together. Fabricate from unperforated steel sheet with thicknesses as follows:

1. Tops and Bottoms: 0.060-inch (1.52-mm) nominal thickness, with single bend at edges.
2. Backs: 0.048-inch (1.21-mm) nominal thickness.
3. Shelves: 0.060-inch (1.52-mm) nominal thickness, with double bend at front and single bend at sides and back.

D. Unperforated Sides: Fabricated from 0.060-inch (1.52-mm) nominal-thickness steel sheet.

E. Perforated Sides: Fabricated from 0.060-inch (1.52-mm) nominal-thickness steel sheet with manufacturer's standard diamond perforations. Perforations shall not occur [above upper shelf] [at security compartment] [or] [at seat/footlocker].

F. Expanded-Metal Sides: Fabricated from 0.090-inch (2.28-mm) nominal-thickness expanded metal; welded to 0.105-inch (2.66-mm) nominal-thickness steel angles or 0.060-inch (1.52-mm) nominal-thickness steel channel frames.

G. Frames: Channel formed; fabricated from 0.060-inch (1.52-mm) nominal-thickness steel sheet or 0.105-inch (2.66-mm) nominal-thickness steel angles; lapped and factory welded at corners; with top and bottom main frames factory welded into vertical main frames.

H. Reinforced Bottoms: Structural channels, formed from 0.075-inch (1.90-mm) nominal-thickness steel sheet; welded to front and rear of side-panel frames.

I. Seats/Shelves: Full width of metal locker; channel formed; fabricated from 0.075-inch (1.90-mm) nominal-thickness steel sheet; with stiffeners for reinforcement.

J. Seats/Footlockers: Enclosure full width of bottom of metal locker; fabricated from cold-rolled steel sheet.

1. Seat/Lid: 0.075-inch (1.90-mm) nominal-thickness steel sheet; channel formed and reinforced with stiffeners; with manufacturer's standard, steel continuous hinge that is completely concealed and tamper resistant when seat/lid is closed; with padlock hasp.
2. Front Panel: 0.075-inch (1.90-mm) nominal-thickness steel sheet; channel formed at top edge; with minilouvers for ventilation; recessed for padlock loop.
3. Sides: [Integral part of unperforated] [Unperforated bottom portions of perforated] [0.060-inch (1.52-mm) nominal-thickness steel sheet inside expanded-metal] sides.

- K. Security Boxes: Nonperforated, consisting of partition extending from upper shelf to top of metal locker, fabricated from **0.060-inch (1.52-mm)** nominal-thickness steel sheet; with channel-formed, **0.060-inch (1.52-mm)** nominal-thickness, steel sheet door frame, and door fabricated from **0.075-inch (1.90-mm)** nominal-thickness steel sheet with right-angle single bend at edges; with manufacturer's standard, steel continuous hinge that is completely concealed and tamper resistant when door is closed; fabricated to swing 180 degrees.
1. Single-Point Latching: Stainless steel strike plate with integral pull; with steel, nonmoving latch hook **[designed to engage bolt of lock] [with steel padlock loop that projects through door and is finished to match metal locker body]**.
 2. Locks: **[Combination padlocks] [Built-in combination locks] <Insert item>**.
- L. Security Compartments: Nonperforated, running full width of metal locker, with door fabricated from **0.075-inch (1.90-mm)** nominal-thickness steel sheet.
1. Locks: **[Combination padlocks] [Built-in combination locks] <Insert item>**.
- M. Identification Plates: Manufacturer's standard, etched, embossed, or stamped **[aluminum] [plastic]** plates, with numbers and letters at least **3/8 inch (9 mm)** high.
- N. Hooks: Manufacturer's standard ball-pointed, aluminum or steel; zinc plated.
- O. Coat Rods: **[1-inch- (25-mm-) diameter steel, chrome finished] [1-inch- (25-mm-) diameter steel, nickel plated] [3/4-inch- (19-mm-) diameter steel, chrome finished] [3/4-inch- (19-mm-) diameter steel, nickel plated] [Manufacturer's standard]**.
- P. Continuous Sloping Tops: Fabricated from **0.048-inch (1.21-mm)** nominal-thickness steel sheet, with a pitch of approximately 20 degrees.
1. Closures: **[Vertical] [Hipped]**-end type.
- Q. Recess Trim: Fabricated from **0.048-inch (1.21-mm)** nominal-thickness steel sheet.
- R. Filler Panels: Fabricated from **0.048-inch (1.21-mm)** nominal-thickness steel sheet.
- S. Boxed End Panels: Fabricated from **0.060-inch (1.52-mm)** nominal-thickness steel sheet.
- T. Finished End Panels: Fabricated from **0.024-inch (0.61-mm)** nominal-thickness steel sheet to cover unused penetrations and fasteners, except for perimeter fasteners, at exposed ends of nonrecessed metal lockers; finished to match lockers.
- U. Materials:
1. Cold-Rolled Steel Sheet: ASTM A1008/A1008M, Commercial Steel (CS), Type B, suitable for exposed applications.
 2. Metallic-Coated Steel Sheet: ASTM A653/A653M, Commercial Steel (CS), Type B; with **A60 (ZF180)** zinc-iron, alloy (galvannealed) coating designation.
 3. Expanded Metal: ASTM F1267, Type II (flattened), Class I (uncoated), **3/4-inch (19-mm)** steel mesh, with at least 70 percent open area.
 4. **<Double click to insert sustainable design text for recycled content.>**
- V. Finish: Baked enamel or powder coat.
1. Color: **[As indicated by manufacturer's designations] [Match Architect's sample] [As selected by Architect from manufacturer's full range] <Insert color>**.

2.8 WELDED, OPEN-FRONT ATHLETIC LOCKERS <Insert designation>

- A. [<Double click here to find, evaluate, and insert list of manufacturers and products.>](#)
- B. Locker Arrangement: Open front, with [seat/shelf] [seat/footlocker] [upper shelf] [upper shelf with security box] [and] [full-width security compartment] [configuration as indicated on Drawings].
- C. Material: [Cold-rolled] [Metallic-coated] steel sheet.
- D. Body: Assembled by [welding] [or] [riveting or bolting] body components together. Fabricate from unperforated steel sheet with thicknesses as follows:
1. Tops and Bottoms: 0.060-inch (1.52-mm) nominal thickness, with single bend at edges.
 2. Backs: 0.048-inch (1.21-mm) nominal thickness.
 3. Shelves: 0.060-inch (1.52-mm) nominal thickness, with double bend at front and single bend at sides and back.
- E. Unperforated Sides: Fabricated from 0.060-inch (1.52-mm) nominal-thickness steel sheet.
- F. Perforated Sides: Fabricated from 0.060-inch (1.52-mm) nominal-thickness steel sheet with manufacturer's standard diamond perforations. Perforations shall not occur [above upper shelf] [at security compartment] [or] [at seat/footlocker].
- G. Expanded-Metal Sides: Fabricated from 0.090-inch (2.28-mm) nominal-thickness expanded metal; welded to 0.105-inch (2.66-mm) nominal-thickness steel angles or 0.060-inch (1.52-mm) nominal-thickness steel channel frames.
- H. Frames: Channel formed; fabricated from 0.060-inch (1.52-mm) nominal-thickness steel sheet or 0.105-inch (2.66-mm) nominal-thickness steel angles; lapped and factory welded at corners; with top and bottom main frames factory welded into vertical main frames.
- I. Reinforced Bottoms: Structural channels, formed from 0.075-inch (1.90-mm) nominal-thickness steel sheet; welded to front and rear of side-panel frames.
- J. Seats/Shelves: Full width of metal locker; channel formed; fabricated from 0.075-inch (1.90-mm) nominal-thickness steel sheet; with stiffeners for reinforcement.
- K. Seats/Footlockers: Enclosure full width of bottom of metal locker; fabricated from cold-rolled steel sheet.
1. Seat/Lid: 0.075-inch (1.90-mm) nominal-thickness steel sheet; channel formed and reinforced with stiffeners; with manufacturer's standard, steel continuous hinge that is completely concealed and tamper resistant when seat/lid is closed; with padlock hasp.
 2. Front Panel: 0.075-inch (1.90-mm) nominal-thickness steel sheet; channel formed at top edge; with minilouvers for ventilation; recessed for padlock loop.
 3. Sides: [Integral part of unperforated] [Unperforated bottom portions of perforated] [0.060-inch (1.52-mm) nominal-thickness steel sheet inside expanded-metal] sides.
- L. Security Boxes: Nonperforated, consisting of partition extending from upper shelf to top of metal locker; fabricated from 0.060-inch (1.52-mm) nominal-thickness steel sheet; with channel-formed, 0.060-inch (1.52-mm) nominal-thickness, steel sheet door frame, and door fabricated from 0.075-inch (1.90-mm) nominal-thickness steel sheet with right-angle single bend at edges; with manufacturer's standard, steel continuous hinge that is completely concealed and tamper resistant when door is closed; fabricated to swing 180 degrees.

1. Single-Point Latching: Stainless steel strike plate with integral pull; with steel, nonmoving latch hook **[designed to engage bolt of lock]** **[with steel padlock loop that projects through door and is finished to match metal locker body]**.
 2. Locks: **[Combination padlocks]** **[Built-in combination locks]** <Insert item>.
- M. Security Compartments: Nonperforated, running full width of metal locker, with door fabricated from **0.075-inch (1.90-mm)** nominal-thickness steel sheet.
1. Locks: **[Combination padlocks]** **[Built-in combination locks]** <Insert item>.
- N. Identification Plates: Manufacturer's standard, etched, embossed, or stamped **[aluminum]** **[plastic]** plates, with numbers and letters at least **3/8 inch (9 mm)** high.
- O. Hooks: Manufacturer's standard ball-pointed, aluminum or steel; zinc plated.
- P. Coat Rods: **[1-inch- (25-mm-) diameter steel, chrome finished]** **[1-inch- (25-mm-) diameter steel, nickel plated]** **[3/4-inch- (19-mm-) diameter steel, chrome finished]** **[3/4-inch- (19-mm-) diameter steel, nickel plated]** **[Manufacturer's standard]**.
- Q. Continuous Sloping Tops: Fabricated from **0.048-inch (1.21-mm)** nominal-thickness steel sheet, with a pitch of approximately 20 degrees.
1. Closures: **[Vertical]** **[Hipped]**-end type.
- R. Recess Trim: Fabricated from **0.048-inch (1.21-mm)** nominal-thickness steel sheet.
- S. Filler Panels: Fabricated from **0.048-inch (1.21-mm)** nominal-thickness steel sheet.
- T. Boxed End Panels: Fabricated from **0.060-inch (1.52-mm)** nominal-thickness steel sheet.
- U. Finished End Panels: Fabricated from **0.024-inch (0.61-mm)** nominal-thickness steel sheet to cover unused penetrations and fasteners, except for perimeter fasteners, at exposed ends of nonrecessed metal lockers; finished to match lockers.
- V. Materials:
1. Cold-Rolled Steel Sheet: ASTM A1008/A1008M, Commercial Steel (CS), Type B, suitable for exposed applications.
 2. Metallic-Coated Steel Sheet: ASTM A653/A653M, Commercial Steel (CS), Type B; with **A60 (ZF180)** zinc-iron, alloy (galvannealed) coating designation.
 3. Expanded Metal: ASTM F1267, Type II (flattened), Class I (uncoated), **3/4-inch (19-mm)** steel mesh, with at least 70 percent open area.
 4. [<Double click to insert sustainable design text for recycled content.>](#)
- W. Finish: Baked enamel or powder coat.
1. Color: **[As indicated by manufacturer's designations]** **[Match Architect's sample]** **[As selected by Architect from manufacturer's full range]** <Insert color>.

2.9 LOCKS

- A. Combination Padlock: **[Key-controlled, three-number dialing combination locks; capable of five combination changes]** **[Provided by Owner]**.



- B. Built-in Combination Lock: Key-controlled, three-number dialing combination locks; capable of at least five combination changes made automatically with a control key.
 - 1. Bolt Operation: **[Manually locking deadbolt]** [or] **[automatically locking spring bolt]**.
- C. Cylinder Lock: Built-in, flush, cam lock with five-pin tumbler keyway, keyed separately and master keyed. Furnish two change keys for each lock and **[two]** <Insert number> master keys.
 - 1. Key Type: **[Flat]** **[Grooved]**, with minimum **2- by 2.68-inch (51- by 68.3-mm)** key head for accessible lockers].
 - 2. Bolt Operation: **[Manually locking deadbolt]** [or] **[automatically locking spring bolt]**.
- D. Built-in, Card-Operated Lock: Self-contained units mounted on interior of door with replaceable lock cylinders keyed separately and master keyed. Mount instruction decals on both door faces. Furnish one change card key for each lock and one master card key.
 - 1. Bolt Operation: **[Manually locking deadbolt]** [or] **[automatically locking spring bolt]**.
- E. Digital Keypad Lock: Battery-powered electronic keypad with reprogrammable manager and owner codes that override access. Three consecutive incorrect code entries shall disable lock for three minutes.
 - 1. Designed for permanently assigned access via entry of user's four-digit code.
 - 2. Designed for shared or temporary access by multiple users, with user-defined code to lock and unlock. Provide LED indicator to show when lock is in use.
- F. Built-in, Coin-Operated Lock: Self-contained units mounted on interior of door with replaceable lock cylinders keyed separately and master keyed. Mount instruction decals on both door faces. Furnish one change key for each lock and one master key.
 - 1. Bolt Operation: **[Manually locking deadbolt]** [or] **[automatically locking spring bolt]**.
 - 2. Lock Type: Fee **[return/deposit]** **[collect/pay]**.
 - 3. Fee Type: **[Token]** **[Coin, one quarter]** **[Coin, two quarters]**.
 - 4. Coin Box: Manufacturer's standard housing or stainless steel cash box with stainless steel flanged cover set into base of lock channel frame. Furnish with removable cylinder and key, and master code changer key.

2.10 LOCKER BENCHES <Insert designation>

- A. [<Double click here to find, evaluate, and insert list of manufacturers and products.>](#)
- B. Provide bench units with overall assembly height of **[17-1/2 inches (445 mm)]** <Insert dimension>.
- C. Bench Tops: Manufacturer's standard one-piece units, with rounded corners and edges.
 - 1. Size: Minimum **9-1/2 inches wide by 1-1/4 inches thick (241 mm wide by 32 mm thick)** **[except provide 20- to 24-inch- (508- to 610-mm-) wide tops where accessible benches are indicated]**.
 - 2. Laminated clear hardwood with one coat of clear sealer on all surfaces and one coat of clear lacquer on top and sides.
 - 3. Plastic laminate over particleboard core, with two steel tubes running full length of top and positioned to receive pedestal fasteners.

- a. Color: **[Match metal lockers] [As indicated by manufacturer's designations] [Match Architect's sample] [As selected by Architect from manufacturer's full range].**
 4. Extruded aluminum with clear anodic finish.
 - D. Fixed-Bench Pedestals: Manufacturer's standard supports, with predrilled fastener holes for attaching bench top and anchoring to floor, complete with fasteners and anchors, and as follows:
 1. Tubular Steel:
 - a. **1-1/2-inch- (38-mm-)** diameter steel tubing: threaded on both ends, with standard pipe flange at top and bell-shaped cast-iron base; with baked-enamel or powder-coat finish; anchored with exposed fasteners.
 - 1) Color: **[Match metal lockers] [As indicated by manufacturer's designations] [Match Architect's sample] [As selected by Architect from manufacturer's full range].**
 - b. **1-1/4-inch- (32-mm-)** diameter steel tubing: with **0.1265-inch- (3.2-mm-)** thick steel flanges welded at top and base; with **[baked-enamel] [zinc-plated]** finish; anchored with exposed fasteners.
 - 1) Color: **[Match metal lockers] [As indicated by manufacturer's designations] [Match Architect's sample] [As selected by Architect from manufacturer's full range].**
 - E. Movable-Bench Pedestals: Manufacturer's standard supports, with predrilled fastener holes for attaching bench top, complete with fasteners, and as follows:
 1. Aluminum: **1/8-inch-thick by 3-inch-wide (3-mm-thick by 76-mm-wide)** channel or **1/4-inch-thick by 3-inch-wide (6-mm-thick by 76-mm-wide)** bar stock, shaped into **[trapezoidal] [inverted-T]** form; with nonskid pads at bottom.
 - a. Finish: **[Clear] [Black] [Gold]** anodic finish.
 2. Stainless Steel: **1/8-inch-thick by 3-inch-wide (3-mm-thick by 76-mm-wide)** channel or **1/4-inch-thick by 3-inch-wide (6-mm-thick by 76-mm-wide)** bar stock, shaped into trapezoidal form; with nonskid pads at bottom.
 - a. Finish: **[Manufacturer's standard] [No. 4B].**
 - F. Materials:
 1. Stainless Steel Plate, Sheet, and Strip: ASTM A240/A240M or ASTM A666, Type 304.
 2. Plastic Laminate: NEMA LD 3, Grade HGP.
 3. Extruded Aluminum: **ASTM B221 (ASTM B221M)**, alloy and temper recommended by aluminum producer and manufacturer for type of use and finish indicated.
 4. Steel Tube: ASTM A500/A500M, cold rolled.
 5. [<Double click to insert sustainable design text for composite wood products.>](#)
 6. Particleboard: ANSI A208.1, Grade M-2.

2.11 FABRICATION

- A. Fabricate metal lockers square, rigid, without warp, and with metal faces flat and free of dents or distortion. Make exposed metal edges safe to touch and free of sharp edges and burrs.
 - 1. Form body panels, doors, shelves, and accessories from one-piece steel sheet unless otherwise indicated.
 - 2. Provide fasteners, filler plates, supports, clips, and closures as required for complete installation.
- B. Fabricate each metal locker with an individual door and frame; individual top, bottom, and back; and common intermediate uprights separating compartments.
- C. Equipment: Provide each locker with an identification plate and the following equipment:
 - 1. Single-Tier Units: Shelf, one double-prong ceiling hook, and two single-prong wall hooks.
 - 2. Double-Tier Units: One double-prong ceiling hook and two single-prong wall hooks.
 - 3. Triple-Tier Units: One double-prong ceiling hook.
 - 4. Coat Rods: **[As indicated on Drawings] [For each compartment of each locker] [In lieu of ceiling hook for metal lockers 24 inches (610 mm) high or more] [In lieu of ceiling hook for metal lockers 18 inches (457 mm) deep or more].**
 - 5. Open-Front Athletic Lockers: Two single-prong wall hooks bolted to locker back and coat rod.
- D. Knocked-Down Construction: Fabricate metal lockers by **[assembling at Project site] [preassembling at plant prior to shipping]**, using manufacturer's nuts, bolts, screws, or rivets.
- E. Welded Construction: Factory preassemble metal lockers by welding all joints, seams, and connections; with no bolts, nuts, screws, or rivets used in assembly of main locker groups. Factory weld main locker groups into one-piece structures. Grind exposed welds smooth and flush.
- F. Accessible Lockers: Fabricate as follows:
 - 1. Locate bottom shelf no lower than **15 inches (381 mm)** above the floor.
 - 2. Where hooks, coat rods, or additional shelves are provided, locate no higher than **48 inches (1219 mm)** above the floor.
- G. Continuous Zee Base: Fabricated in lengths as long as practical to enclose base and base ends; finished to match lockers.
- H. Continuous Sloping Tops: Fabricated in lengths as long as practical, without visible fasteners at splice locations; finished to match lockers.
 - 1. Sloping-top corner fillers, mitered.
- I. Individual Sloping Tops: Fabricated in width to fit one locker frame in lieu of flat locker tops; with integral back; finished to match lockers. Provide wedge-shaped divider panels between lockers.
- J. Recess Trim: Fabricated with minimum **2-1/2-inch (64-mm)** face width and in lengths as long as practical; finished to match lockers.
- K. Filler Panels: Fabricated in an unequal leg angle shape; finished to match lockers. Provide slip-joint filler angle formed to receive filler panel.
- L. Boxed End Panels: Fabricated with **1-inch- (25-mm-)** wide edge dimension, and designed for concealing fasteners and holes at exposed ends of nonrecessed metal lockers; finished to match lockers.

1. Provide one-piece panels for double-row (back-to-back) locker ends.
- M. Finished End Panels: Fabricated to conceal unused penetrations and fasteners, except for perimeter fasteners, at exposed ends of nonrecessed metal lockers; finished to match lockers.

1. Provide one-piece panels for double-row (back-to-back) locker ends.

- N. Center Dividers: Full-depth, vertical partitions between bottom and shelf; finished to match lockers.

2.12 ACCESSORIES

- A. Fasteners: Zinc- or nickel-plated steel, slotless-type, exposed bolt heads; with self-locking nuts or lock washers for nuts on moving parts.
- B. Anchors: Material, type, and size required for secure anchorage to each substrate.
 1. Provide nonferrous-metal or hot-dip galvanized anchors and inserts on inside face of exterior walls[, **and elsewhere as indicated,**] for corrosion resistance.
 2. Provide toothed-steel or lead expansion sleeves for drilled-in-place anchors.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine walls and floors or support bases, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install lockers level, plumb, and true; shim as required, using concealed shims.
 1. Anchor locker runs at ends and at intervals recommended by manufacturer, but not more than **36 inches (910 mm)** o.c. Using concealed fasteners, install anchors through backup reinforcing plates, channels, or blocking as required to prevent metal distortion.
 2. Anchor single rows of metal lockers to walls near top [**and bottom of lockers**] [**of lockers and to floor**].
 3. Anchor back-to-back metal lockers to floor.
- B. Knocked-Down Lockers: Assemble with manufacturer's standard fasteners, with no exposed fasteners on door faces or face frames.
- C. Welded Lockers: Connect groups together with manufacturer's standard fasteners, with no exposed fasteners on face frames.
- D. Equipment:
 1. Attach hooks with at least two fasteners.

2. Attach door locks on doors using security-type fasteners.
3. Identification Plates: Identify metal lockers with identification indicated on Drawings.
 - a. Attach plates to each locker door, near top, centered, with at least two aluminum rivets.
 - b. Attach plates to upper shelf of each open-front metal locker, centered, with a least two aluminum rivets.

E. Trim: Fit exposed connections of trim, fillers, and closures accurately together to form tight, hairline joints, with concealed fasteners and splice plates.

1. Attach recess trim to recessed metal lockers with concealed clips.
2. Attach filler panels with concealed fasteners. Locate filler panels where indicated on Drawings.
3. Attach sloping-top units to metal lockers, with closures at exposed ends.
4. Attach boxed end panels using concealed fasteners to conceal exposed ends of nonrecessed metal lockers.
5. Attach finished end panels using fasteners only at perimeter to conceal exposed ends of nonrecessed metal lockers.

F. Fixed Benches: Provide no fewer than two pedestals for each bench, uniformly spaced not more than **72 inches (1830 mm)** apart. Securely fasten tops of pedestals to undersides of bench tops, and anchor bases to floor.

G. Movable Benches: Place benches in locations indicated on Drawings.

3.3 ADJUSTING

- A. Clean, lubricate, and adjust hardware. Adjust doors and latches to operate easily without binding. **[Verify that integral locking devices operate properly.]**

3.4 PROTECTION

- A. Protect metal lockers from damage, abuse, dust, dirt, stain, or paint. Do not permit use during construction.
- B. Touch up marred finishes, or replace metal lockers that cannot be restored to factory-finished appearance. Use only materials and procedures recommended or furnished by locker manufacturer.

END OF SECTION 10 01 50 11

SECTION 10 11 13 13 - VISUAL DISPLAY SURFACES

1.1 GENERAL

A. Description Of Work:

1. This specification covers the furnishing and installation of materials for visual display surfaces. Product shall be as follows or as directed by the Owner. Installation procedures shall be in accordance with the product manufacturer's recommendations. Demolition and removal of materials shall be as required to support the work.

B. Summary

1. Section Includes:

- a. Chalkboards.
- b. Markerboards.
- c. Tackboards.
- d. Visual display rails.
- e. Visual display wall panels.
- f. Support systems for visual display boards.
- g. Sliding visual display units.
- h. Visual display conference units.
- i. Visual display wall coverings.
- j. Electronic markerboards.

C. Definitions

1. Tackboard: Framed or unframed, tackable, visual display board assembly.
2. Visual Display Board Assembly: Visual display surface that is factory fabricated into composite panel form, either with or without a perimeter frame; includes chalkboards, markerboards, and tackboards.
3. Visual Display Surface: Surfaces that are used to convey information visually, including surfaces of chalkboards, markerboards, tackboards, and surfacing materials that are not fabricated into composite panel form but are applied directly to walls.

D. Submittals

1. Product Data: For each type of product indicated.
 - a. Include rated capacities, operating characteristics, electrical characteristics and individual panel weights for sliding visual display units.
 - b. Include computer system requirements for electronic markerboards.
2. LEED Submittals:
 - a. Product Data for Credit EQ 4.4: For composite wood products, documentation indicating that the product contains no urea formaldehyde.
 - b. Product Data for Credit EQ 4.1: For adhesives, including printed statement of VOC content and chemical components.
3. Shop Drawings: For visual display surfaces. Include plans, elevations, sections, details, and attachments to other work.
 - a. Show locations of panel joints.
 - b. Show locations of special-purpose graphics for visual display surfaces.
 - c. Include sections of typical trim members.
 - d. Wiring Diagrams: For power, signal, and control wiring.
4. Samples: For each exposed product and for each color and texture specified.
5. Qualification Data: For qualified Installer.
6. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for surface-burning characteristics of fabrics.
7. Operation and Maintenance Data: For visual display surfaces and power-operated units to include in maintenance manuals.



8. Warranties: Sample of special warranties.

E. Quality Assurance

1. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for installation of motor-operated, sliding visual display units required for this Project.
2. Surface-Burning Characteristics: As determined by testing identical products according to ASTM E 84 by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
 - a. Flame-Spread Index: 25 or less.
 - b. Smoke-Developed Index: 50 **OR** 450, **as directed**, or less.
3. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
4. Preinstallation Conference: Conduct conference at Project site.

F. Delivery, Storage, And Handling

1. Deliver factory-built visual display surfaces, including factory-applied trim where indicated, completely assembled in one piece without joints, where possible. If dimensions exceed maximum manufactured panel size, provide two or more pieces of equal length as acceptable to the Owner. When overall dimensions require delivery in separate units, prefit components at the factory, disassemble for delivery, and make final joints at the site.
2. Store visual display surfaces vertically with packing materials between each unit.

G. Project Conditions

1. Environmental Limitations: Do not deliver or install visual display surfaces until spaces are enclosed and weathertight, wet work in spaces is complete and dry, work above ceilings is complete, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.
2. Field Measurements: Verify actual dimensions of construction contiguous with visual display surfaces by field measurements before fabrication.
 - a. Allow for trimming and fitting where taking field measurements before fabrication might delay the Work.

H. Warranty

1. Special Warranty for Porcelain-Enamel Face Sheets: Manufacturer's standard form in which manufacturer agrees to repair or replace porcelain-enamel face sheets that fail in materials or workmanship within specified warranty period.
 - a. Failures include, but are not limited to, the following:
 - 1) Surfaces lose original writing and erasing qualities.
 - 2) Surfaces exhibit crazing, cracking, or flaking.
 - b. Warranty Period: 50 years from date of Final Completion **OR** Life of the building, **as directed**.
2. Special Warranty for Electronic Markerboards: Manufacturer's standard form in which manufacturer agrees to repair or replace electronic markerboards that fail in materials or workmanship within two years from date of Final Completion.

1.2 PRODUCTS

A. Materials, General

1. Porcelain-Enamel Face Sheet: ASTM A 424, enameling-grade steel, uncoated thickness indicated; with exposed face and edges coated with primer, **1.7-to-2.5-mil- (0.043-to-0.064-mm-)** thick ground coat, and color cover coat; and with concealed face coated with primer and **1.7-to-2.5-mil- (0.043-to-0.064-mm-)** thick ground coat.
 - a. Matte-Finish Cover Coat: Low reflective; chalk wipes clean with dry cloth or standard eraser. Minimum **2.0-to-2.5-mil- (0.051-to-0.064-mm-)** thick cover coat. Cover and ground

- coats shall be fused to steel at manufacturer's standard firing temperatures but not less than **1250 deg F (677 deg C)**.
- b. Gloss-Finish Cover Coat: Gloss as indicated; dry-erase markers wipe clean with dry cloth or standard eraser. Minimum **3.0-to-4.0-mil- (0.076-to-0.102-mm-)** thick cover coat. Cover and ground coats shall be fused to steel at manufacturer's standard firing temperatures but not less than **1475 deg F (802 deg C)**.
 2. Porcelain-Enamel Face Sheet: Porcelain-enamel-clad, ASTM A 463/A 463M, Type 1, stretcher-leveled aluminized steel, with **0.024-inch (0.60-mm)** uncoated thickness; with porcelain-enamel coating fused to steel at approximately **1000 deg F (538 deg C)**.
 - a. Matte Finish: Low reflective; chalk wipes clean with dry cloth or standard eraser.
 - b. Gloss Finish: Low gloss; dry-erase markers wipe clean with dry cloth or standard eraser. Suitable for use as projection screen.
 3. Porcelain-Enamel Face Sheet: Manufacturer's standard steel sheet with porcelain-enamel coating fused to steel; uncoated thickness indicated.
 - a. Matte Finish: Low reflective; chalk wipes clean with dry cloth or standard eraser.
 - b. Gloss Finish: Gloss as indicated; dry-erase markers wipe clean with dry cloth or standard eraser.
 4. Melamine: Thermally fused, melamine-impregnated decorative paper complying with LMA SAT-1.
 5. High-Pressure Plastic Laminate: NEMA LD 3.
 6. Natural Cork Sheet: Seamless, single-layer, compressed fine-grain cork sheet; bulletin board quality; face sanded for natural finish with surface-burning characteristics indicated.
 7. Plastic-Impregnated Cork Sheet: Seamless, homogeneous, self-sealing sheet consisting of granulated cork, linseed oil, resin binders, and dry pigments that are mixed and calendared onto fabric backing; with washable vinyl finish and integral color throughout with surface-burning characteristics indicated.
 8. Vinyl Fabric: Mildew resistant, washable, complying with FS CCC-W-408D, Type II, burlap weave; weighing not less than **13 oz./sq. yd. (440 g/sq. m)**; with surface-burning characteristics indicated.
 9. Polyester Fabric: Nondirectional weave, 100 percent polyester; weighing not less than **15 oz./sq. yd. (508 g/sq. m)**; with surface-burning characteristics indicated.
 10. Hardboard: ANSI A135.4, tempered.
 11. Particleboard: ANSI A208.1, Grade M-1, made with binder containing no urea formaldehyde.
 12. Fiberboard: ASTM C 208.
 13. Extruded Aluminum: **ASTM B 221 (ASTM B 221M)**, Alloy 6063.
- B. Chalkboard Assemblies
1. Porcelain-Enamel Chalkboards: Balanced, high-pressure, factory-laminated chalkboard assembly of three-ply construction consisting of backing sheet, core material, and **0.021-inch- (0.53-mm-)** thick, **OR 0.013-inch- (0.33-mm-)** thick, **as directed**, porcelain-enamel face sheet with matte finish.
 - a. Hardboard Core: **1/4 inch (6 mm)** thick; with **0.005-inch- (0.127-mm-)** thick, aluminum foil **OR 0.015-inch- (0.38-mm-)** thick, aluminum sheet **OR 0.0129-inch- (0.35-mm-)** thick, galvanized-steel sheet, **as directed**, backing.
 - b. Particleboard Core: **3/8 inch (9.5 mm)** thick; with **0.005-inch- (0.127-mm-)** thick, aluminum foil **OR 0.015-inch- (0.38-mm-)** thick, aluminum sheet **OR 0.0129-inch- (0.35-mm-)** thick, galvanized-steel sheet, **as directed**, backing.
 - c. Fiberboard Core: **3/8 inch (9.5 mm) OR 1/2 inch (13 mm)**, **as directed**, thick; with **0.001-inch- (0.025-mm-)** thick, aluminum foil **OR 0.015-inch- (0.38-mm-)** thick, aluminum sheet **OR 0.0129-inch- (0.35-mm-)** thick, galvanized-steel sheet, **as directed**, backing.
 - d. Manufacturer's Standard Core: Minimum **1/4 inch (6 mm)** thick, with manufacturer's standard moisture-barrier backing.
 - e. Laminating Adhesive: Manufacturer's standard, moisture-resistant thermoplastic type.
 2. High-Pressure-Laminate Chalkboards: Balanced, high-pressure, factory-laminated chalkboard assembly of two-ply construction consisting of fiberboard core material and high-pressure-laminate writing surface.

3. Melamine Chalkboards: Fabricated from **1/4-inch- (6-mm-)** thick, sealed and primed hardboard panels permanently bonded with melamine writing surface.
4. Painted-Finish Chalkboards: Fabricated from two plies of **1/4-inch- (6-mm-)** thick, treated, tempered hardboard panels permanently surfaced with manufacturer's standard, heat-cured organic coating formulated for chalk-receptive matte finish.
5. Natural-Slate Chalkboards: Select grade, resurfaced, natural slate; free from ribbons and other natural marks that impair their functional use and durability as a writing surface.
 - a. Writing surface shall be free of tooling marks, pits, chipping, scratches, and surface spalls in excess of those that can be easily corrected; and shall be free of surface-applied stain, dye, or other artificial coloring.
 - b. Thickness: Not less than **1/4 inch (6 mm)** or more than **3/8 inch (9.5 mm)** thick with maximum deviation of **1/16 inch (1.6 mm)** when an average thickness of at least **1/4 inch (6 mm)** is maintained.

C. Markerboard Assemblies

1. Porcelain-Enamel Markerboards: Balanced, high-pressure, factory-laminated markerboard assembly of three-ply construction consisting of backing sheet, core material, and **0.021-inch- (0.53-mm-)** thick, **OR 0.013-inch- (0.33-mm-)** thick, **as directed**, porcelain-enamel face sheet with high-gloss **OR** low-gloss, **as directed**, finish.
 - a. Hardboard Core: **1/4 inch (6 mm)** thick; with **0.005-inch- (0.127-mm-)** thick, aluminum foil **OR 0.015-inch- (0.38-mm-)** thick, aluminum sheet **OR 0.013-inch- (0.35-mm-)** thick, galvanized-steel sheet, **as directed**, backing.
 - b. Particleboard Core: **3/8 inch (9.5 mm)** **OR 1/2 inch (13 mm)**, **as directed**, thick; with **0.005-inch- (0.127-mm-)** thick, aluminum foil **OR 0.015-inch- (0.38-mm-)** thick, aluminum sheet **OR 0.013-inch- (0.35-mm-)** thick, galvanized-steel sheet, **as directed**, backing.
 - c. Fiberboard Core: **3/8 inch (9.5 mm)** **OR 1/2 inch (13 mm)**, **as directed**, thick; with **0.001-inch- (0.025-mm-)** thick, aluminum foil **OR 0.015-inch- (0.38-mm-)** thick, aluminum sheet **OR 0.013-inch- (0.35-mm-)** thick, galvanized-steel sheet, **as directed**, backing.
 - d. Manufacturer's Standard Core: Minimum **1/4 inch (6 mm)** thick, with manufacturer's standard moisture-barrier backing.
 - e. Laminating Adhesive: Manufacturer's standard, moisture-resistant thermoplastic type.
2. Melamine Markerboards: Fabricated from **1/4-inch- (6-mm-)** thick, sealed and primed hardboard panels permanently bonded with melamine or another high-pressure-laminate writing surface.
3. High-Pressure-Laminate Markerboard Assembly: Balanced, high-pressure, factory-laminated chalkboard assembly of three-ply construction consisting of backing sheet, fiberboard core material, and high-pressure-laminate writing surface.

D. Tackboard Assemblies

1. Natural-Cork Tackboard:
 - a. **1/16-inch- (1.6-mm-)** thick, natural cork sheet factory laminated to **3/8-inch- (9.5-mm-)** **OR 7/16-inch- (11-mm-)**, **as directed**, thick fiberboard backing.
 - b. **1/8-inch- (3-mm-)** thick, natural cork sheet factory laminated to **3/8-inch- (9.5-mm-)** thick fiberboard backing.
 - c. **1/4-inch- (6-mm-)** thick, natural cork sheet factory laminated to **1/4-inch- (6-mm-)** thick hardboard **OR** particleboard, **as directed**, backing.
2. Plastic-Impregnated-Cork Tackboard:
 - a. **1/8-inch- (3-mm-)** thick, plastic-impregnated cork sheet factory laminated to **3/8-inch- (9.5-mm-)** thick fiberboard backing.
 - b. **1/4-inch- (6-mm-)** thick, plastic-impregnated cork sheet factory laminated to **1/4-inch- (6-mm-)** thick hardboard **OR** particleboard, **as directed**, backing.
3. Vinyl-Fabric-Faced Tackboard:
 - a. Vinyl fabric factory laminated to **3/8-inch- (9.5-mm-)** **OR 7/16-inch- (11-mm-)** **OR 1/2-inch- (13-mm-)**, **as directed**, thick fiberboard backing.
 - b. **1/16-inch- (1.6-mm-)** thick, vinyl-fabric-faced cork sheet factory laminated to **3/8-inch- (9.5-mm-)** thick fiberboard backing.

- c. **1/8-inch- (3-mm-)** thick, vinyl-fabric-faced cork sheet factory laminated to **3/8-inch- (9.5-mm-)** thick fiberboard backing.
 - d. **1/4-inch- (6-mm-)** thick, vinyl-fabric-faced cork sheet factory laminated to **1/4-inch- (6-mm-)** thick hardboard **OR** particleboard, **as directed**, backing.
 4. Polyester-Fabric-Faced Tackboard:
 - a. Polyester fabric factory laminated to **3/8-inch- (9.5-mm-)** **OR** **1/2-inch- (13-mm-)**, **as directed**, thick fiberboard backing.
 - b. **1/16-inch- (1.6-mm-)** thick, polyester-fabric-faced cork sheet factory laminated to **3/8-inch- (9.5-mm-)** thick fiberboard backing.
 - c. **1/8-inch- (3-mm-)** thick, polyester-fabric-faced cork sheet factory laminated to **3/8-inch- (9.5-mm-)** thick fiberboard backing.
 - d. **1/4-inch- (6-mm-)** thick, polyester-fabric-faced cork sheet factory laminated to **1/4-inch- (6-mm-)** thick hardboard **OR** particleboard, **as directed**, backing.
- E. Visual Display Rails
 1. General: Manufacturer's standard, aluminum-framed, tackable cork **OR** fabric, **as directed**, visual display surface fabricated into narrow rail shape and designed for displaying material.
- F. Visual Display Wall Panels
 1. Marker Wall Sheets: Fabricated from **0.021-inch (0.53-mm)** uncoated thickness, porcelain-enamel face sheets; for direct application to wall surface.
 2. Marker Wall Panels: Fabricated from markerboard assembly indicated.
 3. Tack Wall Panels: With tackable surface.
 - a. Fabricated from tackboard assembly indicated.
 - b. Natural Cork: **1/8-inch- (3-mm-)** **OR** **1/4-inch- (6-mm-)**, **as directed**, thick, natural cork sheet for direct application to wall surface.
 - c. Plastic-Impregnated Cork: **1/8-inch- (3-mm-)** **OR** **1/4-inch- (6-mm-)**, **as directed**, thick, plastic-impregnated cork sheet for direct application to wall surface.
 - d. Vinyl Fabric-Faced Cork: **1/4-inch- (6-mm-)** thick, vinyl-fabric-faced cork sheet for direct application to wall surface.
 - e. Polyester-Fabric-Faced Cork: **1/4-inch- (6-mm-)** thick, polyester-fabric-faced cork sheet for direct application to wall surface.
 4. Joint Accessories: Manufacturer's standard, exposed trim **OR** concealed aluminum or steel spline, **as directed**, at butt joints.
 5. Adhesive: Mildew-resistant, nonstaining adhesive, for use with specific tack wall panels and substrate application, as recommended in writing by visual display surface manufacturer, and with a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 6. Primer/Sealer: Mildew-resistant primer/sealer complying with requirements in Division 09 Section "Interior Painting" and recommended in writing by visual display surface manufacturer for intended substrate.
- G. Rail Support System For Visual Display Boards
 1. Support Rails: Horizontal, wall-mounted, extruded-aluminum rails designed to receive hanger clip and to support visual display boards; capable of gripping and suspending paper directly from rail.
 - a. Finish: Clear anodic **OR** Color anodic **OR** Baked enamel **OR** Powder coat, **as directed**.
 - b. Color and Gloss: Light bronze **OR** Medium bronze **OR** Dark bronze **OR** Black **OR** As indicated by manufacturer's designations **OR** Match sample **OR** As selected from manufacturer's full range, **as directed**.
 2. Hanger Clips: Extruded aluminum with finish to match rails; designed to support independent visual display boards by engaging support rail and top trim of board.
 3. Visual Display Panels: Fabricated from not less than **3/8-inch- (9.5-mm-)** thick, kraft-paper honeycomb core; designed to be rigid and to resist warpage, and with aluminum trim designed to engage hanger clips.
- H. Modular Support System For Visual Display Boards



1. Standards: **72-inch- (1829-mm-)** long, extruded-aluminum slotted standards designed for supporting visual display boards on panel clips. Standards shall be punched at not less than **4 inches (100 mm)** o.c.
 - a. Finish: Clear anodic **OR** Color anodic **OR** Baked enamel **OR** Powder coat, **as directed**.
 - b. Color and Gloss: Light bronze **OR** Medium bronze **OR** Dark bronze **OR** Black **OR** As indicated by manufacturer's designations **OR** Match sample **OR** As selected from manufacturer's full range, **as directed**.
2. Panel Clips: Extruded aluminum or steel with finish to match standards.

I. Sliding Visual Display Units

1. Horizontal-Sliding Visual Display Units: Factory-fabricated units consisting of extruded-aluminum tubular frame, fixed-rear visual display panel, aluminum-framed horizontal-sliding panels, and extruded-aluminum fascia that conceals overhead sliding track; designed for recessed mounting. Provide panels that operate smoothly without vibration or chatter.
 - a. Two-Track Units: Fabricate unit with fixed rear panel covering entire rear surface. Provide two sliding panels, each equal to not less than one-half of overall length of unit.
 - b. Three-Track Units: Fabricate unit with fixed rear panel covering entire rear surface. Provide three sliding panels, each equal to not less than one-third **OR** one-half, **as directed**, of overall length of unit.
 - c. Four-Track Units: Fabricate unit with fixed rear panel centered in and covering not less than one-half of rear surface, and fixed front panel on each side of unit equal to not less than one-quarter of overall length of unit. Provide four sliding panels, each equal to not less than one-quarter of overall length of unit.
 - 1) Swinging Doors: Fabricated from same construction as sliding panels and supported on full-height continuous hinges. Provide visual display surface on both sides of each door.
 - d. Sliding Panels: Fabricated from not less than **3/8-inch- (9.5-mm-)** thick, kraft-paper honeycomb core; designed to be rigid and to resist warpage.
 - 1) Fabricate sliding panels with **0.021-inch (0.53-mm)** uncoated thickness, porcelain-enamel face sheets.
 - e. Hardware: Manufacturer's standard, extruded-aluminum overhead track and channel-shaped bottom guides; with two nylon ball-bearing carriers and two nylon rollers for each sliding panel.
2. Vertical-Sliding Visual Display Units: Factory-fabricated units consisting of extruded-aluminum tubular frame, fixed-rear visual display panel, and aluminum-framed vertical-sliding panels; designed for recessed mounting. Provide panels that operate smoothly without vibration or chatter.
 - a. Type: Tubular frame on four sides **OR** top and two sides, with sides extending to floor; with kick panel to conceal sliding panels, **as directed**. Unit shall be designed to support panels independent of wall.
 - b. Two-Track Units: Fabricate unit with fixed rear panel covering entire rear surface. Provide two sliding panels, each equal to not less than one-half of overall height of unit.
 - c. Three-Track Units: Fabricate unit with fixed rear panel covering entire rear surface. Provide three sliding panels, each equal to not less than one-half of overall height of unit.
 - d. Four-Track Units: Fabricate unit with fixed rear panel centered in and covering not less than one-half of rear surface. Provide four sliding panels, each equal to not less than one-half of overall height of unit.
 - e. Sliding Panels: Fabricated from not less than **3/8-inch- (9.5-mm-)** thick, kraft-paper honeycomb core; designed to be rigid and to resist warpage.
 - 1) Fabricate sliding panels with **0.021-inch (0.53-mm)** uncoated thickness, porcelain-enamel face sheets.
 - f. Hardware: Manufacturer's standard, neoprene ball-bearing end rollers, four on each side of each sliding panel. Counterbalance each sliding panel with lead counterweights supported by steel aircraft cable over ball-bearing sheaves; with removable cover plate for

access to counterweights. Provide rubber bumpers at top and bottom for each sliding panel.

- g. Motorized Operation: Provide not less than one motor with gearhead reducers for each sliding panel, mounted above visual display unit and connected to sliding panels with steel aircraft cable. Provide removable cover plate for access to motor. Equip motors with limit switches to automatically stop motor at each end of travel.
 - 1) Electric Motors: UL approved or recognized, totally enclosed, complying with NEMA MG 1, with thermal-overload protection; 1/15 hp, single phase, 110 **OR** 220, **as directed**, V, 60 Hz.
 - 2) Control Station: Three-position, maintained-contact **OR** momentary-contact, **as directed**, switch-operated control station with open, close, and off functions; with NEMA ICS 6, Type 1 enclosure. Provide one control station for each sliding panel unit, unless directed otherwise.
 - 3) Key Switch: Provide supplementary key switch for each control station. Furnish two keys for each control station, keyed alike.

J. Visual Display Conference Units

1. Visual Display Conference Units: Factory-fabricated units consisting of hinged-door wood cabinet with perimeter face frame, sides, and back; not less than 3-inch (75-mm) interior depth and designed for surface wall mounting. Fabricate inside of cabinet and cabinet doors with fixed visual display surfaces.
 - a. Wood Cabinets: Fabricated from solid wood with integral, solid-wood markertray. Fabricate hinged door panels with solid wood frame and wood-veneer exterior surface.
 - b. Plastic-Laminate Cabinets: Cabinet and hinged door panels fabricated from manufacturer's standard, high-pressure, plastic-laminate-finished panels; with integral markertray.
 - c. Hardware: Manufacturer's standard, full-height continuous hinges, wire door pulls, and door bumpers.
 - d. Projection Screens: Manufacturer's standard, pull-down, matte, white projection screen, not less than 8 inches (200 mm) smaller in each direction than overall cabinet size, and mounted above rear visual display surface.
 - e. Fluorescent Light: Manufacturer's standard, not less than 24 inches (610 mm) long, and mounted above rear visual display surface.

K. Visual Display Wall Coverings

1. Visual Display Wall Covering: Intended for use with dry-erase markers and as a projection surface, **as directed**, and consisting of low-gloss **OR** moderate-gloss **OR** high-gloss, **as directed**, plastic film bonded to fabric backing; not less than 0.012-mil (0.0003-mm) **OR** 0.020-mil (0.0005-mm), **as directed**, total thickness.
2. Surface Graphics: 2-inch- (50-mm-) square grid.
 - a. Color: As indicated by manufacturer's designations **OR** Match sample **OR** As selected from manufacturer's full range, **as directed**.
3. Magnetic Visual Display Wall Covering: Intended for use with dry-erase markers and magnetic aids and consisting of moderate-gloss plastic film bonded to ferrous-powdered fabric backing; not less than 0.025-mil (0.0006-mm) total thickness.
 - a. Color: As indicated by manufacturer's designations **OR** Match sample **OR** As selected from manufacturer's full range, **as directed**.
4. Adhesive: Mildew-resistant, nonstaining, strippable, **as directed**, adhesive, for use with specific wall covering and substrate application, as recommended in writing by wall covering manufacturer, and with a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
5. Primer/Sealer: Mildew-resistant primer/sealer complying with requirements in Division 09 Section "Interior Painting" and recommended in writing by wall covering manufacturer for intended substrate.

L. Electronic Markerboards

1. General: Provide manufacturer's standard electronic markerboard that consists of touch-sensitive writing surface connected to microcomputer via RS-232 serial cable and that electronically records writing with standard dry-erase markers. Equip unit with cables, software, pens, erasers, mounting hardware, and accessories required for a complete installation.
2. Software: Capable of real-time recording, saving, and printing of everything that is written and drawn on electronic markerboard; with Windows **OR** Macintosh, **as directed**, operating system.
 - a. File Export Formats: BMP, WMF, HTML, and vector-based formats.
 - b. Compatibility: Compatible with Microsoft NetMeeting or other T.120-compliant software.
 - c. Features: Capable of the following:
 - 1) Saving directly from screen.
 - 2) Erasing portions of screen.
 - 3) Printing directly from screen.
 - 4) Saving individual screens as separate pages.
 - 5) Showing onscreen toolbar **OR** keyboard, **as directed**.
 - 6) Recognizing not less than four pen colors.
 - 7) Recognizing finger touch control for presentations.
 - 8) Connecting multiple electronic markerboards to a single computer.
 - 9) Showing online help and tutorial.
3. Overall Size: Approximately **48 inches high by 60 inches wide (1219 mm high by 1524 mm wide)**.
4. Mounting: Wall mounted **OR** Supported by rail support system, **as directed**.

M. Chalkboard, Markerboard, And Tackboard Accessories

1. Aluminum Frames and Trim: Fabricated from not less than **0.062-inch- (1.57-mm-)** thick, extruded aluminum; standard size and shape **OR** slim size and standard shape **OR** of size and shape indicated on Drawings, **as directed**.
 - a. Field-Applied Trim: Manufacturer's standard, snap-on trim with no visible screws or exposed joints **OR** slip-on trim **OR** screw-on trim with Phillips flat-head screws, **as directed**.
 - b. Factory-Applied Trim: Manufacturer's standard.
2. Factory-Applied Wood Trim: Red oak **OR** Walnut **OR** Manufacturer's standard species, **as directed**, not less than **1/2 inch (13 mm)** thick; standard size and shape **OR** of size and shape indicated on Drawings, **as directed**.
3. Field-Applied Wood Trim: Comply with requirements specified in Division 06 Section(s) "Finish Carpentry" **OR** "Interior Architectural Woodwork" **as directed**.
4. Chalktray: Manufacturer's standard, continuous.
 - a. Box Type: Extruded aluminum with slanted front, grooved tray, and cast-aluminum end closures.
 - b. Solid Type: Extruded aluminum with ribbed section and smoothly curved exposed ends.
5. Map Rail: Provide the following accessories:
 - a. Display Rail: Continuous and integral with map rail; fabricated from cork approximately **1 to 2 inches (25 to 50 mm)** wide.
 - b. End Stops: Located at each end of map rail.
 - c. Map Hooks: Two map hooks for every **48 inches (1219 mm)** **OR** 1200 mm, **as directed**, of map rail or fraction thereof.
 - d. Map Hooks and Clips: Two map hooks with flexible metal clips for every **48 inches (1219 mm)** **OR** 1200 mm, **as directed**, of map rail or fraction thereof.
 - e. Flag Holder: One for each room.
 - f. Paper Holder: Extruded aluminum; designed to hold paper by clamping action.
6. Special-Purpose Graphics: Fuse or paint the following graphics into surface of porcelain-enamel visual display unit:
 - a. Semivisible writing guidelines.
 - b. Penmanship lines.
 - c. Music staff lines.
 - d. Grid, **1 inch (25 mm)** square.
 - e. Graph coordinates, rectangular.

- f. Horizontal lines, **2 inches (50 mm)** o.c.
- g. Polar coordinates.
- h. USA map.
- i. World map.
- j. Soccer field.
- k. Football field.
- l. Basketball court.

N. Fabrication

1. Porcelain-Enamel Visual Display Assemblies: Laminate porcelain-enamel face sheet and backing sheet to core material under heat and pressure with manufacturer's standard flexible, waterproof adhesive.
2. Natural-Slate Chalkboards: Surface slate panels to a natural plane. Grind and hone to smooth, uniform finish equivalent to that obtained by minimum 180 grit and maximum 220 grit.
 - a. Cut joints straight and true. Space joints symmetrically. Fit and match panels before shipment to provide continuous, uniform writing surface.
 - b. Length: Furnish panels approximately equal in length with permissible variation not more than **3 inches (75 mm)** in either direction of equal spacing. Allow **1/4-inch (6-mm)** clearance at trim in length and width for fitting. Provide lengths of panels in each space as follows:
 - 1) Up to **5 feet (1.5 m)**; one panel.
 - 2) More than **5 feet (1.5 m)** but less than **9 feet (2.7 m)**; two panels.
 - 3) More than **9 feet (2.7 m)** but less than **13.5 feet (4.1 m)**; three panels.
 - 4) More than **13.5 feet (4.1 m)** but less than **18 feet (5.5 m)**; four panels.
 - 5) More than **18 feet (5.5 m)** but less than **22.5 feet (6.9 m)**; five panels.
 - 6) More than **22.5 feet (6.9 m)** but less than **27 feet (8.2 m)**; six panels.
3. Visual Display Boards: Factory **OR** Field, **as directed**, assemble visual display boards unless otherwise indicated.
 - a. Where factory-applied trim is indicated, trim shall be assembled and attached to visual display boards at manufacturer's factory before shipment.
4. Factory-Assembled Visual Display Units: Coordinate factory-assembled units with trim and accessories indicated. Join parts with a neat, precision fit.
 - a. Make joints only where total length exceeds maximum manufactured length. Fabricate with minimum number of joints, balanced around center of board, as acceptable to the Owner **OR** as indicated on approved Shop Drawings, **as directed**.
 - b. Provide manufacturer's standard vertical-joint spline **OR** H-trim, **as directed**, system between abutting sections of chalkboards **OR** markerboards, **as directed**.
 - c. Provide manufacturer's standard mullion trim at joints between chalkboards **OR** markerboards **OR** tackboards, **as directed**, of combination units.
 - d. Where size of visual display boards or other conditions require support in addition to normal trim, provide structural supports or modify trim as indicated or as selected by the Owner from manufacturer's standard structural support accessories to suit conditions indicated.
5. Modular Visual Display Boards: Fabricated with integral panel clips attached to core material.
6. Aluminum Frames and Trim: Fabricate units straight and of single lengths, keeping joints to a minimum. Miter corners to a neat, hairline closure.
 - a. Where factory-applied trim is indicated, trim shall be assembled and attached to visual display units at manufacturer's factory before shipment.

O. General Finish Requirements

1. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
2. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.



3. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

P. Aluminum Finishes

1. Clear Anodic Finish: AAMA 611, AA-M12C22A31, Class II, 0.010 mm or thicker.
2. Color Anodic Finish: AAMA 611, AA-M12C22A32/A34, Class II, 0.010 mm or thicker.
3. Baked-Enamel or Powder-Coat Finish: AAMA 2603 except with a minimum dry film thickness of **1.5 mils (0.04 mm)**. Comply with coating manufacturer's written instructions for cleaning, conversion coating, and applying and baking finish.

1.3 EXECUTION

A. Examination

1. Examine substrates and conditions, with Installer present, for compliance with requirements for installation tolerances, surface conditions of wall, and other conditions affecting performance of the Work.
2. Examine roughing-in for electrical power systems to verify actual locations of connections before installation of motor-operated, sliding visual display units.
3. Examine walls and partitions for proper preparation and backing for visual display surfaces.
4. Examine walls and partitions for suitable framing depth where sliding visual display units will be installed.
5. Proceed with installation only after unsatisfactory conditions have been corrected.

B. Preparation

1. Comply with manufacturer's written instructions for surface preparation.
2. Clean substrates of substances that could impair the performance of and affect the smooth, finished surfaces of visual display boards, including dirt, mold, and mildew.
3. Prepare surfaces to achieve a smooth, dry, clean surface free of flaking, unsound coatings, cracks, defects, projections, depressions, and substances that will impair bond between visual display surfaces and wall surfaces.
 - a. Prime wall surfaces indicated to receive direct-applied, visual display tack wall panels **OR** visual display wall coverings, **as directed**, and as recommended in writing by primer/sealer manufacturer and wall covering manufacturer.
 - b. Prepare surfaces to receive visual display wall coverings and test for moisture according to requirements specified in Division 09 Section "Wall Coverings".

OR

Prepare substrates indicated to receive visual display wall covering as required by manufacturer's written instructions to achieve a smooth, dry, clean, structurally sound surface that is uniform in color.

 - 1) Moisture Content: Maximum of 4 percent when tested with an electronic moisture meter.
 - 2) Plaster: Allow new plaster to cure. Neutralize areas of high alkalinity. Prime with primer as recommended in writing by primer/sealer manufacturer and wall covering manufacturer.
 - 3) Metals: If not factory primed, clean and apply metal as recommended in writing by primer/sealer manufacturer and wall covering manufacturer.
 - 4) Gypsum Board: Prime with primer as recommended in writing by primer/sealer manufacturer and wall covering manufacturer.
 - 5) Painted Surfaces: Treat areas susceptible to pigment bleeding.
4. Prepare recesses for sliding visual display units as required by type and size of unit.

C. Installation, General

1. General: Install visual display surfaces in locations and at mounting heights indicated on Drawings, or if not indicated, at heights indicated below. Keep perimeter lines straight, level, and plumb. Provide grounds, clips, backing materials, adhesives, brackets, anchors, trim, and accessories necessary for complete installation.
 - a. Mounting Height for Grades K through 3: **24 inches (610 mm)** above finished floor to top of chalktray.
 - b. Mounting Height for Grades 4 through 6: **28 inches (711 mm)** above finished floor to top of chalktray.
 - c. Mounting Height for Grades 7 and Higher: **36 inches (914 mm)** above finished floor to top of chalktray.
 - OR**
 - a. Mounting heights of **24 inches (610 mm)** above finished floor to top of chalktray for kindergarten.
 - b. Mounting heights of **26 inches (660 mm)** above finished floor to top of chalktray for Grades 1 through 3.
 - c. Mounting heights of **30 inches (762 mm)** above finished floor to top of chalktray for Grades 4 through 6.
 - d. Mounting heights of **34 inches (864 mm)** above finished floor to top of chalktray for Grades 7 through 9.
 - e. Mounting heights of **37 inches (940 mm)** above finished floor to top of chalktray for Grades 10 and higher,
as directed
- D. Installation Of Field-Fabricated Visual Display Boards And Assemblies
 1. Field-Assembled Visual Display Units: Coordinate field-assembled units with grounds, trim, and accessories indicated. Join parts with a neat, precision fit.
 - a. Make joints only where total length exceeds maximum manufactured length. Fabricate with minimum number of joints, balanced around center of board, as acceptable to the Owner **OR** as indicated on approved Shop Drawings, **as directed**.
 - b. Provide manufacturer's standard vertical-joint spline **OR** H-trim, **as directed**, system between abutting sections of chalkboards **OR** markerboards, **as directed**.
 - c. Provide manufacturer's standard mullion trim at joints between chalkboards **OR** markerboards **OR** tackboards, **as directed**, of combination units.
 - d. Where size of visual display boards or other conditions require support in addition to normal trim, provide structural supports or modify trim as indicated or as selected by the Owner from manufacturer's standard structural support accessories to suit conditions indicated.
 2. Natural-Slate Chalkboards: Align and level joints between adjoining panels and apply manufacturer's recommended joint-filler compound. Hone and finish joints to continuous even plane.
- E. Installation Of Factory-Fabricated Visual Display Boards And Assemblies
 1. Visual Display Boards:
 - a. Attach visual display boards to wall surfaces with egg-size adhesive gobs at **16 inches (400 mm)** o.c., horizontally and vertically.
OR
Attach concealed clips, hangers, and grounds to wall surfaces and to visual display boards with fasteners at not more than **16 inches (400 mm)** o.c. Secure both top and bottom of boards to walls.
 - b. Field-Applied Aluminum Trim: Attach trim over edges of visual display boards and conceal grounds and clips. Attach trim to boards with fasteners at not more than **24 inches (610 mm)** o.c.
 - 1) Attach chalktrays to boards with fasteners at not more than **12 inches (300 mm)** o.c.
 - c. Field-Applied Wood Trim: Install trim according to requirements in Division 06 Section(s) "Finish Carpentry" **OR** "Interior Architectural Woodwork", **as directed**.



- F. Installation Of Visual Display Rails
1. Display Rails: Install rails in locations and at mounting heights indicated on Drawings, or if not indicated, at height indicated below. Attach to wall surface with fasteners at not more than **16 inches (400 mm)** o.c.
 - a. Mounting Height: **48 inches (1219 mm)** **OR** **60 inches (1524 mm)**, **as directed**, above finished floor to top of rail.
- G. Installation Of Visual Display Wall Panels
1. Marker Wall Sheets: Attach wall sheets to wall surface with thin layer of adhesive over entire wall surface. Butt join adjacent panels and cover joint with matching joint strip installed with double-stick tape, **as directed**.
 2. Marker Wall Panels: Attach panels to wall surface with egg-size adhesive gobs at **16 inches (400 mm)** o.c., horizontally and vertically.
 - a. Join adjacent wall panels with concealed steel splines for smooth alignment.
OR
Join adjacent wall panels with exposed, H-shaped aluminum trim painted to match wall panel.
 3. Tack Wall Panels: Attach panels to wall surface with egg-size adhesive gobs at **16 inches (400 mm)** o.c. horizontally and vertically.
 - a. Install wrapped-edge wall panels with butt joints between adjacent wall panels.
 - b. Join adjacent wall panels with exposed, H-shaped aluminum trim covered with same fabric as wall panels.
- H. Installation Of Rail **OR** Modular, **as directed**, Support System
1. Rail Support System: Install horizontal support rail in locations and at mounting heights indicated on Drawings, or if not indicated, at height indicated below. Attach to wall surface with fasteners at **12 inches (300 mm)** o.c.
 - a. Mounting Height: **72 inches (1829 mm)** above finished floor to top of rail.
 - b. Hang visual display units on rail support system.
 2. Modular Support System: Install adjustable standards in locations and at mounting heights indicated on Drawings, or if not indicated, at height indicated below. Install standards at **48 inches (1219 mm)** o.c., vertically aligned and plumb, and attached to wall surface with fasteners at **12 inches (300 mm)** o.c.
 - a. Mounting Height: **12 inches (300 mm)** above finished floor to bottom of standard.
 - b. Install single-slotted standard at each end of each run of standards and double-slotted standards at intermediate locations.
 - c. Provide locking screw at top corner of visual display board at each standard.
 - d. Hang visual display units on modular support system.
- I. Installation Of Factory-Fabricated Visual Display Units
1. Sliding Visual Display Units: Install units in recessed locations and at mounting heights indicated. Attach to wall framing with fasteners at not more than **16 inches (400 mm)** o.c.
 - a. Adjust panels to operate smoothly without warp or bind. Lubricate operating hardware as recommended by manufacturer.
 2. Visual Display Conference Units: Install units in locations and at mounting heights indicated on Drawings, or if not indicated, at height indicated below. Attach to wall surface with fasteners through back of cabinet **OR** concealed brackets screwed to wall **OR** concealed wood cleats screwed to wall, **as directed**.
 - a. Mounting Height: **72 inches (1829 mm)** above finished floor to top of cabinet.
- J. Installation Of Visual Display Wall Covering
1. General: Comply with visual display wall covering manufacturers' written installation instructions.
 2. Install seams horizontal and level, with lowest seam **24 inches (610 mm)** above finished floor. Railroad fabric (reverse roll direction) to ensure color matching.

3. Double cut seams, with no gaps or overlaps. Remove air bubbles, wrinkles, blisters, and other defects.
 4. After installation, clean visual display wall covering according to manufacturer's written instructions. Remove excess adhesive at finished seams, perimeter edges, and adjacent surfaces.
- K. Installation Of Visual Electronic Markerboards
1. Electronic Markerboards: Install units in locations and at mounting heights indicated on Drawings, or if not indicated, at height indicated below. Attach to wall **OR** cubicle, **as directed**, surface with manufacturer's standard mounting hardware.
 - a. Mounting Height: **72 inches (1829 mm)** above finished floor to top of markerboard.
- L. Cleaning And Protection
1. Clean visual display surfaces according to manufacturer's written instructions. Attach one cleaning label to visual display surface in each room.
 2. Touch up factory-applied finishes to restore damaged or soiled areas.
 3. Cover and protect visual display surfaces after installation and cleaning.
- M. Demonstration
1. Train Owner's maintenance personnel to adjust, operate, and maintain motor-operated, sliding visual display units.

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Task	Specification	Specification Description
10 11 13 33	10 11 13 13	Visual Display Surfaces
10 11 16 13	10 11 13 13	Visual Display Surfaces
10 11 16 33	10 11 13 13	Visual Display Surfaces
10 11 23 13	10 11 13 13	Visual Display Surfaces
10 13 11 00	10 11 13 13	Visual Display Surfaces

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SECTION 10 14 00 00 - VITRIFIED BRICK PAVEMENT REPLACEMENT

1.1 GENERAL

A. General

1. Limits of Brick Pavement Replacement shall be as per the detail entitled "Payment Limits for Surface Restoration" shown in the plans, plus one foot on each side. Alternate individual bricks may have to be removed in order to maintain staggered joint pattern along the edge of the undisturbed brick pavement.

1.2 PRODUCT

A. Preparation

1. Base shall be provided and shaped to match level, kind and thickness (4" min.) of adjoining base. The base material shall be compacted to meet the density standards. 4" 2500 PSI concrete base may be used for irregular patches and where compaction is otherwise impractical. Concrete shall be properly placed, consolidated and cured. One inch of sand, or good grade dirt, free from clay, loam or other foreign matter shall be used for cushion to hold the bricks in place. The sand shall be shaped to a true surface parallel to required finished pavement surface.

B. Materials

1. Existing bricks shall be cleaned, stored, and secured by the Contractor.

1.3 EXECUTION

A. Reinstallation of Bricks

1. The bricks shall be installed in rows, better face upward, sorted by size with joints staggered, then rolled daily with a static tandem wheel roller. Additional bricks, if required, will be supplied by the Owner. City Personnel shall inspect work daily. After inspection, the bricks shall be sprayed with a solution of lime and water, using 26 lbs. of lime to 55 gallons of water. Asphalt steep 7330 or equal shall be used for joint filler. The steep shall be heated until fluid and poured over bricks and removed when cool with square pointed shovels dipped in lime water. Removed asphalt may be reused. If adjoining bricks are grouted, new filler shall be grout (8:1, builders sand: cement).

B. Acceptance

1. Upon completion of the work, and before acceptance and final payment, the Contractor shall remove all false work, equipment, rubbish, surplus, and discarded materials. The Contractor shall restore in an acceptable manner all property, both public and private, damaged during the prosecution of the work. The Contractor shall leave the roadway in a neat and presentable condition each day.

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Task	Specification	Specification Description
10 14 00 00	01 58 13 00	Signage
10 14 16 00	10 14 00 00	Vitrified Brick Pavement Replacement
10 14 16 00	01 58 13 00	Signage
10 14 19 00	01 22 16 00	No Specification Required
10 14 19 00	10 14 00 00	Vitrified Brick Pavement Replacement
10 14 19 00	01 58 13 00	Signage
10 14 23 00	10 14 00 00	Vitrified Brick Pavement Replacement
10 14 23 11	10 14 00 00	Vitrified Brick Pavement Replacement
10 14 23 11	01 58 13 00	Signage
10 14 53 00	10 14 00 00	Vitrified Brick Pavement Replacement

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SECTION 10 14 53 11 - TRAFFIC SIGNS

1.1 GENERAL

A. Description Of Work

1. This specification covers the furnishing and installation of traffic signs. Products shall be as follows or as directed by the Owner. Installation procedures shall be in accordance with the product manufacturer's recommendations. Demolition and removal of materials shall be as required to support the work.

1.2 PRODUCT

A. Sign Foundations:

1. Replacement Foundation Footing Concrete shall be a mixture of cement complying with ASTM C 150 and aggregate complying with ASTM C 33. Compressive strength shall be 2,800 psi at 28 days.
2. Sulfur Mortar shall comply with ASTM C 287.
3. Reinforcing Steel shall comply with ASTM A 615.

B. Sign Supports shall be of the "break-away" type. Supports shall be strong enough to resist applicable wind forces without damage, but shall be designed to experience a brittle rupture type failure or a "quick separation" type joint.

1. Sign Support, Aluminum:

- a. Replacement Castings shall be Alloy A356.0-T6 in compliance with ASTM B 108.
- b. Replacement Structural Members shall comply with ASTM B 308.
- c. Replacement Bars, Rods, Shapes, and Tubes shall comply with ASTM B 221, alloy 6061-T6.
- d. Replacement Bolts, Nuts, and Screws shall match items being replaced and shall be alloy 2024-T4 with anodic coating complying with ASTM B 580, or 6061-T6 in compliance with ASTM B 211. Bolt heads shall be hexagon. Bolt threads shall be Class 2, 2A, or 2B in compliance with ANSI B18.2.1. Nuts shall be hexagon shaped in compliance with ANSI B18.2.2.
- e. Replacement washers shall be furnished from sheet metal complying with ASTM B 209, alloy Alclad 2024-T3 or T4.

2. Sign Support, Steel:

- a. Replacement Structural Members shall comply with ASTM A 36.
- b. Replacement Bars shall comply with ASTM A 108.
- c. Replacement Pipe shall comply with ASTM A 53 standard weight.
- d. Replacement Fasteners shall comply with ASTM A 307 and ASTM A 325.
- e. Replacement Anchor Bolts for anchoring base plates to concrete bases and nuts and washers shall be galvanized in compliance with ASTM A 153.

3. Sign Support, Wood:

- a. Replacement Wood Sign Post shall be of the species listed in AASHTO M168, dressed four sides and having a pyramidal top cut before being treated.
- b. Replacement Sign Post shall be pressure treated with creosote or creosote-tar solution complying with AWPB LP-55.

C. Sign Face:

1. Replacement Plywood Sign Face shall be grade HDOAB G-1 EXTERIOR, in compliance with DOC PS 1. Material shall be cut to size in compliance with ANSI D6.1E.
2. Replacement Galvanizing Steel Sign Face shall comply with USDOT FHA MUTCD.

D. Reflective Sheeting shall be enclosed lens unless otherwise directed by the Owner.



1. Enclosed Lens Reflective Sheeting shall comply with Fed. Spec. L-S-300.
 2. Reflective Sheeting shall comply with FP-79 minimum reflective intensity. Measurements shall comply with Fed. Spec. L-S-300.
 3. Color shall be matched visually and within the limits shown on the Color Tolerance Charts issued by the Federal Highway Administration. The diffuse day color of the reflective sheeting shall be determined in compliance with ASTM E 97.
 4. Film:
 - a. General: Reflective sheeting shall be sufficiently flexible to be easily cut to shape and permit application over, and conformance to, moderate shallow embossing characteristic of certain sign borders and symbols.
 - b. Surface: Sheeting surface shall be smooth and flat, shall facilitate cleaning and wet performance, and shall exhibit 85 degrees glossmeter rating of not less than 40, as specified in ASTM D 523. The sheeting surface shall withstand cleaning with gasoline, VM&P Naphtha, mineral spirits, turpentine, methanol, and xylol.
- E. Demountable Sign Face Materials:
1. Acrylic Plastic Reflectors: Replacement demountable sign letters, digits, arrows, borders, and alphabet accessories shall be reflectorized and shall consist of acrylic plastic reflectors supported by embossed aluminum frames. They shall comply with the Standard Alphabet for Highway Signs, of the Federal Highway Administration, Series E.
 2. Design and Fabrication: The letters shall be modified as necessary to accommodate the required reflectors. All items except border strips shall be fabricated from 0.040-inch minimum sheet aluminum. Border strips shall be of 0.032-inch minimum sheet aluminum. Mounting holes shall be provided within the frames to permit the use of screws, rivets or other acceptable fasteners. The size and spacing of the reflector holes shall provide maximum night legibility and visibility of the finished cutout figure.
 3. General Requirements: The reflectors shall be of acrylic plastic meeting the requirements of Fed. Spec. L-P-380, Type I, Class 3. The reflectors shall be yellow or colorless. The lens shall consist of a smooth front surface, free from projections or indentations other than for identification, and a rear surface bearing a prismatic configuration that will effect total internal reflection of light.
 4. Reflective Sheeting:
 - a. Demountable Sign Letters, Digits, Arrows, Borders, and Alphabet Accessories, when so specified, shall be reflectorized with reflective sheeting supported by flat aluminum backing and shall comply with the Standard Alphabet Highway Signs of the Federal Highway Administration.
 - b. Design and Fabrication: Letter design shall be Series E, modified for legibility. All items except border strips shall be fabricated from 0.040-inch sheet aluminum, 6061-T6 alloy, with mounting holes to permit use of screws, rivets, or other acceptable fasteners.
- F. Highway Delineators, Enclosed Lens Type: Replacement reflectors shall be of acrylic plastic and a minimum of 3 inches in diameter. They shall be mounted in a heavy-duty housing with a back plate. The reflector shall consist of a clear and transparent plastic lens, which shall be colorless, and a plastic back of the same material, fused to the lens under heat and pressure around the entire perimeter to form a homogeneous unit, permanently sealed against dust, water, and water vapor. The acrylic plastic shall comply with Fed. Spec. L-P-380, Type I, Class 3.
- G. Highway Delineators, High Intensity Type:
1. Replacement Reflectorized Delineators shall consist of a reflective sheeting compound of glass spheres, embedded in a weatherproof, synthetic, noncellulose material. The overall size of the plastic reflectors shall be 4 inches by 5 inches, with a reflective area of at least 17.5 square inches.
 2. Delineators shall be silver-white when viewed with reflected light.
- H. Highway Delineators Including Posts and Attachments:

1. Reflective Sheeting: Replacement reflective sheeting for delineators shall match delineators being replaced.
 2. Delineator Posts and Accessories shall be of steel or aluminum. They shall have the necessary holes for attachment of the delineator housing. The assembly shall be furnished with the necessary bolts, nuts, and washers for attaching to the posts.
 3. Insulating Materials: Neoprene, for separation of aluminum and steel parts, shall contain at least 60 percent, by volume, of pure neoprene. Other material may be used, subject to the approval of the Owner as to pliability and ability to withstand wear caused by stretching or distortion.
 4. Reflector Units for guardrail installation shall match existing reflector being replaced in size and color.
 5. Highway Delineators shall be supplemented with directional guidance signs as directed by the Owner. Signs shall be the chevron alignment type and shall comply with ANSI D6.1E, Type W 1-8.
- I. Painting Panels for Nonreflectorized Background:
1. Replacement Metal Panels for sign categories not required to be reflectorized shall have a nonreflectorized background composed of one spray coat of primer and two finish coats of baked enamel.
 2. Finish Coats shall be baked alkyd resin enamels meeting Fed. Spec. TT-E-529, Class B, of a composition that affects the finished background surface. When thoroughly dry, the colors shall match those described in the current Highway Blue Color Tolerance Chart, PR Color No. 3, or in Highway Green Color Tolerance Chart, PR Color No. 4, of the Federal Highway Administration.
 3. Wood Signs shall have two coats of oil paint complying with Fed. Spec. TT-P-52. Message paint shall be a single coat of oil paint. All colors shall comply with ANSI D6.1E.
- J. Sign Wash Detergent shall comply with ASTM D 3399.
- K. Street, Wayside, Utility Location, And Parking Lot Signs; Decals
1. Blanks: aluminum of type, size, and shape indicated.
 2. Reflective sheeting: Type 1 sheeting having Level A reflective intensity.
 3. Silk screen lettering paint and transparent process colors: as directed by the Owner.
 4. Posts
 - a. Drive type: as directed by the Owner.
 - b. Pipe type: Two-inch inside diameter.
 5. Hardware: as directed by the Owner.
 6. Fabrication
 - a. Dimensions, colors, and reflectorizing: As indicated, and in accordance with MUTCD.
 - b. Size, style, and spacing of letters, numerals, symbols, and borders: As indicated, and the Owner; as supplemented by DOT/FHA's publication entitled Standard Highway Signs as specified in MUTCD 1978.
 - c. Workmanship: as directed by the Owner.

1.3 EXECUTION

- A. Footings for Signs, Posts, and Supports:
1. Backfill Material shall be at or near optimum moisture and neither dry nor saturated. It shall be tamped thoroughly in place.
 2. Concrete Footings may be cast in place or precast. Hand mixing of concrete will be permitted where the quantity does not exceed one-half cubic yard.
- B. Erection of Signs and Sign Supports: Sign posts shall be erected vertically. Posts erected in sleeves shall be anchored with sulphur mortar. Mortar shall comply with ASTM C 287. Sign faces shall be positioned to be generally perpendicular to the line-of-sight for the observer. Reflectorized signs shall



be inspected at night. If specular reflection is apparent on any sign, its position shall be adjusted by the Contractor to eliminate the condition.

- C. Delineators and Hazard Markers: Delineator posts shall be driven to a depth of 30 inches.
- D. Removal of Existing Signs and Posts:
 - 1. Damaged, Obsolete, or Change of Purpose Signs and Posts shall be removed and delivered to a storage area designated by the Owner. Post hole shall be backfilled, tamped, and made level with the adjacent surface. Disturbed paving, sidewalks, and grassed areas shall be replaced with matching material of same quality and quantity as existing.
 - 2. Signs and Posts to be Replaced shall be removed and replaced by new signs and posts in identical locations. Backfill around post shall be thoroughly compacted to hold posts securely in a vertical position.
- E. Installation: Install in accordance with manufacturer's recommendations and as directed by the Owner. Unless otherwise indicated, install not more than one sign on each post.

END OF SECTION 10 14 53 11

SECTION 10 21 13 13 - TOILET COMPARTMENTS

1.1 GENERAL

A. Description Of Work:

1. This specification covers the furnishing and installation of materials for toilet compartments. Product shall be as follows or as directed by the Owner. Installation procedures shall be in accordance with the product manufacturer's recommendations. Demolition and removal of materials shall be as required to support the work.

B. Summary

1. Section Includes:

- a. Steel toilet compartments configured as toilet enclosures, entrance screens, and urinal screens.
- b. Stainless-steel toilet compartments configured as toilet enclosures, entrance screens, and urinal screens.
- c. Plastic-laminate-faced toilet compartments configured as toilet enclosures, entrance screens, and urinal screens.
- d. Phenolic-core toilet compartments configured as toilet enclosures, entrance screens, and urinal screens.
- e. Solid-polymer toilet compartments configured as toilet enclosures, entrance screens, and urinal screens.

C. Submittals

1. Product Data: For each type of product indicated.
2. LEED Submittals:
 - a. Product Data for Credit MR 4.1 and Credit MR 4.2, **as directed**: For products having recycled content, documentation indicating percentages by weight of postconsumer and preconsumer recycled content. Include statement indicating costs for each product having recycled content.
 - b. Product Data for Credit EQ 4.4: For particleboard, documentation indicating that product contains no urea formaldehyde.
3. Shop Drawings: For toilet compartments. Include plans, elevations, sections, details, and attachments to other work.
4. Samples for each exposed product and for each color and texture specified.
5. Product certificates.
6. Maintenance data.

D. Quality Assurance

1. Comply with requirements in GSA's CID-A-A-60003, "Partitions, Toilets, Complete", **as directed**.
2. Surface-Burning Characteristics: As determined by testing identical products according to ASTM E 84, or another standard acceptable to authorities having jurisdiction, by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
 - a. Flame-Spread Index: 25 **OR** 75 **OR** 200, **as directed**, or less.
 - b. Smoke-Developed Index: 450 or less.
3. Regulatory Requirements: Comply with applicable provisions in the U.S. Architectural & Transportation Barriers Compliance Board's "Americans with Disabilities Act (ADA) and Architectural Barriers Act (ABA) Accessibility Guidelines for Buildings and Facilities" and ICC/ANSI A117.1 for toilet compartments designated as accessible.

1.2 PRODUCTS

A. Materials

1. Aluminum Castings: ASTM B 26/B 26M.
2. Aluminum Extrusions: **ASTM B 221** (**ASTM B 221M**).
3. Brass Castings: ASTM B 584.
4. Brass Extrusions: ASTM B 455.
5. Steel Sheet: Commercial steel sheet for exposed applications; mill phosphatized and selected for smoothness.
 - a. Electrolytically Zinc Coated: ASTM A 879/A 879M, **01Z** (**03G**).
 - b. Hot-Dip Galvanized: ASTM A 653/A 653M, either hot-dip galvanized or galvanized.
6. Stainless-Steel Sheet: ASTM A 666, Type 304, stretcher-leveled standard of flatness.
7. Stainless-Steel Castings: ASTM A 743/A 743M.
8. Zamac: ASTM B 86, commercial zinc-alloy die castings.
9. Particleboard: ANSI A208.1, Grade M-2 with **45-lb** (**20.4-kg**) density, made with binder containing no urea formaldehyde.
10. Plastic Laminate: NEMA LD 3, general-purpose HGS grade, **0.048-inch** (**1.2-mm**) nominal thickness.

B. Steel Units

1. Toilet-Enclosure Style: Overhead braced **OR** Floor anchored **OR** Ceiling hung **OR** Floor and ceiling anchored, **as directed**.
2. Entrance-Screen Style: Overhead braced **OR** Floor anchored **OR** Ceiling hung **OR** Floor and ceiling anchored, **as directed**.
3. Urinal-Screen Style: Wall hung, flat panel **OR** Wall hung with integral flanges **OR** Wall hung, wedge shaped **OR** Floor anchored **OR** Overhead braced **OR** Post to ceiling, **as directed**.
4. Door, Panel, and Pilaster Construction: Seamless, metal facing sheets pressure laminated to core material; with continuous, interlocking molding strip or lapped-and-formed edge closures; corners secured by welding or clips and exposed welds ground smooth. Provide with no-sightline system, **as directed**. Exposed surfaces shall be free of pitting, seam marks, roller marks, stains, discolorations, telegraphing of core material, or other imperfections.
 - a. Core Material: Manufacturer's standard sound-deadening honeycomb of resin-impregnated kraft paper in thickness required to provide finished thickness of **1 inch** (**25 mm**) for doors and panels and **1-1/4 inches** (**32 mm**) for pilasters.
 - b. Grab-Bar Reinforcement: Provide concealed internal reinforcement for grab bars mounted on units.
 - c. Tapping Reinforcement: Provide concealed reinforcement for tapping (threading) at locations where machine screws are used for attaching items to units.
5. Urinal-Screen Construction:
 - a. Flat-Panel Urinal Screen: Matching panel construction.
 - b. Integral-Flange, Wall-Hung Urinal Screen: Similar to panel construction, with integral full-height flanges for wall attachment, and maximum **1-1/4 inches** (**32 mm**) thick.
 - c. Wedge-Shaped, Wall-Hung Urinal Screen: Similar to panels, V-shaped, fabricated for concealed wall attachment, and maximum **6 inches** (**152 mm**) wide at wall and minimum **1 inch** (**25 mm**) wide at protruding end.
6. Facing Sheets and Closures: Electrolytically coated steel **OR** Hot-dip galvanized-steel **OR** Electrolytically coated or hot-dip galvanized-steel, **as directed**, sheet with nominal base-metal (uncoated) thicknesses as follows:
 - a. Pilasters, Braced at Both Ends (for overhead-braced and floor-and-ceiling-anchored mounting styles): Manufacturer's standard thickness, but not less than **0.036 inch** (**0.91 mm**).
 - b. Pilasters, Unbraced at One End (for floor-anchored and ceiling-hung mounting styles): Manufacturer's standard thickness, but not less than **0.048 inch** (**1.21 mm**).
 - c. Panels: Manufacturer's standard thickness, but not less than **0.030 inch** (**0.76 mm**) **OR** **0.036 inch** (**0.91 mm**), **as directed**.
 - d. Doors: Manufacturer's standard thickness, but not less than **0.030 inch** (**0.76 mm**).
 - e. Flat-Panel Urinal Screens: Thickness matching the panels.

- f. Integral-Flange, Wall-Hung Urinal Screens (for government-style metal screens): Manufacturer's standard thickness, but not less than **0.030 inch (0.76 mm)**.
 - g. Wedge-Shaped, Wall-Hung Urinal Screens: Manufacturer's standard thickness, but not less than **0.036 inch (0.91 mm)**.
 7. Pilaster Shoes and Sleeves (Caps): Stainless-steel sheet, not less than **0.031-inch (0.79-mm)** nominal thickness and **3 inches (76 mm)** high, finished to match hardware.
 8. Urinal-Screen Post (for floor-anchored, overhead-braced, and post-to-ceiling urinal screens): Manufacturer's standard post design of material matching the thickness and construction of pilasters **OR 1-3/4-inch- (44-mm-)** square, aluminum tube with satin finish, **as directed**; with shoe and sleeve (cap), **as directed**, matching that on the pilaster.
 9. Brackets (Fittings):
 - a. Stirrup Type: Ear or U-brackets; chrome-plated zamac **OR** clear-anodized aluminum **OR** stainless steel **OR** chrome-plated brass, **as directed**.
 - b. Full-Height (Continuous) Type: Manufacturer's standard design; stainless steel **OR** aluminum, **as directed**.
 10. Steel-Sheet Finish: Immediately after cleaning and pretreating, apply manufacturer's standard baked-on finish, including thermosetting, electrostatically applied, and powder coatings. Comply with coating manufacturer's written instructions for applying and baking. Apply one color **OR** two colors, **as directed**, in each room.
 - a. Color: As selected from manufacturer's full range.
- C. Stainless-Steel Units
 1. Toilet-Enclosure Style: Overhead braced **OR** Floor anchored **OR** Ceiling hung **OR** Floor and ceiling anchored, **as directed**.
 2. Entrance-Screen Style: Overhead braced **OR** Floor anchored **OR** Ceiling hung **OR** Floor and ceiling anchored, **as directed**.
 3. Urinal-Screen Style: Wall hung flat panel **OR** Wall hung with integral flanges **OR** Wall hung, wedge shaped **OR** Floor anchored **OR** Overhead braced **OR** Post to ceiling, **as directed**.
 4. Door, Panel, and Pilaster Construction: Seamless, metal facing sheets pressure laminated to core material; with continuous, interlocking molding strip or lapped-and-formed edge closures; corners secured by welding or clips and exposed welds ground smooth. Provide with no-sightline system, **as directed**. Exposed surfaces shall be free of pitting, seam marks, roller marks, stains, discolorations, telegraphing of core material, or other imperfections.
 - a. Core Material: Manufacturer's standard sound-deadening honeycomb of resin-impregnated kraft paper in thickness required to provide finished thickness of **1 inch (25 mm)** for doors and panels and **1-1/4 inches (32 mm)** for pilasters.
 - b. Grab-Bar Reinforcement: Provide concealed internal reinforcement for grab bars mounted on units.
 - c. Tapping Reinforcement: Provide concealed reinforcement for tapping (threading) at locations where machine screws are used for attaching items to units.
 5. Urinal-Screen Construction:
 - a. Flat-Panel Urinal Screen: Matching panel construction.
 - b. Integral-Flange, Wall-Hung Urinal Screen (for government-style metal screens): Similar to panel construction, with integral full-height flanges for wall attachment, and maximum **1-1/4 inches (32 mm)** thick.
 - c. Wedge-Shaped, Wall-Hung Urinal Screen: Similar to panels, V-shaped, fabricated for concealed wall attachment, and maximum **6 inches (152 mm)** wide at wall and minimum **1 inch (25 mm)** wide at protruding end.
 6. Facing Sheets and Closures: Stainless-steel sheet of nominal thicknesses as follows:
 - a. Pilasters, Braced at Both Ends (for overhead-braced and floor-and-ceiling-anchored mounting styles): Manufacturer's standard thickness, but not less than **0.038 inch (0.95 mm)**.
 - b. Pilasters, Unbraced at One End (for floor-anchored and ceiling-hung mounting styles): Manufacturer's standard thickness, but not less than **0.050 inch (1.27 mm)**.
 - c. Panels: Manufacturer's standard thickness, but not less than **0.031 inch (0.79 mm) OR 0.038 inch (0.95 mm)**, **as directed**.

- d. Doors: Manufacturer's standard thickness, but not less than **0.031 inch (0.79 mm)**.
 - e. Flat-Panel Urinal Screens: Thickness matching the panels.
 - f. Integral-Flange, Wall-Hung Urinal Screens (for government-style metal screens: Manufacturer's standard thickness, but not less than **0.031 inch (0.79 mm)**).
 - g. Wedge-Shaped, Wall-Hung Urinal Screens: Manufacturer's standard thickness, but not less than **0.038 inch (0.95 mm)**.
 7. Pilaster Shoes and Sleeves (Caps): Stainless-steel sheet, not less than **0.031-inch (0.79-mm)** nominal thickness and **3 inches (76 mm)** high, finished to match hardware.
 8. Urinal-Screen Post (for floor-anchored, overhead-braced, and post-to-ceiling urinal screens): Manufacturer's standard post design of material matching the thickness and construction of pilasters **OR 1-3/4-inch- (44-mm-)** square, aluminum tube with satin finish, **as directed**; with shoe and sleeve (cap) matching that on the pilaster.
 9. Brackets (Fittings):
 - a. Stirrup Type: Ear or U-brackets; chrome-plated zamac **OR** clear-anodized aluminum **OR** stainless steel **OR** chrome-plated brass, **as directed**.
 - b. Full-Height (Continuous) Type: Manufacturer's standard design; stainless steel **OR** aluminum, **as directed**.
 10. Stainless-Steel Finish: No. 4 bright, directional polish **OR** Manufacturer's standard textured finish, **as directed**, on exposed faces. Protect exposed surfaces from damage by application of strippable, temporary protective covering before shipment.
- D. Plastic-Laminate-Faced Units
1. Toilet-Enclosure Style: Overhead braced **OR** Floor anchored **OR** Ceiling hung **OR** Floor and ceiling anchored, **as directed**.
 2. Entrance-Screen Style: Overhead braced **OR** Floor anchored **OR** Ceiling hung **OR** Floor and ceiling anchored, **as directed**.
 3. Urinal-Screen Style: Wall hung **OR** Floor anchored **OR** Overhead braced **OR** Post to ceiling, **as directed**.
 4. Door, Panel, Screen, and Pilaster Construction: One-piece, plastic-laminate facing sheets pressure laminated to core material without splices or joints in facings or cores; with laminate **OR** stainless-steel edge trim **0.050 inch (1.27 mm)** thick, **as directed**, applied to edges before faces to seal edges and prevent laminate from being pried loose. Seal exposed core material at cutouts to protect core from moisture. Provide with no-sightline system, **as directed**.
 - a. Core Material: Particleboard.
 - b. Doors and Panels: Finished to not less than **7/8 inch (22 mm)** **OR 1 inch (25 mm)**, **as directed**, thick.
 - c. Pilasters: Provide construction to comply with one of the following, **as directed**:
 - 1) Finished to not less than **1-1/4 inches (32 mm)** thick and with internal, nominal **0.134-inch- (3.42-mm-)** thick, steel-sheet reinforcement, **as directed**.
 - 2) Finished to **1-1/4 inches (32 mm)** thick and with manufacturer's standard steel-sheet core laminated to both sides of honeycomb of resin-impregnated kraft paper in lieu of particleboard core.
 - 3) Finished to not less than **1 inch (25 mm)** thick and with internal, nominal **0.120-inch- (3.04-mm-)** thick, steel-sheet reinforcement.
 5. Pilaster Shoes and Sleeves (Caps): Formed from stainless-steel sheet, not less than **0.031-inch (0.79-mm)** nominal thickness and **3 inches (76 mm)** high, finished to match hardware.
 6. Urinal-Screen Post (for floor-anchored, overhead-braced, and post-to-ceiling urinal screens): Manufacturer's standard post design of material matching the thickness and construction of pilasters **OR 1-3/4-inch- (44-mm-)** square, aluminum tube with satin finish **OR 1-1/4-inch- (32-mm-)** square, stainless-steel tube **0.050 inch (1.27 mm)** thick with satin finish, **as directed**; with shoe and sleeve (cap) matching that on the pilaster.
 7. Brackets (Fittings):
 - a. Stirrup Type: Ear or U-brackets, chrome-plated zamac **OR** clear-anodized aluminum **OR** stainless steel **OR** chrome-plated brass, **as directed**.

- b. Full-Height (Continuous) Type: Manufacturer's standard design; stainless steel **OR** aluminum, **as directed**.
8. Plastic-Laminate Finish: One color and pattern **OR** Two colors and patterns, **as directed**, in each room.
- a. Color and Pattern: As selected from manufacturer's full range.
- E. Phenolic-Core Units
1. Toilet-Enclosure Style: Overhead braced **OR** Floor anchored **OR** Ceiling hung **OR** Floor and ceiling anchored, **as directed**.
2. Entrance-Screen Style: Overhead braced **OR** Floor anchored **OR** Ceiling hung **OR** Floor and ceiling anchored, **as directed**.
3. Urinal-Screen Style: Wall hung **OR** Floor anchored **OR** Overhead braced **OR** Post to ceiling, **as directed**.
4. Door, Panel, Screen, and Pilaster Construction: Solid phenolic-core panel material with melamine facing on both sides fused to substrate during panel manufacture (not separately laminated), and with eased and polished edges and no-sightline system, **as directed**. Provide minimum **3/4-inch- (19-mm-)** thick doors and pilasters and minimum **1/2-inch- (13-mm-)** thick panels.
5. Pilaster Shoes and Sleeves (Caps): Fabricated from stainless-steel sheet, not less than **0.031-inch (0.79-mm)** nominal thickness and **3 inches (76 mm)** high, finished to match hardware.
6. Urinal-Screen Post (for floor-anchored, overhead-braced, and post-to-ceiling urinal screens): Manufacturer's standard post design of monolithic phenolic urinal screen cut out at bottom to form a post **OR** material matching the thickness and construction of pilasters **OR 1-3/4-inch- (44-mm-)** square, aluminum tube with satin finish, **as directed**; with shoe and sleeve (cap) matching that on the pilaster.
7. Brackets (Fittings):
- a. Stirrup Type: Ear or U-brackets, chrome-plated zamac **OR** clear-anodized aluminum **OR** stainless steel **OR** chrome-plated brass, **as directed**.
- b. Full-Height (Continuous) Type: Manufacturer's standard design; stainless steel **OR** aluminum, **as directed**.
8. Phenolic-Panel Finish:
- a. Facing Sheet Finish: One color and pattern **OR** Two colors and patterns, **as directed**, in each room.
- b. Color and Pattern: As selected from manufacturer's full range, with manufacturer's standard dark color core **OR** through-color core matching face sheet, **as directed**.
- F. Solid-Polymer Units
1. Toilet-Enclosure Style: Overhead braced **OR** Floor anchored **OR** Ceiling hung **OR** Floor and ceiling anchored, **as directed**.
2. Entrance-Screen Style: Overhead braced **OR** Floor anchored **OR** Ceiling hung **OR** Floor and ceiling anchored, **as directed**.
3. Urinal-Screen Style: Wall hung **OR** Floor anchored **OR** Overhead braced **OR** Post to ceiling, **as directed**.
4. Door, Panel, Screen, and Pilaster Construction: Solid, high-density polyethylene (HDPE) **OR** polypropylene (PP), **as directed**, panel material, not less than **1 inch (25 mm)** thick, seamless, with eased edges, no-sightline system, **as directed**, and with homogenous color and pattern throughout thickness of material.
- a. Integral Hinges: Configure doors and pilasters to receive integral hinges.
- b. Heat-Sink Strip: Manufacturer's standard continuous, extruded-aluminum **OR** stainless-steel, **as directed**, strip fastened to exposed bottom edges of solid-polymer components to prevent burning.
- c. Color and Pattern: One color and pattern **OR** Two colors and patterns, **as directed**, in each room as indicated by manufacturer's designations **OR** as selected from manufacturer's full range, **as directed**.
5. Pilaster Shoes and Sleeves (Caps): Manufacturer's standard design; polymer **OR** stainless steel, **as directed**.

- a. Polymer Color and Pattern: Matching pilaster **OR** Contrasting with pilaster, as indicated by manufacturer's designations **OR** Contrasting with pilaster, as selected from manufacturer's full range, **as directed**.
6. Urinal-Screen Post (for floor-anchored, overhead-braced, and post-to-ceiling urinal screens): Manufacturer's standard post design of material matching the thickness and construction of pilasters **OR** 1-3/4-inch- (44-mm-) square, aluminum tube with satin finish, **as directed**; with shoe and sleeve (cap) matching that on the pilaster.
7. Brackets (Fittings):
 - a. Stirrup Type: Ear or U-brackets, chrome-plated zamac **OR** clear-anodized aluminum **OR** stainless steel **OR** chrome-plated brass, **as directed**.
 - b. Full-Height (Continuous) Type: Manufacturer's standard design; polymer or extruded aluminum **OR** polymer **OR** extruded aluminum **OR** stainless steel, **as directed**.
 - 1) Polymer Color and Pattern: Matching panel **OR** Contrasting with panel, as indicated by manufacturer's designations **OR** Contrasting with panel, as selected from manufacturer's full range, **as directed**.
8. Overhead Cross Bracing for Ceiling-Hung Units: As recommended by manufacturer and fabricated from solid polymer.

G. Accessories

1. Hardware and Accessories: Manufacturer's standard design, heavy-duty operating hardware and accessories.
 - a. Material: Chrome-plated zamac **OR** Clear-anodized aluminum **OR** Stainless steel **OR** Chrome-plated brass, **as directed**.
 - b. Hinges: Manufacturer's standard paired, self-closing type that can be adjusted to hold doors open at any angle up to 90 degrees **OR** continuous, cam type that swings to a closed or partially open position **OR** continuous, spring-loaded type **OR** integral hinge for solid-polymer doors, **as directed**.
 - c. Latch and Keeper: Manufacturer's standard recessed **OR** surface-mounted, **as directed**, latch unit designed for emergency access and with combination rubber-faced door strike and keeper. Provide units that comply with regulatory requirements for accessibility at compartments designated as accessible.
 - d. Coat Hook: Manufacturer's standard combination hook and rubber-tipped bumper, sized to prevent in-swinging door from hitting compartment-mounted accessories.
 - e. Door Bumper: Manufacturer's standard rubber-tipped bumper at out-swinging doors and entrance-screen doors, **as directed**.
 - f. Door Pull: Manufacturer's standard unit at out-swinging doors that complies with regulatory requirements for accessibility. Provide units on both sides of doors at compartments designated as accessible.
2. Overhead Bracing (for overhead-braced units): Manufacturer's standard continuous, extruded-aluminum head rail with antigrip profile and in manufacturer's standard finish.
3. Anchorages and Fasteners: Manufacturer's standard exposed fasteners of stainless steel or chrome-plated steel or brass, finished to match the items they are securing, with theft-resistant-type heads. Provide sex-type bolts for through-bolt applications. For concealed anchors, use stainless steel, hot-dip galvanized steel, or other rust-resistant, protective-coated steel.

H. Fabrication

1. Overhead-Braced Units: Provide manufacturer's standard corrosion-resistant supports, leveling mechanism, and anchors at pilasters to suit floor conditions. Provide shoes at pilasters to conceal supports and leveling mechanism.
2. Floor-Anchored Units: Provide manufacturer's standard corrosion-resistant anchoring assemblies with leveling adjustment nuts at pilasters for structural connection to floor. Provide shoes at pilasters to conceal anchorage.
3. Ceiling-Hung Units: Provide manufacturer's standard corrosion-resistant anchoring assemblies with leveling adjustment nuts at pilasters for connection to structural support above finished

- ceiling. Provide assemblies that support pilasters from structure without transmitting load to finished ceiling. Provide sleeves (caps) at tops of pilasters to conceal anchorage.
4. Floor-and-Ceiling-Anchored Units: Provide manufacturer's standard corrosion-resistant anchoring assemblies with leveling adjustment at tops and bottoms of pilasters. Provide shoes and sleeves (caps) at pilasters to conceal anchorage.
 5. Urinal-Screen Posts: Provide manufacturer's standard corrosion-resistant anchoring assemblies with leveling adjustment at tops and bottoms, **as directed**, of posts. Provide shoes and sleeves (caps) at posts to conceal anchorage.
 6. Door Size and Swings: Unless otherwise indicated, provide **24-inch- (610-mm-)** wide, in-swinging doors for standard toilet compartments and **36-inch- (914-mm-)** wide, out-swinging doors with a minimum **32-inch- (813-mm-)** wide, clear opening for compartments designated as accessible.

1.3 EXECUTION

A. Installation

1. General: Comply with manufacturer's written installation instructions. Install units rigid, straight, level, and plumb. Secure units in position with manufacturer's recommended anchoring devices.
 - a. Maximum Clearances:
 - 1) Pilasters and Panels: **1/2 inch (13 mm)**.
 - 2) Panels and Walls: **1 inch (25 mm)**.
 - b. Stirrup Brackets: Secure panels to walls and to pilasters with no fewer than two brackets attached **OR** three brackets attached at midpoint and, **as directed**, near top and bottom of panel.
 - 1) Locate wall brackets so holes for wall anchors occur in masonry or tile joints.
 - 2) Align brackets at pilasters with brackets at walls.
2. Overhead-Braced Units: Secure pilasters to floor and level, plumb, and tighten. Set pilasters with anchors penetrating not less than **1-3/4 inches (44 mm)** into structural floor unless otherwise indicated in manufacturer's written instructions. Secure continuous head rail to each pilaster with no fewer than two fasteners. Hang doors to align tops of doors with tops of panels, and adjust so tops of doors are parallel with overhead brace when doors are in closed position.
3. Floor-Anchored Units: Set pilasters with anchors penetrating not less than **2 inches (51 mm)** into structural floor unless otherwise indicated in manufacturer's written instructions. Level, plumb, and tighten pilasters. Hang doors and adjust so tops of doors are level with tops of pilasters when doors are in closed position.
4. Ceiling-Hung Units: Secure pilasters to supporting structure and level, plumb, and tighten. Hang doors and adjust so bottoms of doors are level with bottoms of pilasters when doors are in closed position.
5. Floor-and-Ceiling-Anchored Units: Secure pilasters to supporting construction and level, plumb, and tighten. Hang doors and adjust so doors are level and aligned with panels when doors are in closed position.
6. Urinal Screens: Attach with anchoring devices to suit supporting structure. Set units level and plumb, rigid, and secured to resist lateral impact.

B. Adjusting

1. Hardware Adjustment: Adjust and lubricate hardware according to hardware manufacturer's written instructions for proper operation. Set hinges on in-swinging doors to hold doors open approximately 30 degrees from closed position when unlatched. Set hinges on out-swinging doors and doors in entrance screens to return doors to fully closed position.

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Task	Specification	Specification Description
10 21 13 13	01 22 16 00	No Specification Required
10 21 13 14	01 22 16 00	No Specification Required
10 21 13 14	10 21 13 13	Toilet Compartments
10 21 13 16	01 22 16 00	No Specification Required
10 21 13 16	10 21 13 13	Toilet Compartments

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SECTION 10 21 13 19 - SOLID SURFACE MATERIAL TOILET COMPARTMENTS

1.1 GENERAL

- A. Description Of Work:
1. This specification covers the furnishing and installation of materials for solid surface material toilet compartments. Product shall be as follows or as directed by the Owner. Installation procedures shall be in accordance with the product manufacturer's recommendations. Demolition and removal of materials shall be as required to support the work.
- B. Submittals
1. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
 2. Samples:
 - a. Panel: 1'-0" by 1'-0" panel showing construction with two sides and two edges, including one finished corner condition.
 - b. Hardware: Actual hardware item
 3. Manufacturer's installation and maintenance instructions.
- C. Warranty
1. Special Warranty: Solid surface material compartment manufacturer's three year warranty against defects in fabricated products. Provide for product replacement only; labor not included. Damage caused by physical or chemical abuse is not warrantied.

1.2 PRODUCTS

- A. Manufactured Units
1. Product standard of quality: E.I. DuPont de Nemours and Company, Inc.; Privacy Partitions.
- B. Types:
1. Floor supported, overhead braced compartments.
 2. Wall hung urinal screens.
- C. Materials:
1. Partitions, panels, headrails, and doors:
 - a. Material: E.I. DuPont de Nemours and Company, Inc.; Corian, or approved equivalent.
 - b. Characteristics:
 - 1) Material type: Homogeneous filled methyl methacrylate sheet, not coated.
 - 2) Meet ANSI Z124.3 and 6, Type Six.
 - 3) Thickness: 1/2".
 - a) Partition panels and doors: 1/2".
 - b) Urinal screen panels: 1/2".
 - c. Colors: Selected from manufacturer's color selection.
 - d. Finish: Matte.
 2. Pilasters, hardware, and fittings: Note requirements in FABRICATION Article for hardware concealment.
 - a. Pilaster material: Same material as panels; 1" thickness.
 - b. Acceptable hardware manufacturer: Jack Knob Hardware, or approved equivalent.
 - c. Hinges:
 - 1) ANSI Type 304 stainless steel; surface mounted; self closing pivot hinge type, two per door; matt finish.
 - 2) Type: Adjustable to return door by gravity to preset position when not latched.
 - d. Wall brackets:

- 1) Material: ASTM B209-90, extruded aluminum alloy 6463-T5, mill finish, full length continuous wall brackets; extrusion weighing not less than 1.685 lbs. per LF.
- 2) Predrill by manufacturer; holes spaced 6" along full bracket length; tamper resistant bolt attachment.
- e. Pilaster hanger:
 - 1) Manufacturer's standard galvanized anchorage device for attachment of pilaster to structural support and for leveling compartment.
 - 2) Hanger consists of threaded rods, saddle, lock washers, and leveling nuts.
 - 3) Design pilaster hangers to transmit loads to above-ceiling support system, not finished ceiling.
- f. Pilaster base:
 - 1) Type: Manufacturer's standard galvanized anchorage devices for attachment of pilaster to supporting floor and for leveling of compartment. Base consists of threaded rods, saddle, lock washers, leveling nuts, and minimum of two brass or lead expansion shields per base.
 - 2) Anchor penetration: Penetrate floor at least 1" for overhead braced compartments.
- g. Latch and keeper: AISI Type 304 Type stainless steel; 360 deg. pivot on latch; ADA compatible; surface mounted.
- h. Door stop/bumper: AISI Type 304 Type stainless steel; surface mounted.
- i. Door pull: Same material as panels; meet ADA requirements on handicap stalls.
- j. Coat hook; one per unit: Same material as panels; surface mounted.
- k. Grab bar mounting plate: Same material as panels; recessed back; complete with "T" nuts and screws; one per each mounting location to divider panel.
- l. Headrail for overhead braced units: ASTM B209-90, 6063-T6 extruded aluminum, satin anodized finish.

D. Accessories:

1. Exposed fasteners: Stainless steel or chrome plated brass with theft resistant one-way heads,
2. Unexposed fasteners: Galvanized steel, hot-dip coated following fabrication.
3. Inserts for door hardware, hinges, latches, and coat hooks: Threaded steel.
4. Adhesives: Type recommended by panel material manufacturer for joints.
5. Silicone sealant: Specified in Joints Sealants Section.

E. Fabrication

1. Shop assembly:
 - a. Fabricate components in accord with manufacturers standards, without face or edge seams in solid plastic material; bevel exposed edges.
 - b. Factory install metal inserts into components for screw fastened hardware; fasteners secured directly into core are prohibited.
 - c. Pre-notch and predrill panels for hardware at factory. Exposed hardware in completed installation includes only the following items or portion of items:
 - 1) Door hinge barrel.
 - 2) Door latch and keeper.
 - 3) Door striker.
 - d. Cover hardware with 1/2" solid surfacing material strips, except as indicated above.
 - e. Secure templates and factory cut panels for installation of accessories furnished under other Sections.
 - f. Doors: Inswing and outswing type indicated.
 - g. Exposed surfaces free from marks and blemishes; completely hide through material joints.
2. Tolerances; variation in size: $\pm 1/8"$

1.3 EXECUTION

A. Installation

1. General:
 - a. Erect solid surface material compartment system plumb; attach to supporting structure indicated on reviewed shop drawings.
 - b. Attach solid surface material compartment system to back-up construction; use fasteners indicated on reviewed shop drawings.
 - c. Secure solid surface material panels to walls with continuous mounting flanges.
 - d. Locate wall brackets aligning holes for fasteners with masonry or tile joints.
 - e. Floor supported, overhead braced compartments:
 - 1) Attach pilasters to supporting floor with pilaster base indicated on reviewed shop drawings.
 - 2) Level and plumb compartments. Tighten pilaster base fasteners.
 - 3) Secure pilaster shoes in position against finished floor.
 - 4) Secure headrail to panels with minimum of two fasteners per face. Provide cover plates for exposed ends.
 - 5) Set door tops parallel with headrail when doors are in closed position.
 - f. Wall hung screens:
 - 1) Attach screens to wall construction with brackets and fasteners, indicated on reviewed shop drawings.
 - 2) Position and level units. Tighten fasteners in place.

B. Application

1. Tolerances:
 - a. Between panel and pilaster: 1/2", except where concealed fasteners are used.
 - b. Between door edge and pilaster: 1/4"
 - c. Between panel and wall: 1".
2. Conceal evidence of drilling, cutting, and fitting to room finishes.

C. Adjustment And Cleaning

1. Adjustment:
 - a. Lubricate and adjust hardware. Tighten fasteners.
 - b. Set hinges on in-swing doors to hold doors open approximately 15 deg. from closed position when unlatched.
 - c. Set hinges on out-swing doors to return to closed position.
2. Cleaning:
 - a. Remove protective coverings from compartments and hardware.
 - b. Clean exposed surfaces of compartments and hardware using materials and methods recommended by solid surface material compartment system manufacturer.

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Task	Specification	Specification Description
10 21 13 19	10 21 13 13	Toilet Compartments
10 21 13 43	01 22 16 00	No Specification Required
10 21 13 43	10 21 13 13	Toilet Compartments

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SECTION 10 21 16 17 - SHOWER AND DRESSING COMPARTMENTS

1.1 GENERAL

A. Description Of Work

1. This specification covers the furnishing and installation of materials for shower and dressing compartments. Product shall be as follows or as directed by the Owner. Installation procedures shall be in accordance with the product manufacturer's recommendations. Demolition and removal of materials shall be as required to support the work.

B. Summary

1. Section Includes:
 - a. Shower compartments fabricated from steel, stainless steel, solid phenolic, or solid polymer.
 - b. Dressing compartments fabricated from steel, stainless steel, solid phenolic, solid polymer, or plastic laminate.
 - c. Shower receptors.

C. Submittals

1. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.
2. LEED Submittals:
 - a. Product Data for Credit MR 4.1 and Credit MR 4.2, **as directed**: For products having recycled content, documentation indicating percentages by weight of postconsumer and preconsumer recycled content. Include statement indicating costs for each product having recycled content.
 - b. Product Data for Credit EQ 4.4: For particleboard, documentation indicating that product contains no urea formaldehyde.
3. Shop Drawings: For shower and dressing compartments. Include plans, elevations, sections, details, and attachments to other work.
 - a. Show locations of cutouts for compartment-mounted accessories.
 - b. Show locations of reinforcements for compartment-mounted grab bars.
 - c. Show locations of centerlines of drains.
 - d. Show ceiling grid and overhead support or bracing locations.
4. Samples: For the following products, in manufacturer's standard sizes unless otherwise indicated:
 - a. Each type of material, color, and finish required for compartments, prepared on **6-inch- (152-mm-)** square Samples of same thickness and material indicated for the Work.
 - b. Each type of hardware and accessory.
 - c. Curtain Fabric: **12-inch- (305-mm-)** square swatch or larger as required to show complete pattern repeat, from dye lot used for the Work, with specified treatments applied. Mark top and face of material.
5. Product Certificates: For each type of shower and dressing compartment, from manufacturer.
6. Maintenance Data: For shower and dressing compartments to include in maintenance manuals.

D. Quality Assurance

1. Surface-Burning Characteristics: As determined by testing identical products according to ASTM E 84, or another standard acceptable to authorities having jurisdiction, by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
 - a. Flame-Spread Index: **25 OR 75 OR 200, as directed**, or less.
 - b. Smoke-Developed Index: 450 or less.
2. Regulatory Requirements: Comply with applicable provisions in the U.S. Architectural & Transportation Barriers Compliance Board's ADA-ABA Accessibility Guidelines and ICC/ANSI A117.1 for shower and dressing compartments designated as accessible.

E. Project Conditions

1. Field Measurements: Verify actual locations of walls, columns, ceilings, and other construction contiguous with shower and dressing compartments by field measurements before fabrication.

1.2 PRODUCTS

A. Materials

1. Aluminum Castings: ASTM B 26/B 26M.
2. Aluminum Extrusions: **ASTM B 221 (ASTM B 221M)**.
3. Brass Castings: ASTM B 584.
4. Brass Extrusions: ASTM B 455.
5. Steel Sheet: ASTM A 653/A 653M, either hot-dip galvanized or galvanized; mill phosphatized and selected for smoothness.
6. Stainless-Steel Sheet: ASTM A 666, Type 304, stretcher-leveled standard of flatness.
7. Stainless-Steel Castings: ASTM A 743/A 743M.
8. Particleboard: ANSI A208.1, Grade M-2 with **45-lb (20.4-kg)** density, made with binder containing no urea formaldehyde.
9. Plastic Laminate: NEMA LD 3, general-purpose HGS grade, **0.048-inch (1.2-mm)** nominal thickness.

B. Steel Compartments

1. Configuration: Shower compartment **OR** Shower and dressing compartments **OR** Shower compartment with two dressing compartments **OR** As shown on Drawings, **as directed**.
2. Enclosure Style: Overhead braced **OR** Floor and ceiling anchored, **as directed**.
3. Panel and Pilaster Construction: Seamless metal facing sheets, pressure laminated to core material; with continuous, interlocking molding strip or lapped-and-formed edge closures and with corners secured by welding or clips and exposed welds ground smooth. Exposed surfaces shall be free of pitting, seam marks, roller marks, stains, discolorations, telegraphing of core material, or other imperfections.
 - a. Core Material: Manufacturer's standard, sound-deadening honeycomb of resin-impregnated kraft paper in thickness required to provide finished thickness of **1 inch (25 mm)** for panels and **1-1/4 inches (32 mm)** for pilasters.
 - b. Grab-Bar Reinforcement: Provide concealed internal reinforcement for grab bars mounted on compartments.
 - c. Tapping Reinforcement: Provide concealed reinforcement for tapping (threading) at locations where machine screws are used for attaching items to compartments.
4. Door Construction: Match panels; **1-inch (25-mm)** finished thickness.
5. Facing Sheets and Closures: Hot-dip galvanized-steel sheet with nominal base-metal (uncoated) thicknesses as follows:
 - a. Pilasters, Braced at Both Ends: Manufacturer's standard thickness, but not less than **0.036 inch (0.91 mm)**.
 - b. Panels: Manufacturer's standard thickness, but not less than **0.030 inch (0.76 mm) OR 0.036 inch (0.91 mm), as directed**.
 - c. Doors: Manufacturer's standard thickness, but not less than **0.030 inch (0.76 mm)**.
6. Pilaster Shoes and Sleeves (Caps): Formed from stainless-steel sheet, not less than **0.031-inch (0.79-mm)** nominal thickness and **3 inches (76 mm)** high, finished to match hardware.
7. Brackets (Fittings):
 - a. Full-Height (Continuous) Type: Manufacturer's standard design; clear-anodized aluminum.
 - b. Stirrup Type: Ear or U-brackets; clear-anodized aluminum **OR** stainless steel **OR** chrome-plated brass, **as directed**.
 - c. Dressing-Compartment Brackets: Match toilet-compartment brackets specified in Division 10 Section "Toilet Compartments".
8. Steel-Sheet Finish: Immediately after cleaning and pretreating, apply manufacturer's standard baked-on finish, including thermosetting, electrostatically applied, and powder coatings. Comply

with coating manufacturer's written instructions for applying and baking. Apply one color **OR** two colors, **as directed**, in each room.

- a. Color: As indicated by manufacturer's designations **OR** As selected from manufacturer's full range **OR** Match steel toilet compartments specified in Division 10 Section "Toilet Compartments", **as directed**.

C. Stainless-Steel Compartments

1. Configuration: Shower compartment **OR** Shower and dressing compartments **OR** Shower compartment with two dressing compartments **OR** As shown on Drawings, **as directed**.
2. Enclosure Style: Overhead braced **OR** Floor and ceiling anchored, **as directed**.
3. Panel and Pilaster Construction: Seamless metal facing sheets, pressure laminated to core material; with continuous, interlocking molding strip or lapped-and-formed edge closures and with corners secured by welding or clips and exposed welds ground smooth. Exposed surfaces shall be free of pitting, seam marks, roller marks, stains, discolorations, telegraphing of core material, or other imperfections.
 - a. Core Material: Manufacturer's standard, sound-deadening honeycomb of resin-impregnated kraft paper in thickness required to provide finished thickness of 1 inch (25 mm) for panels and 1-1/4 inches (32 mm) for pilasters.
 - b. Grab-Bar Reinforcement: Provide concealed internal reinforcement for grab bars mounted on compartments.
 - c. Tapping Reinforcement: Provide concealed reinforcement for tapping (threading) at locations where machine screws are used for attaching items to compartments.
4. Door Construction: Match panels; 1-inch (25-mm) finished thickness.
5. Facing Sheets and Closures: Stainless-steel sheet of nominal thicknesses as follows:
 - a. Pilasters, Braced at Both Ends: Manufacturer's standard thickness, but not less than 0.038 inch (0.95 mm).
 - b. Panels: Manufacturer's standard thickness, but not less than 0.031 inch (0.79 mm) **OR** 0.038 inch (0.95 mm), **as directed**.
6. Doors: Manufacturer's standard thickness, but not less than 0.031 inch (0.79 mm).
7. Pilaster Shoes and Sleeves (Caps): Formed from stainless-steel sheet, not less than 0.031-inch (0.79-mm) nominal thickness and 3 inches (76 mm) high, finished to match hardware.
8. Brackets (Fittings):
 - a. Full-Height (Continuous) Type: Manufacturer's standard design; clear-anodized aluminum.
 - b. Stirrup Type: Ear or U-brackets; clear-anodized aluminum **OR** stainless steel **OR** chrome-plated brass, **as directed**.
 - c. Dressing-Compartment Brackets: Match toilet-compartment brackets specified in Division 10 Section "Toilet Compartments".
9. Stainless-Steel Finish: No. 4, bright, directional polish **OR** Manufacturer's standard textured finish **OR** Match stainless-steel toilet-compartment finish, specified in Division 10 Section "Toilet Compartments", **as directed**, on exposed faces. Protect exposed surfaces from damage by applying strippable, temporary protective covering before shipment.

D. Phenolic-Core Compartments

1. Configuration: Shower compartment **OR** Shower and dressing compartments **OR** Shower compartment with two dressing compartments **OR** As shown on Drawings, **as directed**.
2. Enclosure Style: Overhead braced **OR** Floor and ceiling anchored, **as directed**.
3. Panel and Pilaster Construction: Solid phenolic material consisting of solid phenolic-core panel with melamine facing on both sides fused to substrate during panel manufacture (not separately laminated) and with eased and polished edges. Provide minimum 3/4-inch- (19-mm-) thick pilasters and minimum 1/2-inch- (13-mm-) thick panels.
4. Door Construction: Match panels; 3/4-inch (19-mm) minimum thickness.
5. Pilaster Shoes and Sleeves (Caps): Formed from stainless-steel sheet, not less than 0.031-inch (0.79-mm) nominal thickness and 3 inches (76 mm) high, finished to match hardware.
6. Brackets (Fittings):
 - a. Full-Height (Continuous) Type: Manufacturer's standard design; clear-anodized aluminum.



- b. Stirrup Type: Ear or U-brackets; clear-anodized aluminum **OR** stainless steel **OR** chrome-plated brass, **as directed**.
 - c. Dressing-Compartment Brackets: Match toilet-compartment brackets specified in Division 10 Section "Toilet Compartments".
- 7. Phenolic-Core-Panel Finish:
 - a. Facing Sheet Finish: One color and pattern **OR** Two colors and patterns, **as directed**, in each room.
 - b. Color and Pattern: As indicated by manufacturer's designations, **OR** As selected from manufacturer's full range, **OR** Match phenolic-core toilet compartments specified in Division 10 Section "Toilet Compartments", **as directed**, with manufacturer's standard dark-color core **OR** through-color core matching face sheet, **as directed**.
- E. Solid-Polymer Compartments
 - 1. Configuration: Shower compartment **OR** Shower and dressing compartments **OR** Shower compartment with two dressing compartments **OR** As shown on Drawings, **as directed**.
 - 2. Enclosure Style: Overhead braced **OR** Floor and ceiling anchored, **as directed**.
 - 3. Panel and Pilaster Construction: Solid HDPE panel material, not less than **1 inch (25 mm)** thick, seamless, with eased edges and with homogenous color and pattern throughout thickness of material.
 - a. Integral Hinges: Configure doors and pilasters to receive integral hinges.
 - b. Heat-Sink Strip: Manufacturer's standard, continuous, clear-anodized extruded-aluminum or stainless-steel strip fastened to exposed bottom edges of solid-polymer components to prevent burning.
 - c. Color and Pattern: One color and pattern **OR** Two colors and patterns, **as directed**, in each room; as indicated by manufacturer's designations **OR** as selected from manufacturer's full range **OR** match solid-polymer toilet compartments specified in Division 10 Section "Toilet Compartments", **as directed**.
 - 4. Door Construction: Match panels.
 - 5. Pilaster Shoes and Sleeves (Caps): Manufacturer's standard design; polymer or stainless steel.
 - a. Polymer Color and Pattern: Match pilaster **OR** Contrast with pilaster, as indicated by manufacturer's designations **OR** Contrast with pilaster, as selected from manufacturer's full range **OR** Match solid-polymer toilet compartments specified in Division 10 Section "Toilet Compartments", **as directed**.
 - 6. Brackets (Fittings):
 - a. Full-Height (Continuous) Type: Manufacturer's standard design; polymer or clear-anodized extruded aluminum **OR** polymer **OR** clear-anodized extruded aluminum, **as directed**.
 - 1) Polymer Color and Pattern: Match panel **OR** Contrast with panel, as indicated by manufacturer's designations **OR** Contrast with panel, as selected from manufacturer's full range **OR** Match solid-polymer toilet compartments specified in Division 10 Section "Toilet Compartments", **as directed**.
 - b. Stirrup Type: Ear or U-brackets; clear-anodized aluminum **OR** stainless steel **OR** chrome-plated brass, **as directed**.
 - c. Dressing-Compartment Brackets: Match toilet-compartment brackets specified in Division 10 Section "Toilet Compartments".
- F. Plastic-Laminate-Faced Dressing Compartments
 - 1. Configuration: Dressing compartment attached to steel **OR** stainless-steel **OR** phenolic-core **OR** solid-polymer, **as directed**, shower compartment as shown on Drawings.
 - 2. Enclosure Style: Overhead braced **OR** Floor and ceiling anchored, **as directed**.
 - 3. Panel and Pilaster Construction: One-piece, plastic-laminate facing sheets pressure laminated to core material without splices or joints in facings or cores; with laminate **OR** stainless-steel edge trim **0.050 inch (1.27 mm)** thick, **as directed**, applied to edges before faces to seal edges and prevent laminate from being pried loose. Seal exposed core material at cutouts to protect core from moisture.
 - a. Core Material: Particleboard.

- b. Panels: Finished to not less than **1 inch (25 mm)** thick.
 - c. Pilasters: Comply with one of the following:
 - 1) Finished to not less than **1-1/4 inches (32 mm)** thick and with internal, nominal **0.134-inch- (3.42-mm-)** thick, steel-sheet reinforcement.
OR
Finished to not less than **1 inch (25 mm)** thick and with internal, nominal **0.120-inch- (3.04-mm-)** thick, steel-sheet reinforcement.
 - 4. Door Construction: Match panels.
 - 5. Pilaster Shoes and Sleeves (Caps): Formed from stainless-steel sheet, not less than **0.031-inch (0.79-mm)** nominal thickness and **3 inches (76 mm)** high, finished to match hardware.
 - 6. Brackets (Fittings):
 - a. Full-Height (Continuous) Type: Manufacturer's standard design; clear-anodized aluminum.
 - b. Stirrup Type: Ear or U-brackets; clear-anodized aluminum **OR** stainless steel **OR** chrome-plated brass, **as directed**.
 - 7. Plastic-Laminate Finish: One color and pattern **OR** Two colors and patterns, **as directed**, in each room.
 - a. Color and Pattern: As indicated by manufacturer's designations **OR** As selected from manufacturer's full range **OR** Match toilet compartments specified in Division 10 Section "Toilet Compartments", **as directed**.
- G. Shower Receptors
- 1. General: Manufacturer's standard, prefabricated, terrazzo receptor complete with integral drain.
 - a. Curb: Not less than **2 inches (51 mm)** and not more than **9 inches (229 mm)** deep when measured from the top of the curb to the top of the drain; with curb threshold not less than **1 inch (25 mm)** below the sides and back of the receptor; and with a ramped entrance surface for accessible compartments, **as directed**.
 - b. Floor: Finished, sloping uniformly toward the drain and not less than 1/4 unit vertical in 12 units horizontal and not more than **1/2 inch (13 mm)**.
 - c. Drain Strainer: Manufacturer's standard, removable brass strainer **OR** chrome strainer **OR** stainless-steel strainer **OR** plastic strainer, matching the receptor, **as directed**.
 - d. Drain Gasket: Manufacturer's standard gasket sized to fit waste pipe.
 - e. Waterstop: Manufacturer's standard, continuous galvanized-steel flange or rabbeted groove to receive panels and create a waterstop when panels are in place.
 - 2. Finish: Manufacturer's standard finish on exposed surfaces, matching the enclosure panels **OR** contrasting with the enclosure panels, as indicated by manufacturer's designations **OR** contrasting with the enclosure panels, as selected from manufacturer's full range, **as directed**, and with slip-resistant floor surface texture.
- H. Accessories
- 1. Door Hardware and Accessories: Manufacturer's standard design, heavy-duty, operating hardware and accessories.
 - a. Material: Clear-anodized aluminum **OR** Stainless steel **OR** Chrome-plated brass, **as directed**.
 - b. Hinges: Manufacturer's standard, paired, self-closing type that can be adjusted to hold doors open at any angle up to 90 degrees **OR** continuous, cam type that swings to a closed or partially open position **OR** continuous, spring-loaded type **OR** integral hinge for solid-polymer doors, **as directed**.
 - c. Latch and Keeper: Manufacturer's standard, recessed **OR** surface-mounted, **as directed**, latch unit designed for emergency access and with combination rubber-faced door strike and keeper. Provide units that comply with regulatory requirements for accessibility at each compartment, accessible or not **OR** at compartments designated as accessible, **as directed**.
 - d. Clothing Hooks: Manufacturer's standard clothing hooks in each dressing compartment; include one combination hook and rubber-tipped bumper at in-swinging doors, sized to prevent door from hitting wall panel or compartment-mounted accessories, **as directed**.

- e. Door Bumper: Manufacturer's standard, rubber-tipped bumper at out-swinging doors.
- f. Door Pull: Manufacturer's standard unit at out-swinging doors that complies with regulatory requirements for accessibility. Provide units on both sides of doors at compartments designated as accessible.
- 2. Overhead Bracing: Manufacturer's standard, continuous, extruded-aluminum head rail or cap with antigrip profile; in manufacturer's standard finish.
- 3. Head Rail with Hooks: Manufacturer's standard, continuous, extruded-aluminum head rail or cap with curtain hooks running in concealed track; with antigrip profile; in manufacturer's standard finish.
- OR**
- Curtain Rod with Hooks: Manufacturer's standard, **1-inch- (25-mm-)** diameter, stainless-steel curtain rod with matching hooks.
- 4. Curtain: Flame-resistant, polyester-reinforced vinyl fabric **OR** manufacturer's standard fabric, **as directed**, that is stain resistant, self-sanitizing, antistatic, and antimicrobial; launderable to a temperature of not less than **90 deg F (32 deg C)**.
 - a. Flame Resistance: Passes NFPA 701 tests when tested by a testing and inspecting agency acceptable to authorities having jurisdiction.
 - b. Labeling: Identify fabrics with appropriate markings of applicable testing and inspecting agency.
 - c. Curtain Grommets: Two-piece, rolled-edge, rustproof, nickel-plated brass; spaced not more than **6 inches (152 mm)** o.c.; machined into top hem.
 - d. Length: Where curtain extends to a floor surface, size so that bottom hem clears finished floor by not more than **1 inch (25 mm)** and not less than **1/2 inch (13 mm)** above floor surface. Where curtains extend to a shower-receptor curb, size so that bottom hem hangs above curb line and clears curb line by not more than **1/2 inch (13 mm)**.
 - e. Color and Pattern: As indicated by manufacturer's designations **OR** As selected from manufacturer's full range, **as directed**.
- 5. Soap Holder: Surface-mounted **OR** Recessed, **as directed**, seamless stainless-steel soap dish.
- 6. Seats: Manufacturer's standard, panel-mounted, wall-mounted or floor-mounted benches.
 - a. Material: Wood **OR** Solid phenolic **OR** Molded plastic **OR** Stainless steel, **as directed**.
 - b. Operation: Fixed **OR** Folding, **as directed**.
 - c. Finish: As indicated by manufacturer's designations **OR** As selected from manufacturer's full range **OR** Match enclosure panels, **as directed**.
- 7. Anchorages and Fasteners: Manufacturer's standard, exposed fasteners of stainless steel, chrome-plated steel, or solid brass, finished to match the items they are securing; with theft-resistant-type heads. Provide sex-type bolts for through-bolt applications. For concealed anchors, use stainless steel, hot-dip galvanized steel, or other rust-resistant, protective-coated steel.
- I. Fabrication
 - 1. Overhead-Braced Compartments: Provide manufacturer's standard, corrosion-resistant supports, leveling method, and anchors at pilasters and walls to suit floor and wall conditions. Provide shoes at pilasters to conceal supports and leveling method.
 - 2. Floor-and-Ceiling-Anchored Compartments: Provide manufacturer's standard, corrosion-resistant anchoring assemblies at pilasters and walls with leveling adjustment at tops and bottoms of pilasters. Provide shoes and sleeves (caps) at pilasters to conceal anchorage.
 - 3. Door Sizes and Swings: Unless otherwise indicated, provide **24-inch- (610-mm-)** wide, in-swinging doors for standard shower and dressing compartments, and **36-inch- (914-mm-)** wide, out-swinging doors with a minimum **32-inch- (813-mm-)** wide, clear opening for compartments designated as accessible.

1.3 EXECUTION

A. Installation

1. General: Comply with manufacturer's written installation instructions. Install compartments rigid, straight, level, and plumb. Secure compartments in position with manufacturer's recommended anchoring devices.
 - a. Maximum Clearances for Dressing Compartment:
 - 1) Pilasters and Panels: **1/2 inch (13 mm)**.
 - 2) Panels and Walls: **1 inch (25 mm)**.
 - b. Stirrup Brackets: Secure panels to walls and to pilasters with no fewer than two brackets attached **OR** three brackets attached at midpoint and, **as directed**, near top and bottom of panel.
 - 1) Locate wall brackets so holes for wall anchors occur in masonry or tile joints.
 - 2) Align brackets at pilasters with brackets at walls.
 2. Overhead-Braced Compartments: Secure pilasters to floor, and level, plumb, and tighten. Set pilasters with anchors penetrating not less than **1-3/4 inches (44 mm)** into structural floor unless otherwise indicated in manufacturer's written instructions. Secure continuous head rail to each pilaster with no fewer than two fasteners. Hang doors to align tops of doors with tops of panels, and adjust so tops of doors are parallel with overhead brace when doors are in closed position, **as directed**.
 3. Floor-and-Ceiling-Anchored Compartments: Secure pilasters to supporting construction, and level, plumb, and tighten. Hang doors and adjust so doors are level and aligned with panels when doors are in closed position, **as directed**.
 4. Curtains: Install curtains to specified length and verify that they hang vertically without stress points or diagonal folds.
 5. Shower Receptors: Install prefabricated shower receptors with drain gasket compression fit to outside diameter of waste pipe.
- B. Adjusting
1. Curtain Adjustment: After hanging curtains, test and adjust each track or rod to produce unencumbered, smooth operation. Steam and dress down curtains as required to produce crease- and wrinkle-free installation. Remove and replace curtains that are stained or soiled or that have stress points or diagonal folds.
 2. Hardware Adjustment: Adjust and lubricate hardware according to hardware manufacturer's written instructions for proper operation. Set hinges on in-swinging doors to hold doors open approximately 30 degrees from closed position when unlatched. Set hinges on out-swinging doors to return doors to fully closed position.

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SECTION 10 21 16 17a - CUBICLE CURTAINS AND TRACKS

1.1 GENERAL

A. Description Of Work

1. This specification covers the furnishing and installation of materials for cubicle curtains and tracks. Product shall be as follows or as directed by the Owner. Installation procedures shall be in accordance with the product manufacturer's recommendations. Demolition and removal of materials shall be as required to support the work.

B. Summary

1. This Section includes the following:
 - a. Curtain tracks and curtain carriers.
 - b. IV tracks and hangers.
 - c. Cubicle, dressing area, tub, and shower curtains.

C. Definition

1. IV: Intravenous.

D. Performance Requirements

1. Curtains: Provide curtain fabrics with the following characteristics:
 - a. Fabrics are launderable to a temperature of not less than 160 deg F (71 deg C) OR 90 deg F (32 deg C), as directed.
 - b. Fabrics are flame resistant and are identical to those that have passed NFPA 701 when tested by a testing and inspecting agency acceptable to authorities having jurisdiction.
 - 1) Identify fabrics with appropriate markings of applicable testing and inspecting agency.

E. Submittals

1. Product Data: Include durability, laundry temperature limits, fade resistance, and fire-test-response characteristics for each type of curtain fabric indicated.
 - a. Include data on each type of applied curtain treatment.
2. Shop Drawings: Show layout and types of cubicles, sizes of curtains, number of carriers, anchorage details, and conditions requiring accessories. Indicate dimensions taken from field measurements.
 - a. Include details on blocking above ceiling and in walls.
3. Samples: For each type of product required.
4. Curtain and Track Schedule: Use same designations indicated on Drawings.
5. Operation and Maintenance Data.

1.2 PRODUCTS

A. Curtain Tracks

1. Extruded-Aluminum Track: Not less than 1-1/4 inches wide by 3/4 inch high (32 mm wide by 19 mm high) OR 5/8 inch wide by 1/2 inch high (16 mm wide by 13 mm high), as directed; with minimum wall thickness of 0.050 inch (1.27 mm) OR 0.058 inch (1.47 mm) OR 0.062 inch (1.57 mm), as directed.
 - a. Curved Track: Factory-fabricated, 12-inch- (305-mm-) OR 14-inch- (356-mm-) OR 18-inch- (457-mm-), as directed, radius bends.
 - b. Finish: Clear anodized OR Satin anodized OR Baked enamel, acrylic, or epoxy, as directed.
2. PVC Track: Not less than 1-1/4 inches wide by 15/16 inch high (32 mm wide by 24 mm high).
 - a. Curved Track: Factory-fabricated, 12-inch- (305-mm-) radius bends.



3. Track Accessories: Fabricate splices, end caps, connectors, end stops, coupling and joining sleeves, wall flanges, brackets, ceiling clips, and other accessories from same material and with same finish as track.
 - a. Suspended Track Support: Not less than **5/8-inch- (16-mm-)** square **OR 7/8-inch- (22.2-mm-)** OD, **as directed**, tube.
 - b. End Stop: Nonremovable **OR** Removable with carrier hook, **as directed**.
 - c. Switch Unit: Shuttle and coupling device for rerouting and securing cubicle curtain, with pull chain for switching track.
 - d. Hinged Loading Unit: Detachable hinge and lock unit factory assembled on **60-inch (1524-mm)** section of manufacturer's extruded-aluminum track. Provide 1 operating wand for every 10 cubicles.
4. Curtain Carriers: Two nylon rollers and nylon axle with chrome-plated steel **OR** nylon **OR** aluminum, **as directed**, hook.
5. Curtain Carriers: One-piece nylon glide with chrome-plated steel **OR** nylon, **as directed**, hook.
6. Breakaway Curtain Carriers: One-piece nylon **OR** Velcro, **as directed**, breakaway curtain carriers designed to allow curtains to detach from tracks with a pulling force of no more than **5 lbf (22.2 N)**.
7. Exposed Fasteners: Stainless steel.
8. Concealed Fasteners: Hot-dip galvanized **OR** Stainless steel, **as directed**.

B. IV Support Systems

1. Extruded-Aluminum IV Track: Not less than **1-1/4 inches wide by 3/4 inch high (32 mm wide by 19 mm high)**; with minimum wall thickness of **0.058 inch (1.47 mm) OR 0.062 inch (1.57 mm)**, **as directed**.
 - a. Curved Track: Factory fabricated **12-inch- (305-mm-)** **OR 14-inch- (356-mm-)** **OR 18-inch- (457-mm-)**, **as directed**, radius bends.
 - b. Finish: Clear anodized **OR** Satin anodized **OR** Baked enamel, acrylic, or epoxy, **as directed**.
2. IV Carriers: Four nylon rollers and nylon **OR** steel or stainless-steel, **as directed**, axles, with ball bearings, **as directed**, with hanger loop fabricated from **1/4-inch- (6-mm-)** diameter stainless steel.
3. Stationary IV Hangers: **24-inch (610-mm) OR 30-inch (762-mm) OR 36-inch (914-mm) OR 42-inch (1067-mm) OR 48-inch (1219-mm)**, **as directed**, overall height with stainless-steel shaft; with 4 **OR** 8, **as directed**, folding **OR** nonfolding, **as directed**, **1/4-inch (6-mm)** stainless-steel arms with loops, a stainless-steel bottom loop, and a stainless-steel top loop to attach to carrier.
 - a. Top Loop: Coated for nonconductivity **OR** Uncoated, **as directed**.
4. Telescoping IV Hangers: **28-inch (711-mm) OR 39-inch (991-mm) OR 45-inch (1143-mm) OR 51-inch (1295-mm) OR 57-inch (1448-mm)**, **as directed**, overall height with a **3/4-inch (19-mm)** stainless-steel main shaft and a **3/8-inch (9.5-mm)** stainless-steel inner shaft, minimum vertical adjustment of **16 inches (406 mm)**; with 4 **OR** 8, **as directed**, folding **OR** nonfolding, **as directed**, **1/4-inch (6-mm)** stainless-steel arms with loops and a stainless-steel top loop to attach to carrier.
 - a. Top Loop: Coated for nonconductivity **OR** Uncoated, **as directed**.
 - b. Adjustment Control: Push button **OR** Release ring, **as directed**.

C. Curtains

1. Cubicle Curtain and Dressing Area Fabric: Curtain manufacturer's standard, 100 percent polyester, inherently and permanently flame resistant, stain resistant, and antimicrobial.
 - a. Pattern: **<Insert manufacturer's style name.>**
 - b. Color: As selected from manufacturer's full range.
2. Shower and Tub Curtain Fabric: Curtain manufacturer's standard. Polyester-reinforced vinyl fabric; flame resistant, stain resistant, and antimicrobial.
 - a. Pattern: **<Insert manufacturer's style name.>**
 - b. Color: As selected from manufacturer's full range.
3. Curtain Grommets: Two-piece, rolled-edge, rustproof, nickel-plated brass; spaced not more than **6 inches (152 mm)** o.c.; machined into top hem.

4. Mesh Top: No. 50 **OR** 40 **OR** 42, **as directed**, nylon mesh.
5. Beaded-Chain Curtain Drop: **6 inches (152 mm) OR 9 inches (229 mm) OR 12 inches (305 mm) OR 15 inches (381 mm) OR 18 inches (457 mm)**, **as directed**, long; nickel-plated steel, with aluminum hook.
6. PVC-Strip Curtain Drop: **16 inches (406 mm) OR 18 inches (457 mm)**, **as directed**, long, with chrome-plated steel hook.
 - a. Curtain Movers: In-line hinged nylon spacers that connect to the top of PVC-strip curtain drops to provide tangle-free operation.
7. Curtain Tieback: Nickel-plated brass chain; one at each curtain termination.

D. Curtain Fabrication

1. Fabricate curtains to comply with the following requirements:
 - a. Width: Equal to track length from which curtain is hung plus 10 percent added fullness, but not less than **12 inches (305 mm)** added fullness.
 - b. Length: Equal to floor-to-ceiling height minus depth of track and carrier at top, and minus distance above the finished floor at bottom as follows:
OR
 Length: Equal to floor-to-ceiling height, with **20-inch (508-mm)** mesh top, and minus distance above the finished floor at bottom as follows:
OR
 Length: Equal to floor-to-ceiling height minus **18 inches (457 mm)** from finished ceiling at top, and minus distance above the finished floor at bottom as follows:
 - 1) Cubicle Curtains: **12 inches (305 mm) OR 15 inches (381 mm)**, **as directed**.
 - 2) Dressing Area Curtains: **4 inches (102 mm) OR 6 inches (152 mm)**, **as directed**.
 - 3) Tub Curtains: **6 inches (152 mm)**.
 - 4) Shower Curtains: **1/2 inch (13 mm)**.
 - c. Top Hem: Not less than **1 inch (25.4 mm)** and not more than **1-1/2 inches (38 mm)** wide, triple thickness, reinforced with integral web, and double lock stitched.
 - d. Mesh Top: Top hem not less than **1 inch (25.4 mm)** and not more than **1-1/2 inches (38 mm)** wide, triple thickness, reinforced with integral web, and double lock stitched. Double lock stitch bottom of mesh directly to **1/2-inch (13-mm)** triple thickness, top hem of curtain fabric.
 - e. Bottom Hem: Not less than **1 inch (25.4 mm)** and not more than **1-1/2 inches (38 mm)** wide, double thickness and single **OR** double thickness and double **OR** triple thickness, reinforced, and double, **as directed**, lock stitched.
 - f. Side Hems: Not less than **1/2 inch (13 mm)** and not more than **1-1/4 inches (32 mm)** wide, with double **OR** triple, **as directed**, turned edges, and single lock stitched.
2. Vertical Seams: Not less than **1/2 inch (13 mm)** wide, double turned and double stitched.

1.3 EXECUTION

A. Installation

1. General: Install tracks level and plumb, according to manufacturer's written instructions.
2. Up to **16 feet (4.9 m) OR 20 feet (6.0 m)**, **as directed**, in length, provide track fabricated from 1 continuous length.
 - a. Curtain Track Mounting: Surface **OR** Suspended **OR** Recessed **OR** As indicated on Drawings, **as directed**.
 - b. IV Track Mounting: Surface.
3. Surface Track Mounting: Fasten surface-mounted tracks at intervals of not less than **24 inches (610 mm)**. Fasten support at each splice and tangent point of each corner. Center fasteners in track to ensure unencumbered carrier operation. Attach track to ceiling as follows:
 - a. Mechanically fasten directly to bottom of concrete deck with post-installed anchors.
 - b. Mechanically fasten directly to finished ceiling with toggle bolts.
 - c. Mechanically fasten to furring through suspended ceiling with screw and tube spacer.
 - d. Mechanically fasten to suspended ceiling grid with screws.

- e. Attach track to suspended ceiling grid with manufacturer's proprietary clip.
 4. Suspended Track Mounting: Install track with suspended supports at intervals of not more than **48 inches (1219 mm)**. Fasten support at each splice and tangent point of each corner. Secure ends of track to wall with flanged fittings or brackets.
 5. Track Accessories: Install splices, end caps, connectors, end stops, coupling and joining sleeves, and other accessories as required for a secure and operational installation.
 - a. Provide one locking switch unit for each pair of beds.
 - b. Provide one hinged loading unit for each bed **OR** pair of beds with locking switch unit, **as directed**.
 6. IV Hangers: Unless otherwise indicated, install one IV hook on each IV track and hang one IV hanger.
 7. Curtain Carriers: Provide curtain carriers adequate for **6-inch (152-mm)** spacing along full length of curtain plus an additional carrier.
 8. Curtains: Hang curtains on each curtain track. Secure with curtain tieback, **as directed**.
- B. Protection
1. Protect installed recessed track openings with nonresidue adhesive tape to prevent construction debris from impeding carrier operation. Remove tape prior to Final Completion.

END OF SECTION 10 21 16 17a



Task	Specification	Specification Description
10 21 16 17	10 21 13 13	Toilet Compartments

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SECTION 10 22 13 00 - WIRE MESH PARTITIONS

1.1 GENERAL

A. Description Of Work:

1. This specification covers the furnishing and installation of materials for wire mesh partitions. Product shall be as follows or as directed by the Owner. Installation procedures shall be in accordance with the product manufacturer's recommendations. Demolition and removal of materials shall be as required to support the work.

B. Summary

1. Section Includes:
 - a. Standard-duty wire mesh partitions.
 - b. Heavy-duty wire mesh partitions.
 - c. Wire mesh ceilings.
 - d. Wire mesh storage lockers.
 - e. Wire mesh stairway partitions.
 - f. Wire mesh equipment barriers.

C. Definitions

1. As defined in ASTM E 2016:
 - a. Intermediate Crimp: Wires pass over one and under the next adjacent wire in both directions, with wires crimped before weaving and with extra crimps between the intersections.
 - b. Lock Crimp: Deep crimps at points of the intersection that lock wires securely in place.

D. Performance Requirements

1. Delegated Design: Design wire mesh units, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.
2. Structural Performance: Wire mesh units shall withstand the effects of gravity loads and loads and stresses within limits and under conditions indicated according to SEI/ASCE 7.
3. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes. Base calculations on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.
 - a. Temperature Change (Range): 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.

E. Submittals

1. Product Data: For each type of product indicated.
2. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
3. Samples: For each exposed product and for each color and texture specified.
4. Delegated-Design Submittal: For wire mesh units indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
5. Maintenance data.

F. Quality Assurance

1. Welding Qualifications: Qualify procedures and personnel according to the following:
 - a. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
 - b. AWS D1.3, "Structural Welding Code - Sheet Steel."
2. Preinstallation Conference: Conduct conference at Project site.

G. Delivery, Storage, And Handling

1. Deliver wire mesh items with cardboard protectors on perimeters of panels and doors and with posts wrapped **OR** palletted **OR** crated, **as directed**, to provide protection during transit and Project-site storage. Use vented plastic.
2. Inventory wire mesh partition door hardware on receipt and provide secure lockup for wire mesh partition door hardware delivered to Project site.
 - a. Tag each item or package separately with identification and include basic installation instructions with each item or package.
3. Deliver keys to the Owner by registered mail or overnight package service.

1.2 PRODUCTS

A. Materials

1. Steel Wire: **ASTM A 510 (ASTM A 510M)**.
2. Steel Plates, Channels, Angles, and Bars: ASTM A 36/A 36M.
3. Cold-Rolled Steel Sheet: ASTM A 1008/A 1008M, Commercial Steel (CS), Type B.
4. Steel Pipe: ASTM A 53/A 53M, Schedule 40 unless another weight is indicated or required by structural loads.
5. Square Steel Tubing: ASTM A 500, cold-formed structural-steel tubing.
6. Metallic-Coated Steel Sheet: ASTM A 653/A 653M, Commercial Steel (CS), Type B; with **G60 (Z180)** zinc (galvanized) or **A60 (ZF180)** zinc-iron-alloy (galvannealed) coating designation.
7. Panel-to-Panel Fasteners: Manufacturer's standard steel bolts, nuts, and washers.
8. Postinstalled Expansion Anchors: With capability to sustain, without failure, load imposed within factors of safety indicated, as determined by testing per ASTM E 488, conducted by a qualified independent testing agency.
 - a. Carbon Steel: Zinc plated to comply with ASTM B 633, Class Fe/Zn 5 (0.005 mm) for Class SC 1 service condition (mild).
 - b. Stainless Steel: **ASTM F 593 and ASTM F 594, Alloy Group 1 or 2 (ASTM F 738M and ASTM F 836M, Alloy Group 1 or 4)**, for bolts and nuts; ASTM A 276 or ASTM A 666, Type 304 or 316, for anchors.
 - c. For Postinstalled Anchors in Concrete: Capability to sustain, without failure, a load equal to four times the loads imposed.
 - d. For Postinstalled Anchors in Grouted Masonry Units: Capability to sustain, without failure, a load equal to six times the loads imposed.
9. Power-Actuated Fasteners in Concrete: Fastener system of type suitable for application indicated and fabricated from corrosion-resistant materials; with clips or other accessory devices for attaching hangers of type indicated, and with capability to sustain, without failure, a load equal to 10 times that imposed by wire mesh construction, as determined by testing per ASTM E 1190, conducted by a qualified testing and inspecting agency.
10. Seismic Bracing: Angles with legs not less than **1-1/4 inch (32 mm)** wide, formed from **0.04-inch- (1-mm-)** thick, metallic-coated steel sheet; with bolted connections and **1/4-inch- (6-mm-)** diameter bolts.
11. Shop Primers: Provide primers that comply with Division 07..
12. Universal Shop Primer: Fast-curing, lead- and chromate-free, universal modified-alkyd primer, complying with MPI#79.
 - a. Use primer containing pigments that make it easily distinguishable from zinc-rich primer.
13. Zinc-Rich Primer: Compatible with topcoat, complying with SSPC-Paint 20 or SSPC-Paint 29.
14. Galvanizing Repair Paint: High-zinc-dust-content paint for reglvanizing welds in steel, complying with SSPC-Paint 20.

B. Standard-Duty Wire Mesh Partitions

1. Mesh: **0.135-inch- (3.5-mm-)** diameter, intermediate-crimp steel wire woven into **1-1/2-inch (38-mm)** diamond mesh.

2. Vertical Panel Framing: 1-1/4-by-5/8-by-0.097-inch (32-by-16-by-2.5-mm) cold-rolled, C-shaped steel channels with 1/4-inch- (6-mm-) diameter bolt holes spaced not more than 18 inches (450 mm) o.c. along center of framing.
3. Horizontal and Vertical Panel Framing: 1-by-1/2-by-1/8-inch (25-by-13-by-3-mm) cold-rolled steel channels.
4. Horizontal Panel Stiffeners: 2 cold-rolled steel channels, not less than 1 by 3/8 by 1/8 inch (25 by 9.5 by 3 mm), bolted or riveted toe to toe through mesh or 1-by-1/2-by-1/8-inch (25-by-13-by-3-mm) cold-rolled steel channels with wire woven through.
5. Top Capping Bars: 2-1/4-by-1-inch (57-by-25-mm) cold-rolled steel channels.
6. Posts for 90-Degree Corners: 1-1/4-by-1-1/4-by-1/8-inch (32-by-32-by-3-mm) steel angles with 1/4-inch- (6-mm-) diameter bolt holes aligning with bolt holes in vertical framing; with floor anchor clips.
7. Posts for Other-Than-90-Degree Corners: Manufacturer's standard steel pipe or tubing with 1/4-inch- (6-mm-) diameter bolt holes aligning with bolt holes in vertical framing.
 - a. Partitions up to 12 Feet (3.7 m) High: 1-1/4-inch (32-mm) OD.
 - b. Partitions up to 20 Feet (6.1 m) High: 2-1/2-inch (65-mm) OD.
8. Adjustable Corner Posts: 2, manufacturer's standard steel pipe or tubing posts connected by steel hinges at 36 inches (900 mm) o.c. attached to posts; with 1/4-inch- (6-mm-) diameter bolt holes aligning with bolt holes in vertical framing.
9. Line Posts: 3-inch-by-4.1-lb (76-mm-by-1.9-kg) or 3-1/2-by-1-1/4-by-0.127-inch (89-by-32-by-3.2-mm) steel channels; with 5-by-18-by-1/4-inch (125-by-450-by-6-mm) steel base plates punched for attachment to floor.
10. Three- and Four-Way Intersection Posts: 1-1/4-by-1-1/4-inch (32-by-32-mm) tubular steel, with 1/4-inch- (6-mm-) diameter bolt holes aligned for bolting to adjacent panels.
11. Floor Shoes: Steel, cast iron, or cast aluminum, not less than 2 inches (50 mm) high; sized to suit vertical framing, drilled for attachment to floor, and with set screws for leveling adjustment.
12. Swinging Doors: Fabricated from same mesh as partitions, with framing fabricated from 1-1/4-by-1/2-by-1/8-inch (32-by-13-by-3-mm) steel channels or C-channels, banded with 1-1/4-by-1/8-inch (32-by-3-mm) flat steel bar cover plates on 3 OR 4, **as directed**, sides, and with 1/8-inch- (3-mm-) thick angle strike bar and cover on strike jamb.
 - a. Hinges: Full-surface type, 3-by-3-inch (76-by-76-mm) steel, 1-1/2 pairs per door; bolted, riveted, or welded to door and jamb framing.
 - b. Padlock Lug: Mortised into door framing and enclosed with steel cover.
 - c. Cylinder Lock: Mortise type with manufacturer's standard cylinder OR cylinder specified in Division 08 Section "Door Hardware", **as directed**; operated by key outside and recessed turn knob OR knob OR lever, **as directed**, inside.
 - d. Inactive Leaf Hardware: Cane bolt at bottom and chain bolt at top.
13. Swinging Dutch Doors: Fabricated from same mesh as partitions, with framing fabricated from 1-1/4-by-1/2-by-1/8-inch (32-by-13-by-3-mm) steel channels or C-channels, banded with 1-1/4-by-1/8-inch (32-by-3-mm) flat steel bar cover plates on 3 OR 4, **as directed**, sides, and with 1/8-inch- (3-mm-) thick angle strike bar and cover on strike jamb.
 - a. Hinges: Full-surface type, 3-by-3-inch (76-by-76-mm) steel, 1 pair per section of door (top and bottom); bolted, riveted, or welded to door and jamb framing.
 - b. Cylinder Lock: Mortise type with manufacturer's standard cylinder OR cylinder specified in Division 08 Section "Door Hardware", **as directed**; operated by key outside and recessed turn knob OR knob OR lever, **as directed**, inside; mounted in lower section of door.
 - c. Bolt: Mounted in, securing upper section of door.
 - d. Shelf: Fabricated from 0.097-inch- (2.5-mm-) thick, cold-rolled steel sheet, 12 inches (300 mm) deep by full width of door; with corners rounded and edges finished smooth; mounted on top of lower section of door and braced with manufacturer's standard brackets.
14. Sliding Doors: Fabricated from same mesh as partitions, with framing fabricated from 1-1/2-by-3/4-by-1/8-inch (38-by-19-by-3-mm) steel channels or C-channels, banded with 1-1/2-by-1/8-inch (38-by-3-mm) flat steel bar cover plates on 4 sides.
 - a. Hardware: Two, four-wheel roller-bearing carriers, box track, and bottom guide channel for each door.
 - b. Padlock Lug: Mortised into door framing and enclosed with steel cover.

- c. Cylinder Lock: Mortise type with manufacturer's standard cylinder **OR** cylinder specified in Division 08 Section "Door Hardware", **as directed**; operated by key outside and recessed turn knob **OR** knob **OR** lever, **as directed**, inside.
 - 15. Vertically Sliding Service Windows: Fabricated from same mesh and framing as panels and equipped with spring catch **OR** slide bolts, **as directed**, on each jamb that locks window in open and closed positions. Include opening frame in partition fabricated from **1-1/4-by-1/2-by-1/8-inch (32-by-13-by-3-mm)** steel channels or C-channels.
 - a. Size: **24 inches wide by 18 inches high (600 mm wide by 450 mm high)** **as directed** As indicated, **as directed**.
 - b. Shelf: Fabricated from **0.097-inch- (2.5-mm-)** thick, cold-rolled steel sheet; with corners rounded and edges finished smooth; braced with manufacturer's standard brackets.
 - 1) Size: **24 inches wide by 12 inches deep (600 mm wide by 300 mm deep)** **OR** As indicated, **as directed**.
 - 16. Swinging Service Windows: Fabricated from same mesh and framing as panels and equipped with spring catch on strike jamb that locks window in closed position. Include opening frame in partition fabricated from **1-1/4-by-1/2-by-1/8-inch (32-by-13-by-3-mm)** steel channels or C-channels.
 - a. Size: **24 inches wide by 18 inches high (600 mm wide by 450 mm high)** **OR** As indicated, **as directed**.
 - b. Shelf: Fabricated from **0.097-inch- (2.5-mm-)** thick, cold-rolled steel sheet; with corners rounded and edges finished smooth; braced with manufacturer's standard brackets.
 - 1) Size: **24 inches wide by 12 inches deep (600 mm wide by 300 mm deep)** **OR** As indicated, **as directed**.
 - 17. Accessories:
 - a. Sheet Metal Base: Not less than **0.060-inch- (1.5-mm-)** thick, cold-rolled steel sheet.
 - b. Adjustable Filler Panels: Not less than **0.060-inch- (1.5-mm-)** thick, cold-rolled steel sheet; capable of filling openings from **2 to 12 inches (50 to 300 mm)**.
 - c. Wall Clips: Manufacturer's standard, cold-rolled steel sheet; allowing up to **1 inch (25 mm)** of adjustment, **as directed**.
 - 18. Finish for Uncoated Ferrous Steel: Hot-dip galvanized **OR** Hot-dip galvanized and shop primed for field painting **OR** Shop primed for field painting **OR** Shop coat **OR** Baked-enamel finish **OR** Powder-coated finish, **as directed**, unless otherwise indicated.
 - a. Color: As selected from manufacturer's full range.
- C. Heavy-Duty Wire Mesh Partitions
- 1. Mesh: **0.192-inch- (4.8-mm-)** diameter, intermediate-crimp steel wire woven into **2-inch (50-mm)** diamond mesh.
 - 2. Vertical and Horizontal Panel Framing: **1-1/2-by-3/4-by-0.097-inch (38-by-19-by-2.5-mm)** cold-rolled, C-shaped steel channels; with **3/8-inch- (9.5-mm-)** diameter bolt holes spaced not more than **18 inches (450 mm)** o.c. along center of framing.
 - 3. Vertical and Horizontal Panel Framing: **1-1/2-by-3/4-by-1/4-inch (38-by-19-by-6-mm)** cold-rolled steel channels; with **3/8-inch- (9.5-mm-)** diameter bolt holes spaced not more than **18 inches (450 mm)** o.c. along center of framing. Provide vertical panel stiffeners in shapes and sizes as recommended by manufacturers.
 - 4. Horizontal Panel Stiffeners: 2 cold-rolled steel channels, not less than **1 by 1/2 by 1/8 inch (25 by 13 by 3 mm)**, bolted or riveted toe to toe through mesh or **1-1/2-by-3/4-by-1/8-inch (38-by-19-by-3-mm)** cold-rolled steel channels with wire woven through.
 - 5. Top Capping Bars: **3-inch-by-4.1-lb (76-mm-by-1.9-kg)** hot-rolled steel channels.
 - 6. Posts for 90-Degree Corners: **2-by-2-by-1/8-inch (50-by-50-by-3-mm)** steel angles with **3/8-inch- (9.5-mm-)** diameter bolt holes aligning with bolt holes in vertical framing; with floor anchor clips.
 - 7. Posts for Other-Than-90-Degree Corners: Manufacturer's standard steel **2-inch- (50-mm)** OD pipe or tubing with **3/8-inch- (9.5-mm-)** diameter bolt holes aligning with bolt holes in vertical framing.

8. Adjustable Corner Posts: 2, manufacturer's standard steel pipe or tubing posts connected by steel hinges at **36 inches (900 mm)** o.c. attached to posts; with **1/4-inch- (6-mm-)** diameter bolt holes aligning with bolt holes in vertical framing.
9. Line Posts: **3-inch-by-4.1-lb (76-mm-by-1.9-kg)** or **3-1/2-by-1-1/4-by-0.1265-inch (89-by-32-by-3.2-mm)** steel channels; with **5-by-18-by-1/4-inch (125-by-450-by-6-mm)** steel base plates punched for attachment to floor.
10. Three- and Four-Way Intersection Posts: **2-by-2-inch (50-by-50-mm)** tubular steel, with **3/8-inch- (9.5-mm-)** diameter bolt holes aligned for bolting to adjacent panels.
11. Floor Shoes: Steel, cast iron, or cast aluminum, not less than **2 inches (50 mm)** high; sized to suit vertical framing, drilled for attachment to floor, and with set screws for leveling adjustment.
12. Swinging Doors: Fabricated from same mesh as partitions, with framing fabricated from **1-1/2-by-3/4-by-1/8-inch (38-by-19-by-3-mm)** steel channels or C-channels, banded with **1-1/2-by-1/8-inch (38-by-3-mm)** flat steel bar cover plates on 4 sides, and with **1/8-inch- (3-mm-)** thick angle strike bar and cover on strike jamb.
 - a. Hinges: Full-surface type, **3-1/2-by-3-1/2-inch (89-by-89-mm)** steel, 1-1/2 pairs per door; bolted, riveted, or welded to door and jamb framing.
 - b. Padlock Lug: Mortised into door framing and enclosed with steel cover.
 - c. Cylinder Lock: Mortise type with manufacturer's standard cylinder **OR** cylinder specified in Division 08 Section "Door Hardware", **as directed**; operated by key outside and recessed turn knob **OR** knob **OR** lever, **as directed**, inside.
 - d. Inactive Leaf Hardware: Cane bolt at bottom and chain bolt at top.
13. Swinging Dutch Doors: Fabricated from same mesh as partitions, with framing fabricated from **1-1/2-by-3/4-by-1/8-inch (38-by-19-by-3-mm)** steel channels or C-channels, banded with **1-1/2-by-1/8-inch (38-by-3-mm)** flat steel bar cover plates on 3 **OR** 4, **as directed**, sides, and with **1/8-inch- (3-mm-)** thick angle strike bar and cover on strike jamb.
 - a. Hinges: Full-surface type, **3-1/2-by-3-1/2-inch (89-by-89-mm)** steel, 1 pair per section of door (top and bottom); bolted, riveted, or welded to door and jamb framing.
 - b. Cylinder Lock: Mortise type with manufacturer's standard cylinder **OR** cylinder specified in Division 08 Section "Door Hardware", **as directed**; operated by key outside and recessed turn knob **OR** knob **OR** lever, **as directed**, inside.
 - c. Bolt: Mounted in, securing upper section of door.
 - d. Shelf: Fabricated from **0.097-inch- (2.5-mm-)** thick, cold-rolled steel sheet, **12 inches (300 mm)** deep by full width of door; with corners rounded and edges finished smooth; mounted on top of lower section of door and braced with manufacturer's standard brackets.
14. Sliding Doors: Fabricated from same mesh as partitions, with framing fabricated from **1-1/2-by-3/4-by-1/8-inch (38-by-19-by-3-mm)** steel channels or C-channels, banded with **1-1/2-by-1/8-inch (38-by-3-mm)** flat steel bar cover plates on 4 sides.
 - a. Hardware: Two, four-wheel roller-bearing carriers, box track, and bottom guide channel for each door.
 - b. Padlock Lug: Mortised into door framing and enclosed with steel cover.
 - c. Cylinder Lock: Mortise type with manufacturer's standard cylinder **OR** cylinder specified in Division 08 Section "Door Hardware", **as directed**; operated by key outside and recessed turn knob **OR** knob **OR** lever, **as directed**, inside.
15. Vertically Sliding Service Windows: Fabricated from same mesh and framing as panels and equipped with spring catch **OR** slide bolts, **as directed**, on each jamb that locks window in open and closed positions. Include opening frame in partition fabricated from **1-1/4-by-1/2-by-1/8-inch (32-by-13-by-3-mm)** steel channels or C-channels.
 - a. Size: **24 inches wide by 18 inches high (600 mm wide by 450 mm high)** **OR** As indicated, **as directed**.
 - b. Shelf: Fabricated from **0.097-inch- (2.5-mm-)** thick, cold-rolled steel sheet; with corners rounded and edges finished smooth; braced with manufacturer's standard brackets.
 - 1) Size: **24 inches wide by 12 inches deep (600 mm wide by 300 mm deep)** **OR** As indicated, **as directed**.
16. Swinging Service Windows: Fabricated from same mesh and framing as panels and equipped with spring catch on strike jamb that locks window in closed position. Include opening frame in

partition fabricated from **1-1/4-by-1/2-by-1/8-inch (32-by-13-by-3-mm)** steel channels or C-channels.

- a. Size: **24 inches wide by 18 inches high (600 mm wide by 450 mm high)** OR As indicated, **as directed**.
- b. Shelf: Fabricated from **0.097-inch- (2.5-mm-)** thick, cold-rolled steel sheet; with corners rounded and edges finished smooth; braced with manufacturer's standard brackets.
 - 1) Size: **24 inches wide by 12 inches deep (600 mm wide by 300 mm deep)** OR As indicated, **as directed**.

17. Accessories:

- a. Sheet Metal Base: Not less than **0.060-inch- (1.5-mm-)** thick, cold-rolled steel sheet.
- b. Adjustable Filler Panels: Not less than **0.0598-inch- (1.5-mm-)** thick, cold-rolled steel sheet; capable of filling openings from **2 to 12 inches (50 to 300 mm)**.
- c. Wall Clips: Manufacturer's standard, cold-rolled steel sheet; allowing up to **1 inch (25 mm)** of adjustment, **as directed**.

18. Finish for Uncoated Ferrous Steel: Hot-dip galvanized OR Hot-dip galvanized and shop primed for field painting OR Shop primed for field painting OR Shop coat OR Baked-enamel finish OR Powder-coated finish, **as directed**, unless otherwise indicated.

- a. Color: As selected from manufacturer's full range.

D. Wire Mesh Ceilings

1. Mesh, Framing, and Stiffeners: Fabricated from same mesh and framing as wire mesh partition panels.
2. Perimeter Partition Supports: **1-1/2-by-1-1/2-by-1/8-inch (38-by-38-by-3-mm)** steel angle, with **1/4-inch- (6-mm-)** diameter bolt holes aligned for bolting to top of wire mesh partitions and to sides of wire mesh ceiling panels.
3. Wall Supports: **1-1/2-by-1-1/2-by-1/8-inch (38-by-38-by-3-mm)** steel angle punched for attachment to wall and wire mesh ceiling panels.
4. Intermediate Supports: Steel I-beam, as recommended by manufacturer.
5. Intermediate Support Posts: **2-by-2-by-1/8-inch (50-by-50-by-3-mm)** steel pipe or tubing.
6. Finishes: Match adjacent wire mesh partitions.

E. Wire Mesh Storage Lockers

1. Unit Sizes:
 - a. Width: **36 inches (914 mm)** OR **48 inches (1219 mm)**, **as directed**.
 - b. Depth: **36 inches (914 mm)** OR **48 inches (1219 mm)** OR **60 inches (1524 mm)**, **as directed**.
 - c. Height: **90 inches (2286 mm)**.
2. Mesh: **0.135-inch- (3.5-mm-)** diameter, intermediate-crimp steel wire woven into **1-1/2-inch (38-mm)** diamond OR **1-by-2-inch (25-by-50-mm)** rectangular, **as directed**, mesh.
3. Wall Panels: **1-1/4-by-1-1/4-by-1/8-inch (32-by-32-by-3-mm)** steel angle framing on top, bottom, and back sides, and **3-by-1/8-inch (76-by-3-mm)** cold-rolled steel flat bar framing on front side; with wire mesh welded to framing.
 - a. Horizontal Panel Stiffeners: **1-1/4-by-1-1/4-by-1/8-inch (32-by-32-by-3-mm)** steel angles or **3/4-by-1/4-inch (19-by-6-mm)** hot-rolled steel flat bars.
4. Backs: **0.027-inch- (0.7-mm-)** thick, metallic-coated steel sheet.
5. Tops: Fabricated from same mesh and framing as doors OR **0.027-inch- (0.7-mm-)** thick, metallic-coated steel sheet, **as directed**.
6. Horizontal Dividers/Shelves: **0.043-inch- (1.1-mm-)** thick, metallic-coated, **as directed**, steel sheet; with flanged edges and reinforced across width with **3/4-by-1/4-inch (19-by-6-mm)** steel stiffeners, **as directed**.
7. Doors: Fabricated from same mesh as wall panels, with framing fabricated from **1-1/4-by-1-1/4-by-1/8-inch (32-by-32-by-3-mm)** steel angles on 4 sides; with wire mesh welded to framing. Include door strike and padlock hasp.
 - a. Horizontal Stiffeners for Single-Tier Doors: **3/4-by-1/4-inch (19-by-6-mm)** steel flat bars.

- b. Hinges: Full-surface type, 2-1/2-by-2-1/2-inch (64-by-64-mm) steel, 1-1/2 pairs per single-tier door and 1 pair per double-tier door; bolted, riveted, or welded to door and jamb framing.
8. Finish for Uncoated Ferrous Steel: Hot-dip galvanized **OR** Hot-dip galvanized and shop primed for field painting **OR** Shop primed for field painting **OR** Shop coat **OR** Baked-enamel finish **OR** Powder-coated finish, **as directed**, unless otherwise indicated.
- a. Color: As selected from manufacturer's full range.
- F. Wire Mesh Stairway Partitions
1. Standard-Duty Stairway Partitions:
- a. Diamond Mesh: 0.135-inch- (3.5-mm-) diameter, intermediate-crimp steel wire woven into 1-1/2-inch (38-mm) diamond pattern and securely clinched to frames.
- b. Square Mesh: 0.135-inch- (3.5-mm-) diameter, intermediate **OR** lock, **as directed**,-crimp steel wire woven into 1-1/2-inch (38-mm) square pattern, inserted through frame holes and welded into frame. Vertical wires are plumb, and horizontal wires are perpendicular to vertical wires.
- c. Rectangular Mesh: 0.135-inch- (3.5-mm-) diameter, intermediate **OR** lock, **as directed**, -crimp steel wire woven into 2-by-1-inch (50-by-25-mm) rectangular pattern, inserted through frame holes and welded into frame. Vertical wires are plumb, and horizontal wires are perpendicular to vertical wires.
- d. Vertical Panel Framing: 1-1/4-by-5/8-by-0.0966-inch (32-by-16-by-2.5-mm) cold-rolled, C-shaped steel channels; with 1/4-inch- (6-mm-) diameter bolt holes spaced not more than 18 inches (450 mm) o.c. along center of framing.
- e. Horizontal Panel Framing: 1-by-1/2-by-1/8-inch (25-by-13-by-3-mm) cold-rolled steel channels.
- f. Horizontal Panel Stiffeners: 1-by-1/2-by-1/8-inch (25-by-13-by-3-mm) cold-rolled steel channels with wire woven through, or two 1-by-1/2-by-1/8-inch (25-by-13-by-3-mm) cold-rolled steel channels bolted or riveted toe to toe through mesh.
2. Heavy-Duty Stairway Partitions:
- a. Diamond Mesh: 0.192-inch- (4.9-mm-) diameter, intermediate-crimp steel wire woven into 2-inch (50-mm) diamond pattern and securely clinched to frames.
- b. Square Mesh: 0.192-inch- (4.9-mm-) diameter, intermediate **OR** lock, **as directed**, -crimp steel wire woven into 2-inch (50-mm) square pattern, inserted through frame holes and welded into frame. Vertical wires are plumb, and horizontal wires are perpendicular to vertical wires.
- c. Rectangular Mesh: 0.192-inch- (4.9-mm-) diameter, intermediate **OR** lock, **as directed**, -crimp steel wire woven into 2-by-1-inch (50-by-25-mm) rectangular pattern, inserted through frame holes and welded into frame. Vertical wires are plumb, and horizontal wires are perpendicular to vertical wires.
- d. Vertical and Horizontal Panel Framing: 1-1/2-by-3/4-by-0.0966-inch (38-by-19-by-2.5-mm) cold-rolled, C-shaped steel channels; with 3/8-inch- (9.5-mm-) diameter bolt holes spaced not more than 18 inches (450 mm) o.c. along center of framing.
- e. Horizontal Panel Stiffeners: 1-1/2-by-3/4-by-1/8-inch (38-by-19-by-3-mm) cold-rolled steel channels with wire woven through, or two 1-by-1/2-by-1/8-inch (25-by-13-by-3-mm) cold-rolled steel channels bolted or riveted toe to toe through mesh.
3. Swinging Doors: Fabricated from same mesh as partitions, with framing fabricated from 1-1/2-by-3/4-by-1/8-inch (38-by-19-by-3-mm) steel channels, banded with 1-1/2-by-1/8-inch (38-by-3-mm) flat steel bar cover plates on 3 **OR** 4, **as directed**, sides, and with 1/8-inch- (3-mm-) thick angle strike bar and cover on strike jamb.
- a. Hinges: Full-surface spring type, 3-1/2-by-3-1/2-inch (89-by-89-mm) steel, 1-1/2 pairs per door; bolted, riveted, or welded to door and jamb framing.
- b. Exit Device: As specified in Division 08 Section "Door Hardware".
- c. Tamper Shield: Fabricated from 0.097-inch- (2.5-mm-) thick, cold-rolled steel sheet; 15 inches (381 mm) high by width of door.
4. Door Jamb Framing: 2-by-2-by-1/8-inch (50-by-50-by-3-mm) steel pipe or tubing.



5. Floor Shoes: Steel, cast iron, or cast aluminum, not less than **2 inches (50 mm)** high; sized to suit vertical framing, drilled for attachment to floor, and with set screws for leveling adjustment.
6. Wall Clips: Manufacturer's standard, cold-rolled steel sheet; allowing up to **1 inch (25 mm)** of adjustment, **as directed**.
7. Finish for Uncoated Ferrous Steel: Hot-dip galvanized **OR** Hot-dip galvanized and shop primed for field painting **OR** Shop primed for field painting **OR** Shop coat **OR** Baked-enamel finish **OR** Powder-coated finish, **as directed**, unless otherwise indicated.
 - a. Color: As selected from manufacturer's full range.

G. Wire Mesh Equipment Barriers

1. Mesh: **0.135-inch- (3.5-mm-)** diameter, intermediate-crimp steel wire woven into **1-1/2-inch (38-mm)** diamond **OR** **1-by-2-inch (25-by-50-mm)** rectangular, **as directed**, mesh.
2. Panels: **1-1/4-by-1-1/4-by-1/8-inch (32-by-32-by-3-mm)** steel angle framing on 4 sides, with wire mesh welded to framing.
 - a. Horizontal Panel Stiffeners: **1-1/4-by-1-1/4-by-1/8-inch (32-by-32-by-3-mm)** steel angles or **3/4-by-1/4-inch (19-by-6-mm)** hot-rolled steel flat bars.
 - b. Height: **48 inches (1220 mm) OR 60 inches (1525 mm)**, **as directed**.
3. Line and Corner Posts: **2-by-2-by-0.068-inch (50-by-50-by-1.7-mm)** steel tubing with steel base plates welded to bottoms, drilled for attachment to floor, and with steel caps welded to tops.
 - a. Height: Panel height plus **12-inch- (300-mm-)**, **as directed**, high, sweep space.
4. Swinging Gates: Fabricated from same mesh as panels, with gate framing fabricated from **1-1/4-by-1-1/4-by-3/16-inch (32-by-32-by-4.7-mm)** steel angles on 4 sides, and with wire mesh welded to framing.
 - a. Hinges: Full-surface spring, **as directed**, type, **3-1/2-by-3-1/2-inch (89-by-89-mm)** steel, 1 pair per door; bolted, riveted, or welded to door and jamb framing.
 - b. Padlock Lug: Mortised into door framing and enclosed with steel cover.
 - c. Cylinder Lock: Mortise type with manufacturer's standard cylinder **OR** cylinder specified in Division 08 Section "Door Hardware", **as directed**; operated by key outside and recessed turn knob **OR** knob **OR** lever, **as directed**, inside.
5. Sliding Gates: Fabricated from same mesh as panels, with framing fabricated from **1-1/4-by-1-1/4-by-3/16-inch (32-by-32-by-4.7-mm)** steel angles on 4 sides, and with wire mesh welded to framing.
 - a. Hardware: Two, four-wheel roller-bearing carriers, box track, and bottom guide channel for each door.
 - b. Padlock Lug: Mortised into door framing and enclosed with steel cover.
 - c. Cylinder Lock: Mortise type with manufacturer's standard cylinder **OR** cylinder specified in Division 08 Section "Door Hardware", **as directed**; operated by key outside and recessed turn knob **OR** knob **OR** lever, **as directed**, inside.
6. Finish for Uncoated Ferrous Steel: Hot-dip galvanized **OR** Hot-dip galvanized and shop primed for field painting **OR** Shop primed for field painting **OR** Shop coat **OR** Baked-enamel finish **OR** Powder-coated finish, **as directed**, unless otherwise indicated.
 - a. Color: As selected from manufacturer's full range.

H. Fabrication

1. General: Fabricate wire mesh items from components of sizes not less than those indicated. Use larger-sized components as recommended by wire mesh item manufacturer. As required for complete installation, provide bolts, hardware, and accessories with manufacturer's standard finishes.
 - a. Fabricate wire mesh items to be readily disassembled.
 - b. Welding: Weld corner joints of framing and grind smooth, leaving no evidence of joint **OR** finish sand **OR** remove spatter **OR** leave as applied, **as directed**.
2. Standard- and Heavy-Duty Wire Mesh Partitions: Fabricate wire mesh partitions with cutouts for pipes, ducts, beams, and other items indicated. Finish edges of cutouts to provide a neat, protective edge.
 - a. Mesh: Securely clinch mesh to framing.

- b. Framing: Fabricate framing with mortise and tenon corner construction.
 - 1) Provide horizontal stiffeners as indicated or, if not indicated, as required by panel height and as recommended by wire mesh partition manufacturer. Weld horizontal stiffeners to vertical framing.
 - 2) Fabricate three- and four-way intersections using intersection posts **OR** manufacturer's standard connecting clips and fasteners, **as directed**.
 - 3) Fabricate partition and door framing with slotted holes for connecting adjacent panels.
 - c. Fabricate wire mesh partitions with **3 inches (76 mm)** of clear space between finished floor and bottom horizontal framing.
 - d. Fabricate wire mesh partitions with bottom horizontal framing flush with finished floor.
 - e. Doors: Align bottom of door with bottom of adjacent panels.
 - 1) For doors that do not extend full height of partition, provide transom over door, fabricated from same mesh and framing as partition panels.
 - f. Hardware Preparation: Mortise, reinforce, drill, and tap doors and framing as required to install hardware.
 3. Wire Mesh Ceilings: Fabricate wire mesh partitions with cutouts for pipes, ducts, beams, and other items indicated. Finish edges of cutouts to provide a neat, protective edge.
 - a. Mesh: Securely clinch mesh to framing.
 - b. Framing: Fabricate framing with mortise and tenon corner construction.
 - 1) Provide stiffeners as indicated or, if not indicated, as required by panel span and as recommended by wire mesh ceiling manufacturer. Weld stiffeners to framing.
 4. Wire Mesh Stairway Partitions: Provide door jamb framing on each side of doors. Attach tamper shields centered behind exit devices.
 5. Wire Mesh Storage Lockers: Fabricate initial storage locker with front and two sides. Fabricate additional storage lockers similarly, so each unit is independent **OR** as add-on units, designed to share one side with initial storage locker, **as directed**.
 - a. Fabricate wall panel and door framing with slotted holes for connecting adjacent panels.
 - b. Prehang doors in factory.
- I. General Finish Requirements
 1. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
 2. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- J. Steel And Iron Finishes
 1. Galvanizing: Hot-dip galvanize items as indicated to comply with applicable standard listed below:
 - a. ASTM A 123/A 123M, for galvanizing steel and iron components.
 - b. ASTM A 153/A 153M, for galvanizing steel and iron hardware.
 - c. Preparation for Shop Priming: After galvanizing, thoroughly clean wire mesh components of grease, dirt, oil, flux, and other foreign matter, and treat with metallic-phosphate process.
 2. Preparation for Shop Priming: Prepare uncoated ferrous-metal surfaces to comply with minimum requirements indicated below for SSPC surface-preparation specifications and environmental exposure conditions of installed metal fabrications:
 - a. Exteriors (SSPC Zone 1B) and Items Indicated to Receive Zinc-Rich Primer: SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
 - b. Interiors (SSPC Zone 1A): SSPC-SP 3, "Power Tool Cleaning."
 3. Shop Priming: Apply shop primer to uncoated surfaces of metal fabrications, except those with galvanized finishes and those to be embedded in concrete or masonry, unless otherwise indicated. Comply with SSPC-PA 1, "Paint Application Specification No. 1: Shop, Field, and Maintenance Painting of Steel," for shop painting.
 - a. Stripe paint corners, crevices, bolts, welds, and sharp edges.

4. Shop Coat Finish: Immediately after cleaning and pretreating, apply manufacturer's standard one-coat, shop-coat finish suitable for use intended. Comply with paint manufacturer's written instructions for applying and curing.
 - a. Color and Gloss: As selected from manufacturer's full range.
5. Baked-Enamel or Powder-Coat Finish: Immediately after cleaning and pretreating, apply manufacturer's standard 2-coat, baked-on finish, suitable for use indicated, consisting of prime coat and thermosetting topcoat, with a minimum dry film thickness of **1 mil (0.025 mm)** for topcoat.
 - a. Color and Gloss: As selected from manufacturer's full range.

1.3 EXECUTION

A. Wire Mesh Partitions Erection

1. Anchor wire mesh partitions to floor with **3/8-inch- (9.5-mm-)** diameter, postinstalled expansion anchors at **12 inches (305 mm)** o.c. through anchor clips located at each post and corner. Shim anchor clips as required to achieve level and plumb installation.
2. Anchor wire mesh partitions to floor with **3/8-inch- (9.5-mm-)** diameter, postinstalled expansion anchors at **12 inches (305 mm)** o.c. through floor shoes located at each post and corner. Adjust wire mesh partition posts in floor shoes to achieve level and plumb installation.
3. Anchor wire mesh partitions to walls at **12 inches (305 mm)** o.c. through back corner panel framing and as follows:
 - a. For concrete and solid masonry anchorage, use drilled-in expansion shields and hanger or lag bolts.
 - b. For hollow masonry anchorage, use toggle bolts.
 - c. For wood stud partitions, use hanger or lag bolts set into wood backing between studs. Coordinate with carpentry work to locate backing members.
 - d. For steel-framed gypsum board assemblies, use hanger or lag bolts set into wood backing between studs. Coordinate with stud installation to locate backing members.
 - e. For steel-framed gypsum board assemblies, fasten brackets directly to steel framing or concealed reinforcements using self-tapping screws of size and type required to support structural loads.
4. Secure top capping bars to top framing channels with **1/4-inch- (6-mm-)** diameter "U" bolts spaced not more than **28 inches (700 mm)** o.c.
5. Provide line posts at locations indicated or, if not indicated, as follows:
 - a. On each side of sliding door openings.
 - b. For partitions that are **7 to 9 feet (2.1 to 2.7 m)** high, spaced at **15 to 20 feet (4.6 to 6.1 m)** o.c.
 - c. For partitions that are **10 to 12 feet (3.0 to 3.7 m)** high, located between every other panel.
 - d. For partitions that are more than **12 feet (3.7 m)** high, located between each panel.
6. Provide seismic supports and bracing as indicated or, if not indicated, as recommended by manufacturer and as required for stability, extending and fastening members to supporting structure.
7. Where standard-width wire mesh partition panels do not fill entire length of run, provide adjustable filler panels to fill openings.
8. Install doors complete with door hardware.
9. Install service windows complete with window hardware.
10. Weld or bolt sheet metal bases to wire mesh partitions and doors **OR** where indicated, **as directed**.
11. Bolt accessories to wire mesh partition framing.

B. Wire Mesh Ceilings Erection

1. Anchor wall support angle to walls at **12 inches (305 mm)** o.c. and as follows:
 - a. For concrete and solid masonry anchorage, use drilled-in expansion shields and hanger or lag bolts.

- b. For hollow masonry anchorage, use toggle bolts.
 - c. For wood stud partitions, use hanger or lag bolts set into wood backing between studs. Coordinate with carpentry work to locate backing members.
 - d. For steel-framed gypsum board assemblies, use hanger or lag bolts set into wood backing between studs. Coordinate with stud installation to locate backing members.
 - e. For steel-framed gypsum board assemblies, fasten brackets directly to steel framing or concealed reinforcements using self-tapping screws of size and type required to support structural loads.
 2. Attach wire mesh ceiling panels to wall support angles with bolts at **12 inches (305 mm)** o.c.
 3. Attach wire mesh ceiling panels to wire mesh partitions with slotted angles bolted to sides of ceiling panels and to top of partitions at **12 inches (305 mm)** o.c.
 4. Attach wire mesh ceiling panels to intermediate supports as recommended by manufacturer.
 5. Provide seismic supports and bracing as indicated or, if not indicated, as recommended by manufacturer and as required for stability, extending and fastening members to supporting structure.
- C. Wire Mesh Storage Lockers Erection
 1. Anchor wire mesh storage lockers to floor with **3/8-inch- (9.5-mm-)** diameter, expansion anchors at **12 inches (305 mm)** o.c. through bottom panel framing. Shim panel framing as required to achieve level and plumb installation.
 2. Anchor wire mesh storage lockers to walls at **12 inches (305 mm)** o.c. through back corner panel framing and as follows:
 - a. For concrete and solid masonry anchorage, use drilled-in expansion shields and hanger or lag bolts.
 - b. For hollow masonry anchorage, use toggle bolts.
 - c. For wood stud partitions, use hanger or lag bolts set into wood backing between studs. Coordinate with carpentry work to locate backing members.
 - d. For steel-framed gypsum board assemblies, use hanger or lag bolts set into wood backing between studs. Coordinate with stud installation to locate backing members.
 - e. For steel-framed gypsum board assemblies, fasten brackets directly to steel framing or concealed reinforcements using self-tapping screws of size and type required to support structural loads.
 3. Attach adjacent wire mesh storage lockers to each other through side panel framing.
 4. Install horizontal dividers/shelving in double-tier storage lockers.
 5. Install doors complete with door hardware.
- D. Wire Mesh Stairway Partitions Erection
 1. Anchor wire mesh stairway partitions to floor with **3/8-inch- (9.5-mm-)** diameter, postinstalled expansion anchors at **12 inches (305 mm)** o.c. through floor shoes located at each post. Adjust wire mesh partition posts in floor shoes to achieve level and plumb installation.
 2. Anchor angle clips supporting wire mesh stairway partitions at stairs and intermediate landings with **3/8-inch- (9.5-mm-)** diameter, postinstalled expansion anchors at **12 inches (305 mm)** o.c. Weld stairway partition framing to angle clips.
 3. Provide seismic supports and bracing as indicated or, if not indicated, as recommended by manufacturer and as required for stability, extending and fastening members to supporting structure.
 4. Install doors complete with door hardware.
- E. Wire Mesh Equipment Barriers Erection
 1. Anchor wire mesh equipment barriers to floor with **3/8-inch- (9.5-mm-)** diameter, expansion anchors through post bases. Shim post bases as required to achieve level and plumb installation.
 2. Floor anchors may be set with power-actuated fasteners instead of postinstalled expansion anchors if indicated on Shop Drawings.
 3. Install gates complete with gate hardware.



F. Adjusting And Cleaning

1. Adjust doors **OR** gates **OR** service windows, **as directed**, to operate smoothly and easily, without binding or warping. Adjust hardware to function smoothly. Confirm that latches and locks engage accurately and securely without forcing or binding.
2. Remove and replace defective work including doors and framing that are warped, bowed, or otherwise unacceptable.
3. Touchup Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas. Paint uncoated and abraded areas with the same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.
4. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A 780.

END OF SECTION 10 22 13 00

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SECTION 10 22 19 13 - DEMOUNTABLE PARTITIONS

1.1 GENERAL

A. Description Of Work:

1. This specification covers the furnishing and installation of materials for demountable partitions. Product shall be as follows or as directed by the Owner. Installation procedures shall be in accordance with the product manufacturer's recommendations. Demolition and removal of materials shall be as required to support the work.

B. Summary

1. This Section includes the following:
 - a. Demountable site-assembled partitions.
 - b. Demountable unitized-panel partitions.

C. Performance Requirements

1. Structural Performance: Provide demountable partitions capable of withstanding the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:
 - a. Load-Bearing Capacity of Panel System: Not less than **300-lb (136-kg concentrated) OR 2.3-lb/linear inch (0.041-kg/linear mm)** distributed, **as directed**, proof load when tested according to BIFMA X 5.6, Section 6, Table 1.
 - b. Transverse-Load Capacity of Panel System: Lateral deflection of not more than 1/120 **OR 1/240, as directed**, of the overall span when tested under a uniformly distributed load of **5 lb/sq. ft. (24.4 kg/sq. m)** according to ASTM E 72.
 - c. Seismic Performance: Provide demountable partitions capable of withstanding the effects of earthquake motions determined according to ASCE 7, "Minimum Design Loads for Buildings and Other Structures."

D. Submittals

1. Product Data: For each type of product indicated.
2. Shop Drawings: For demountable partitions. Include plans, elevations, sections, details, and attachments to other work.
3. Samples: For each type of exposed finish required.
4. Product Test Reports.
5. Maintenance Data.

E. Quality Assurance

1. Sound Transmission Characteristics: Where STC ratings are indicated, provide partitions with STC rating that was determined by testing an identical system according to ASTM E 90 and classified according to ASTM E 413 by a qualified independent testing agency.
2. Fire-Test-Response Characteristics: Provide demountable partitions complying with the following requirements:
 - a. Where indicated, provide demountable partitions identical to those of assemblies tested for fire resistance per ASTM E 119 by UL or a testing and inspecting agency acceptable to authorities having jurisdiction.
 - 1) Fire-Resistance Ratings: Indicated by design designations from UL's "Fire Resistance Directory" or from the listings of another testing and inspecting agency.
 - b. Surface-Burning Characteristics: Provide demountable partitions per ASTM E 84:
 - 1) Flame-Spread Index: 25 or less.
 - 2) Smoke-Developed Index: 450 or less.
3. Fire-Rated Door and Frame Assemblies: Assemblies complying with NFPA 80 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire ratings indicated.
 - a. Test Pressure:



- 1) Test at atmospheric (neutral) pressure according to NFPA 252 or UL 10B.
OR
Test according to NFPA 252 or UL 10C. After 5 minutes into the test, neutral pressure level in furnace shall be established at **40 inches (1016 mm)** or less above the sill.
- b. As scheduled on Drawings.
4. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

1.2 PRODUCTS

A. Demountable Site-Assembled Partitions

1. Face Panels: Manufacturer's standard **OR** Gypsum board, ASTM C 36/C 36M **OR** Wood composite **OR** Fiber composite **OR** Steel-sheet-faced gypsum board, ASTM C 36/C 36M **OR** Stainless-steel-sheet-faced gypsum board, ASTM C 36/C 36M, **as directed**.
 - a. Thickness: Manufacturer's standard **OR 1/2 inch (13 mm) OR 5/8 inch (16 mm) OR 3/4 inch (19 mm), as directed**.
 - b. Width: Manufacturer's standard **OR 24 inches (610 mm) OR 30 inches (762 mm) OR** As indicated, **as directed**.
 - c. Finish: Unfinished **OR** Manufacturer's standard prime-coat finish ready for field painting **OR** Vinyl wall covering complying with CFFA-W-101-A **OR** Fabric **OR** Factory-applied paint finish **OR** Powder-coat finish **OR** No. 4 satin, **as directed**.
 - d. Colors, Textures, and Patterns: As indicated by manufacturer's designations **OR** Match samples **OR** As selected from manufacturer's full range, **as directed**.
2. Accessory Panels: Manufacturer's standard fabric-covered tackable panels **OR** porcelain-enamel chalkboard and markerboard panels, **as directed**.
3. Framing: Studs, top and bottom track, **2-1/2 inches (64 mm) OR 4 inches (102 mm) OR** manufacturer's standard, **as directed**, deep.
 - a. Steel: Metallic-coated, **0.0359-inch (0.912-mm)** base metal thickness.
 - b. Aluminum.
 - c. Fiberglass.
4. Panel Joint Closure: Manufacturer's standard **OR** Vinyl **OR** Aluminum **OR** Steel, **as directed**.
5. Trim: Continuous, factory-finished, snap-on type; adjustable for variations in floor level **OR** floor and ceiling levels, **as directed**.
 - a. Outside Corner Trim: Square **OR** Radiused, **as directed**.
 - b. Base: Snap-on vinyl **OR** metal, **as directed**.
 - c. Base Trim Profile: Recessed **OR** Projected **OR** Flush, **as directed**.
 - d. Ceiling Trim Profile: Recessed **OR** Projected, **as directed**.
 - e. Cornice Trim: Continuous over tops of partial-height units for maximum stability.
 - f. Exposed-Metal Trim Finish: Factory-applied paint finish **OR** Clear-anodized aluminum; AAMA 611, AA-M12C22A31, Class II **OR** Color-anodized aluminum; AAMA 611, AA-M12C22A32/A34, Class II **OR** Manufacturer's standard prime-coat finish ready for field painting, **as directed**.
 - g. Trim Color: As indicated by manufacturer's designations **OR** Match samples **OR** As selected from manufacturer's full range, **as directed**.
6. Doors: As specified in Division 12.
7. Door Frames: Manufacturer's standard steel **OR** aluminum, **as directed**, reversible, **as directed**, factory mortised to receive hardware, **as directed**, for **1-3/4-inch (45-mm)** doors.
 - a. Frame Finishes: Factory-applied paint finish **OR** Clear-anodized aluminum; AAMA 611, AA-M12C22A31, Class II **OR** Color-anodized aluminum; AAMA 611, AA-M12C22A32/A34, Class II **OR** Manufacturer's standard prime-coat finish ready for field painting, **as directed**.
 - b. Frame Color: As indicated by manufacturer's designations **OR** Match samples **OR** As selected from manufacturer's full range, **as directed**.

8. Fire-Protection Rating of Rated Door Assemblies: Labeled 20 **OR** 45, **as directed**, minutes.
 9. Hardware: As specified in Division 08 Section "Door Hardware".
 10. Glazing Frames: Manufacturer's standard **OR** Match door frames, **as directed**, for glazing thickness indicated.
 - a. Frame Finishes: Factory-applied paint finish **OR** Clear-anodized aluminum; AAMA 611, AA-M12C22A31, Class II **OR** Color-anodized aluminum; AAMA 611, AA-M12C22A32/A34, Class II **OR** Manufacturer's standard prime-coat finish ready for field painting, **as directed**.
 - b. Frame Color: As indicated by manufacturer's designations **OR** Match samples **OR** As selected from manufacturer's full range, **as directed**.
 11. Glazing: Fully tempered clear float glass **OR** Laminated clear float glass **OR** Glass type indicated, **as directed**, complying with Division 08 Section "Glazing".
 12. Acoustical Rating: STC 35, unless directed otherwise.
 13. Fire-Resistance Rating of Partition Assemblies: 1 hour.
 14. Seals: Manufacturer's standard **OR** Open cell, 2 lb/cu. ft. (32 kg/cu. m), **as directed**.
- B. Demountable Unitized-Panel Partitions
1. Panels: Manufacturer's standard **OR** Gypsum board, ASTM C 36/C 36M **OR** Wood composite **OR** Fiber composite **OR** Steel-sheet-faced gypsum board, ASTM C 36/C 36M **OR** Stainless-steel-sheet-faced gypsum board, ASTM C 36/C 36M, **as directed**.
 - a. Type: Unfinished **OR** Factory finished **OR** Metal faced, **as directed**.
 - b. Thickness: Manufacturer's standard **OR** 1-3/4 inches (45 mm) **OR** 2-1/4 inches (57 mm), **as directed**.
 - c. Width: Manufacturer's standard **OR** 24 inches (610 mm) **OR** 30 inches (762 mm) **OR** As indicated, **as directed**.
 - d. Finish: Vinyl wall covering complying with CFFA-W-101-A **OR** Fabric **OR** Factory-applied paint finish **OR** Powder-coat finish **OR** Stainless steel, **as directed**.
 - e. Colors, Textures, and Patterns: As indicated by manufacturer's designations **OR** Match samples **OR** As selected from manufacturer's full range, **as directed**.
 2. Accessory Panels: Manufacturer's standard fabric-covered tackable panels **OR** porcelain-enamel chalkboard and markerboard panels, **as directed**.
 3. Framing: Manufacturer's standard **OR** Steel **OR** Aluminum, **as directed**.
 - a. Frame Finishes: Factory-applied paint finish **OR** Clear-anodized aluminum; AAMA 611, AA-M12C22A31, Class II **OR** Color-anodized aluminum; AAMA 611, AA-M12C22A32/A34, Class II **OR** Manufacturer's standard prime-coat finish ready for field painting, **as directed**.
 - b. Frame Color: As indicated by manufacturer's designations **OR** Match samples **OR** As selected from manufacturer's full range, **as directed**.
 4. Panel Joint Closure: Manufacturer's standard **OR** Flush **OR** Vinyl **OR** Aluminum **OR** Steel, **as directed**.
 5. Trim: Continuous, factory-finished, snap-on type; adjustable for variations in floor level **OR** floor and ceiling levels, **as directed**.
 - a. Base Trim Profile: Recessed **OR** Projected **OR** Flush, **as directed**.
 - b. Ceiling Trim Profile: Recessed **OR** Projected, **as directed**.
 - c. Cornice Trim: Continuous over tops of partial-height units for maximum stability.
 - d. Exposed-Metal Trim Finish: Factory-applied paint finish **OR** Clear-anodized aluminum; AAMA 611, AA-M12C22A31, Class II **OR** Color-anodized aluminum; AAMA 611, AA-M12C22A32/A34, Class II **OR** Manufacturer's standard prime-coat finish ready for field painting, **as directed**.
 - e. Colors: As indicated by manufacturer's designations **OR** Match samples **OR** As selected from manufacturer's full range, **as directed**.
 6. Doors: Manufacturer's standard solid-core wood **OR** steel **OR** glazed, **as directed**, 1-3/4 inches (45 mm) thick.
 - a. Door Finishes: Factory-applied paint finish **OR** Clear-anodized aluminum; AAMA 611, AA-M12C22A31, Class II **OR** Color-anodized aluminum; AAMA 611, AA-M12C22A32/A34, Class II **OR** Manufacturer's standard prime-coat finish ready for field painting, **as directed**.
 - b. Door Color: As indicated by manufacturer's designations **OR** Match samples **OR** As selected from manufacturer's full range, **as directed**.



7. Door Frames: Manufacturer's standard steel **OR** aluminum, **as directed**, reversible, **as directed**, factory mortised to receive hardware, **as directed**, for **1-3/4-inch (45-mm)** doors.
 - a. Frame Finishes: Factory-applied paint finish **OR** Clear-anodized aluminum; AAMA 611, AA-M12C22A31, Class II **OR** Color-anodized aluminum; AAMA 611, AA-M12C22A32/A34, Class II **OR** Manufacturer's standard prime-coat finish ready for field painting, **as directed**.
 - b. Frame Color: As indicated by manufacturer's designations **OR** Match samples **OR** As selected from manufacturer's full range, **as directed**.
8. Hardware: As specified in Division 08 Section "Door Hardware".
9. Glazing Frames: Manufacturer's standard **OR** Match door frames, **as directed**, for glazing thickness indicated.
 - a. Frame Finishes: Factory-applied paint finish **OR** Clear-anodized aluminum; AAMA 611, AA-M12C22A31, Class II **OR** Color-anodized aluminum; AAMA 611, AA-M12C22A32/A34, Class II **OR** Manufacturer's standard prime-coat finish ready for field painting, **as directed**.
 - b. Frame Color: As indicated by manufacturer's designations **OR** Match samples **OR** As selected from manufacturer's full range, **as directed**.
10. Glazing: Fully tempered clear float glass **OR** Laminated clear float glass **OR** Glass type indicated, **as directed**, complying with Division 08 Section "Glazing".
11. Acoustical Rating: STC 35, unless directed otherwise.
12. Seals: Manufacturer's standard **OR** Open cell, **2 lb/cu. ft. (32 kg/cu. m)**, **as directed**.

C. Fabrication

1. Demountable Site-Assembled Panels: Fabricate each panel from one sheet **OR** two sheets, **as directed**, of gypsum board.
 - a. Transom Panels: Fabricate in material and finish to match wall panels, unless otherwise indicated.
2. Demountable Unitized Panels: Factory-assembled, flush, hollow unit construction; with faces smooth and free of buckles, oil canning, and seams; and insulated with solidly packed, inorganic, mineral filler. Fabricate panels for installation with concealed fastening devices and pressure-fit components that will not damage ceiling or floor coverings. Fabricate panels with continuous light-and-sound seals at floor, ceiling, and other locations where panels abut fixed construction.
 - a. Factory glaze panels to the greatest extent possible.
3. Components: Fabricate components for installation with concealed fastening devices and pressure-fit members that will not damage ceiling or floor coverings. Fabricate for installation with continuous seals at floor, ceiling, and other locations where partition assemblies abut fixed construction and for installation of sound attenuation insulation in partition cavities.

D. Finishes, General

1. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
2. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in the same piece are not acceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

1.3 EXECUTION

A. Installation

1. Install demountable partition systems rigid, level, plumb, and aligned. Install seals to prevent light and sound transmission at connections to floors, ceilings, fixed walls, and abutting surfaces.
 - a. Installation Tolerance: Install each demountable partition so surfaces vary not more than **1/8 inch (3 mm)** from the plane formed by the faces of adjacent partitions.
2. Do not alter ceiling suspension system **OR** Make alterations to ceiling suspension system required by partition installation or to gain access to electrical or communication systems without

- affecting the structural integrity of ceiling suspension system. Make alterations so they are not noticeable after panel installation, **as directed**.
3. Install door-and-frame and glazing-and-glazing-frame assemblies securely anchored to partitions and with doors aligned and fitted. Install and adjust door hardware for proper operation.
 - a. Install fire-rated door frames according to NFPA 80.

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Task	Specification	Specification Description
10 22 19 43	10 22 19 13	Demountable Partitions
10 22 19 53	10 22 19 13	Demountable Partitions
10 22 23 23	10 22 19 13	Demountable Partitions

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SECTION 10 22 43 00 - OPERABLE PANEL PARTITIONS

1.1 GENERAL

A. Description Of Work

1. This specification covers the furnishing and installation of materials for operable panel partitions. Product shall be as follows or as directed by the Owner. Installation procedures shall be in accordance with the product manufacturer's recommendations. Demolition and removal of materials shall be as required to support the work.

B. Summary

1. Section Includes:
 - a. Manually operated, acoustical panel partitions.
 - b. Electrically operated, acoustical panel partitions.
 - c. Manually operated, fire-rated panel partitions.
 - d. Manually operated, glass panel partitions.

C. Definitions

1. ADA-ABA Accessibility Guidelines: U.S. Architectural & Transportation Barriers Compliance Board's "Americans with Disabilities Act (ADA) and Architectural Barriers Act (ABA) Accessibility Guidelines for Buildings and Facilities."
2. Glass and Glazing Definitions: See Division 08 Section "Glazing".
3. NIC: Noise Isolation Class.
4. NRC: Noise Reduction Coefficient.
5. STC: Sound Transmission Class.

D. Performance Requirements

1. Delegated Design: Design operable panel partitions, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.
2. Seismic Performance: Operable panel partitions shall withstand the effects of earthquake motions determined according to SEI/ASCE 7.
 - a. The term "withstand" means "the panels will remain in place without separation of any parts from the system when subjected to the seismic forces specified."
3. Acoustical Performance: Provide operable panel partitions tested by a qualified testing agency for the following acoustical properties according to test methods indicated:
 - a. Sound-Transmission Requirements: Operable panel partition assembly tested for laboratory sound-transmission loss performance according to ASTM E 90, determined by ASTM E 413, and rated for not less than the STC indicated.
 - b. Noise-Reduction Requirements: Operable panel partition assembly, identical to partition tested for STC, tested for sound-absorption performance according to ASTM C 423, and rated for not less than the NRC indicated.
 - c. Acoustical Performance Requirements: Installed operable panel partition assembly, identical to partition tested for STC, tested for NIC according to ASTM E 336, determined by ASTM E 413, and rated for 10 dB less than STC value indicated.
4. Fire Resistance: Provide fire-rated operable panel partition assemblies including pass doors with fire-resistance ratings indicated.
 - a. Pass Doors: Provide doors in fire-rated operable panel partition assemblies with fire-resistance ratings indicated. Pass doors shall meet positive-pressure requirements.

E. Submittals

1. Product Data: For each type of product indicated.
2. LEED Submittals:



- a. Certificates for Credit MR 7: Chain-of-custody certificates certifying that operable panel partitions comply with forest certification requirements. Include evidence that manufacturer is certified for chain of custody by an FSC-accredited certification body.
- b. Product Data for Credit EQ 4.4: For each composite wood product used in operable panel partitions, documentation indicating that product contains no urea formaldehyde.
3. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
 - a. For installed products indicated to comply with design loads, include structural analysis data for attachments, signed and sealed by the qualified professional engineer responsible for their preparation.
 - b. Indicate storage and operating clearances. Indicate location and installation requirements for hardware and track, blocking, and direction of travel.
 - c. Wiring Diagrams: For power, signal, and control wiring.
4. Samples: For each type of exposed material, finish, covering, or facing indicated.
5. Delegated-Design Submittal: For operable panel partitions indicated to comply with performance requirements, including analysis data and calculations signed and sealed by the qualified professional engineer responsible for their preparation.
 - a. Design Calculations: Calculate requirements for seismic restraints.
6. Coordination Drawings: Reflected ceiling plans, drawn to scale, and coordinated with each other, based on input from installers of the items involved:
7. Setting Drawings: For embedded items and cutouts required in other work, including support-beam, mounting-hole template.
8. Seismic Qualification Certificates: For operable panel partitions, accessories, and components, from manufacturer.
9. Product Certificates.
10. Product Test Reports.
11. Field quality-control reports.
12. Operation and Maintenance Data.
13. Warranty: Sample of special warranty.

F. Quality Assurance

1. Manufacturer Qualifications: A qualified manufacturer that is certified for chain of custody by an FSC-accredited certification body.
2. Installer Qualifications: An employer of workers trained and approved by manufacturer.
3. Forest Certification: Fabricate products with wood, wood veneers, and wood-based panel products produced from wood obtained from forests certified by an FSC-accredited certification body to comply with FSC STD-01-001, "FSC Principles and Criteria for Forest Stewardship."
4. Fire-Test-Response Characteristics: Provide panels with finishes meeting one of the following as determined by testing identical products by UL or another testing and inspecting agency acceptable to authorities having jurisdiction:
 - a. Surface-Burning Characteristics: As determined by testing per ASTM E 84.
 - 1) Flame-Spread Index: 25 or less **OR** 26 to 75 **OR** 76 to 200, **as directed**.
 - 2) Smoke-Developed Index: 450 or less.
 - b. Fire Growth Contribution: Meeting acceptance criteria of local code and authorities having jurisdiction when tested according to NFPA 265 **OR** NFPA 286, **as directed**.
5. Fire-Rated Door Assemblies: Comply with NFPA 80, based on testing according to UL 10B.
 - a. Oversize Fire-Rated Door Assemblies: For units exceeding sizes of tested assemblies, provide certification by a testing agency acceptable to authorities having jurisdiction that doors comply with standard construction requirements for tested and labeled fire-rated door assemblies except for size.
6. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
7. Preinstallation Conference: Conduct conference at Project site.

G. Delivery, Storage, And Handling

1. Protectively package and sequence panels in order for installation. Clearly mark packages and panels with numbering system used on Shop Drawings. Do not use permanent markings on panels.

H. Warranty

1. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of operable panel partitions that fail in materials or workmanship within two years from date of Final Completion.

1.2 PRODUCTS

A. Materials

1. Steel Frame: Steel sheet, manufacturer's standard **OR 0.0508-inch (1.3-mm) OR 0.0641-inch (1.6-mm) OR 0.0747-inch (1.9-mm), as directed**, nominal minimum thickness for uncoated steel.
2. Steel Face/Liner Sheets: Tension-leveled steel sheet, manufacturer's standard **OR minimum 0.0299-inch (0.75-mm) OR 0.0359-inch (0.9-mm) OR 0.0478-inch (1.2-mm) OR 0.0598-inch (1.5-mm) OR 0.0747-inch (1.9-mm), as directed**, nominal minimum thickness for uncoated steel.
3. Aluminum: Alloy and temper recommended by aluminum producer and finisher for type of use, corrosion resistance, and finish indicated; **ASTM B 221 (ASTM B 221M)** for extrusions; manufacturer's standard strengths and thicknesses for type of use.
 - a. Frame Reinforcement: Manufacturer's standard steel or aluminum.
4. Wood Frame: Clear, vertical-grain, straight, kiln-dried, wood **OR fire-retardant-treated wood, as directed**; of manufacturer's standard species **OR one of the following species, as directed**:
 - a. Cherry.
 - b. Hemlock.
 - c. Maple.
 - d. Meranti.
 - e. Poplar.
 - f. Red oak.
5. Gypsum Board: ASTM C 36/C 36M.
6. Cement Board: ASTM C 1288.
7. Plywood: DOC PS 1.
8. Particleboard: ANSI A208.1, made with binder containing no urea formaldehyde.
9. Medium-Density Fiberboard: ANSI A208.2, made with binder containing no urea formaldehyde.

B. Operable Acoustical Panels

1. Operable Acoustical Panels: Operable acoustical panel partition system, including panels, seals, finish facing, suspension system, operators, and accessories.
2. Panel Operation: Manually operated, individual **OR Manually operated, paired OR Manually operated, continuously hinged OR Electrically operated, continuously hinged, as directed**, panels.
3. Panel Construction: Provide top reinforcement as required to support panel from suspension components and provide reinforcement for hardware attachment. Fabricate panels with tight hairline joints and concealed fasteners. Fabricate panels so finished in-place partition is rigid; level; plumb; aligned, with tight joints and uniform appearance; and free of bow, warp, twist, deformation, and surface and finish irregularities.
4. Dimensions: Fabricate operable acoustical panel partitions to form an assembled system of dimensions indicated and verified by field measurements.
 - a. Panel Width: Standard widths **OR Equal widths OR As indicated, as directed**.
5. STC: Not less than 38 **OR 41 OR 45 OR 47 OR 50 OR 52 OR 54, as directed**.
6. NRC: Not less than 0.50 **OR 0.60 OR 0.65 OR 0.90, as directed**.
7. Panel Weight: **8 lb/sq. ft. (40 kg/sq. m) OR 10 lb/sq. ft. (50 kg/sq. m) OR 12 lb/sq. ft. (59 kg/sq. m), as directed**, maximum.
8. Panel Thickness: Not less than **3 inches (75 mm) OR 3-1/2 inches (89 mm) OR 4 inches (102 mm), as directed**.



9. Panel Closure: Manufacturer's standard.
 - a. Initial Closure: Flexible, resilient PVC, bulb-shaped acoustical seal **OR** Fixed jamb **OR** As indicated, **as directed**.
 - b. Final Closure: Constant-force, lever-operated mechanical closure expanding from panel edge to create a constant-pressure acoustical seal **OR** Hinged jamb closure **OR** Hinged communicating panel **OR** Fixed jamb **OR** Angle jamb **OR** Flexible, resilient PVC, bulb-shaped acoustical seal, **as directed**.
 10. Hardware: Manufacturer's standard as required to operate operable panel partition and accessories; with decorative, protective finish.
 - a. Hinges: Manufacturer's standard **OR** Concealed (invisible), **as directed**.
 - b. Exit Device: Manufacturer's standard.
- C. Operable Fire-Rated Panels
1. Operable Fire-Rated Panels: Operable fire-rated acoustical panel partition system, including panels, seals, finish facing, suspension system, operators, and accessories.
 2. Panel Operation: Manually operated, individual **OR** Manually operated, paired, **as directed**, panels.
 3. Panel Construction: Provide top reinforcement as required to support panel from suspension components and provide reinforcement for hardware attachment. Fabricate panels with tight hairline joints and concealed fasteners. Fabricate panels so finished in-place partition is rigid; level; plumb; aligned, with tight joints and uniform appearance; and free of bow, warp, twist, deformation, and surface and finish irregularities.
 4. Dimensions: Fabricate operable fire-rated panel partitions to form an assembled system of dimensions indicated and verified by field measurements.
 - a. Panel Width: Standard widths **OR** Equal widths **OR** As indicated, **as directed**.
 5. Fire Rating: 1 hour **OR** 2 hours, **as directed**.
 6. STC: Not less than 38 **OR** 41 **OR** 45 **OR** 47 **OR** 50 **OR** 52 **OR** 54, **as directed**.
 7. NRC: Not less than 0.50 **OR** 0.60 **OR** 0.65 **OR** 0.90, **as directed**.
 8. Panel Weight: 8 lb/sq. ft. (40 kg/sq. m) **OR** 10 lb/sq. ft. (50 kg/sq. m) **OR** 12 lb/sq. ft. (59 kg/sq. m), **as directed**, maximum.
 9. Panel Thickness: Not less than 3 inches (75 mm) **OR** 3-1/2 inches (89 mm) **OR** 4 inches (102 mm), **as directed**.
 10. Panel Closure: Manufacturer's standard fire-rated closure.
 - a. Initial Closure: Flexible, resilient PVC, bulb-shaped acoustical seal **OR** Fixed jamb **OR** As indicated, **as directed**.
 - b. Final Closure: Fire-rated, constant-force, lever-operated mechanical closure expanding from panel edge to create a constant-pressure acoustical seal **OR** hinged jamb closure **OR** hinged communicating panel **OR** fixed jamb **OR** angle jamb **OR** flexible, resilient PVC, bulb-shaped acoustical seal, **as directed**.
 11. Hardware: Manufacturer's standard as required to operate fire-rated operable panel partition and accessories; with decorative, protective finish.
 - a. Hinges: Manufacturer's standard **OR** Concealed (invisible), **as directed**.
 - b. Exit Device: Manufacturer's standard.
- D. Operable Glass Panels
1. Operable Glass Panels: Operable frameless aluminum **OR** aluminum-framed **OR** wood-framed, **as directed**, glass panel partition system with acoustical properties, **as directed**, including panels, seals, **as directed**, suspension system, operators, and accessories.
 2. Panel Operation: Manually operated, individual **OR** Manually operated, paired **OR** Manually operated, continuously hinged, **as directed**, panels.
 3. Panel Construction: Manufacturer's standard glazed panels, reinforced as required to support panel from suspension components and with reinforcement for hardware attachment. Fabricate panels with tight hairline joints and concealed fasteners. Fabricate panels so finished in-place partition is rigid; level; plumb; aligned, with tight joints and uniform appearance; and free of bow, warp, twist, deformation, and surface and finish irregularities.

- a. Factory-Glazed Fabrication: Glaze operable glass panels in the factory where practical and possible for applications indicated. Comply with manufacturer's written requirements and with requirements in Division 08 Section "Glazing".
4. Glass and Glazing:
 - a. Safety Glass: Provide glass products complying with testing requirements in 16 CFR 1201, for Category II materials, unless those of Category I are expressly indicated and permitted.
 - b. Glass: Manufacturer's standard **OR** Custom, **as directed**, glass and glass assemblies as indicated and complying with the following:
 - 1) Tempered Glass: ASTM C 1048, Kind FT (fully tempered), Type I (transparent flat glass), Class 1 (clear) **OR** Class 2 (tinted), **as directed**, Quality-Q3.
 - 2) Tempered Patterned Glass: ASTM C 1048, Kind FT (fully tempered), Type II (patterned flat glass), Class 1 (clear), Form 3 (patterned); and of quality, finish, and pattern specified.
 - 3) Laminated Glass: ASTM C 1172, with clear **OR** colored **OR** patterned **OR** graphic, **as directed**, interlayer.
 - a) Annealed Float Glass: ASTM C 1036, Type I (transparent flat glass), Class 1 (clear) **OR** Class 2 (tinted), **as directed**, Quality-Q3.
 - b) Patterned Glass: ASTM C 1036, Type II (patterned and wired flat glass), Class 1 (clear), Form 3 (patterned); and of quality, finish, and pattern specified.
 - 4) Insulating-Glass Units: Factory-assembled units consisting of sealed lites of glass as indicated, separated by a dehydrated interspace, and complying with ASTM E 774 for Class CBA units.
 - a) Spacer Specifications: Manufacturer's standard spacer material and construction.
 - b) Spacer Specifications: Manufacturer's standard spacer construction and material as follows: Aluminum with mill or clear anodic finish **OR** Aluminum with black, color anodic finish **OR** Aluminum with bronze, color anodic finish **OR** Aluminum with powdered-metal paint finish in color selected **OR** Galvanized steel **OR** Stainless steel, **as directed**.
 - 5) Glass Thickness: Manufacturer's standard thickness for indicated requirements **OR** As indicated **OR** 1/4 inch (6 mm) **OR** 3/8 inch (10 mm) **OR** 1 inch (25 mm) **OR** 2-1/4 inches (57 mm), **as directed**.
 - 6) Glass Vertical Edge: Polished **OR** Manufacturer's standard, permanently adhered edge trim, **as directed**.
 - c. Glazing System: Manufacturer's standard factory-glazing system **OR** Manufacturer's standard factory-glazing system that produces acoustical seal **OR** Manufacturer's standard factory-glazing system as indicated, **as directed**.
5. Dimensions: Fabricate operable glass panel partitions to form an assembled system of dimensions indicated and verified by field measurements.
 - a. Panel Width: Standard widths **OR** Equal widths **OR** As indicated, **as directed**.
6. STC: Not less than 36 **OR** 41 **OR** 46 **OR** 48, **as directed**.
7. Panel Weight: 8 lb/sq. ft. (40 kg/sq. m) **OR** 20 lb/sq. ft. (98 kg/sq. m), **as directed**, maximum.
8. Panel Frame Thickness: Maximum 1-7/8 inches (48 mm) **OR** 2-1/4 inches (57 mm) **OR** 3-3/4 inches (96 mm), **as directed**.
9. Panel Closure: Manufacturer's standard.
10. Hardware: Manufacturer's standard as required to operate operable panel partition and accessories; with decorative, protective finish.
11. Finishes:
 - a. Exposed Metal: Match sample **OR** As selected from manufacturer's full range, **as directed**, as follows:
 - 1) Aluminum: Clear anodized **OR** Light bronze anodized **OR** Medium bronze anodized **OR** Dark bronze anodized **OR** Black anodized **OR** Baked powder coating, **as directed**.



- 2) Metal-Clad Aluminum: Satin stainless steel **OR** Polished stainless steel **OR** Satin brass **OR** Polished brass **OR** Satin bronze **OR** Polished bronze, **as directed**.
- b. Wood Finish: Match sample **OR** As selected from manufacturer's full range, **as directed**, as follows:
 - 1) Type: Transparent finish **OR** Transparent finish over stain, **as directed**, over wood variety indicated.

E. Seals

1. General: Provide types of seals indicated that produce operable panel partitions complying with acoustical and fire-resistive performance requirements, **as directed**, and the following:
 - a. Manufacturer's standard seals.
 - b. Seals made from materials and in profiles that minimize sound leakage.
 - c. Seals fitting tight at contact surfaces and sealing continuously between adjacent panels and between operable panel partition perimeter and adjacent surfaces, when operable panel partition is extended and closed.
2. Vertical Seals: Deep-nesting, interlocking steel, **as directed**, astragals mounted on each edge of panel, with continuous PVC acoustical seal.
3. Horizontal Top Seals:
 - a. Continuous-contact, extruded-PVC seal exerting uniform constant pressure on track.
OR
PVC-faced, mechanical, retractable, constant-force-contact seal exerting uniform constant pressure on track when extended.
OR
Continuous-contact, extruded-PVC seal exerting uniform constant pressure on track or PVC-faced, mechanical, retractable, constant-force-contact seal exerting uniform constant pressure on track when extended.
4. Horizontal Bottom Seals: PVC-faced, mechanical, retractable, constant-force-contact seal exerting uniform constant pressure on floor when extended, ensuring horizontal and vertical sealing and resisting panel movement.
 - a. Mechanically Operated for Acoustical Panels: Extension and retraction of bottom seal by operating handle or built-in operating mechanism, with operating range not less than **1-1/2 inches (38 mm) OR 2 inches (50 mm) OR 4 inches (102 mm) OR 6 inches (152 mm)**, **as directed**, between retracted seal and floor finish.
OR
Mechanically Operated for Fire-Rated Panels: Extension and retraction of bottom seal by operating handle or built-in operating mechanism, with operating range not less than **1-1/2 inches (38 mm) OR 2 inches (50 mm) OR 4 inches (102 mm)**, **as directed**, between retracted seal and floor finish.
OR
Automatically Operated for Acoustical Panels: Extension and retraction of bottom seal automatically operated by movement of partition, with operating range not less than **1 inch (25 mm) OR 1-1/2 inches (38 mm) OR 2 inches (50 mm)**, **as directed**, between retracted seal and floor finish.

F. Finish Facing

1. General: Provide finish facings for panels that comply with indicated fire-test-response characteristics and that are factory applied to operable panel partitions with appropriate backing, using mildew-resistant nonstaining adhesive as recommended by facing manufacturer's written instructions.
 - a. Apply facings **OR** one-piece, seamless facings, **as directed**, free of air bubbles, wrinkles, blisters, and other defects, with edges tightly butted, and **OR** with invisible seams complying with Shop Drawings for location, and, **as directed**, with no gaps or overlaps. Horizontal butted edges **OR** seams, **as directed**, are not permitted. Tightly secure and conceal raw and selvedge edges of facing for finished appearance.

- b. Where facings with directional or repeating patterns or directional weave **OR** directional, repeating, or matching grain, **as directed**, are indicated, mark facing top and attach facing in same direction.
 - c. Match facing pattern **72 inches (1830 mm)** above finished floor.
 - d. Color/Pattern: Match samples **OR** As selected from manufacturer's full range, **as directed**.
 2. Vinyl-Coated Fabric Wall Covering: Manufacturer's standard, mildew-resistant, washable, vinyl-coated fabric wall covering; complying with CFFA-W-101-D for type indicated; Class A.
 - a. Antimicrobial Treatment: Additives capable of inhibiting growth of bacteria, fungi, and yeasts.
 3. Carpet Wall Covering: Manufacturer's standard nonwoven, needle-punched carpet with fibers fused to backing, from same dye lot, treated to resist stains.
 4. Fabric Wall Covering: Manufacturer's standard fabric **OR** 100 percent polyolefin woven fabric, **as directed**, from same dye lot, treated to resist stains.
 5. High-Pressure Decorative Laminate: NEMA LD 3, Horizontal grade.
 6. Wood Veneer: Laminated to noncombustible **OR** fire-retardant-treated wood, **as directed**, core with moisture-resistant adhesive, of wood species indicated.
 - a. Wood Finish: Match sample **OR** As selected from manufacturer's full range, **as directed**, as follows:
 - 1) Type: Transparent finish **OR** Transparent finish over stain, **as directed**, over wood variety indicated.
 7. Paint: Manufacturer's standard factory-painted finish.
 - a. Color: As indicated **OR** As selected, **as directed**.
 8. Cap-Trimmed Edges: Protective perimeter-edge trim with tight hairline joints concealing edges of panel and finish facing, finished as follows:
 - a. Steel, Painted: Finished with manufacturer's standard neutral color **OR** Matching sample **OR** As selected from manufacturer's full range, **as directed**.
 - b. Aluminum: Alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated, and with not less than the strength and durability properties of alloy and temper required to comply with performance requirements; and with manufacturer's standard mill **OR** clear anodic **OR** color anodic, **as directed**, finish.
 9. Trimless Edges: Fabricate exposed panel edges so finish facing wraps uninterrupted around panel, covering edge and resulting in an installed partition with facing visible on vertical panel edges, without trim, for minimal sightlines at panel-to-panel joints.
- G. Suspension Systems
 1. Suspension Tracks: Steel or aluminum mounted directly to overhead structural support, **OR** with adjustable steel hanger rods for overhead support, **as directed**, designed for type of operation, size, and weight of operable panel partition indicated. Size track to support partition operation and storage without damage to suspension system, operable panel partitions, or adjacent construction. Limit track deflection to no more than **0.10 inch (2.54 mm)** between bracket supports. Provide a continuous system of track sections and accessories to accommodate configuration and layout indicated for partition operation and storage.
 - a. Panel Guide: Aluminum; finished with factory-applied, decorative, protective finish.
 - b. Head Closure Trim: As required for acoustical performance; with factory-applied, decorative, protective finish **OR** primed for field finish, **as directed**.
 2. Carriers: Trolley system as required for configuration type, size, and weight of partition and for easy operation; with ball-bearing wheels.
 - a. Multidirectional Carriers: Capable of negotiating 90-degree L, T, and X intersections without track switches.
 3. Track Intersections, Switches, and Accessories: As required for type of operation, storage, track configuration, and layout indicated for operable panel partitions, and compatible with partition assembly specified. Fabricate track intersections and switches from steel or aluminum.
 - a. Curve-and-Diverter Switches: Allowing radius turns to divert panels to an auxiliary track.
 - b. L Intersections: Allowing panels to change 90 degrees in direction of travel.
 - c. T Intersections: Allowing panels to pass through or change 90 degrees to another direction of travel.



- d. X Intersections: Allowing panels to pass through or change travel direction full circle in 90-degree increments, and allowing 1 partition to cross track of another.
- e. Multidirectional Switches: Adjustable switch configuring track into L, T, or X intersections and allowing panels to be moved in all pass-through, 90-degree change, and cross-over travel direction combinations.
- f. Center carrier stop.
- 4. Aluminum Finish: Mill finish or manufacturer's standard, factory-applied, decorative finish unless otherwise indicated.
- 5. Steel Finish: Manufacturer's standard, factory-applied, corrosion-resistant, protective coating unless otherwise indicated.

H. Electric Operators

- 1. General: Provide factory-assembled electric operation system of size and capacity recommended and provided by operable panel partition manufacturer for partition specified; with electric motor and factory-prewired motor controls, speed reducer, chain drive, remote-control stations, control devices, and accessories required for proper operation. Include wiring from motor control to motor. Coordinate operator wiring requirements and electrical characteristics with building electrical system.
- 2. Comply with NFPA 70.
- 3. Control Equipment: Complying with NEMA ICS 1, NEMA ICS 2, and NEMA ICS 6.
- 4. Motor Characteristics: Sufficient to start, accelerate, and operate connected loads at designated speeds, within installed environment, with indicated operating sequence, and without exceeding nameplate rating or considering service factor. Comply with NEMA MG 1 and the following:
 - a. Voltage: 120 V **OR** 208-220 V **OR** NEMA standard voltage selected to operate on nominal circuit voltage to which motor is connected, **as directed**.
 - b. Horsepower: 1/4 **OR** 1/3 **OR** 3/4 **OR** Manufacturer's standard, **as directed**.
 - c. Efficiency: Standard **OR** Premium, **as directed**.
 - d. Enclosure: Open dripproof **OR** Totally enclosed **OR** Manufacturer's standard, **as directed**.
 - e. Duty: Continuous duty at ambient temperature of **105 deg F (40 deg C)** and at altitude of **3300 feet (1005 m)** above sea level.
 - f. Service Factor: 1.15 for open dripproof motors; 1.0 for totally enclosed motors.
 - g. Phase: Single **OR** Polyphase, **as directed**.
- 5. Remote-Control Stations: Two single-key-operated, constant-pressure control stations located remotely from each other on opposite sides and opposite ends of partition run. Wire in series to require simultaneous activation of both key stations to operate partition. Each three-position control station labeled "Open," "Close," and "Off **OR** Stop, **as directed**." Provide two keys per station.
- 6. Obstruction-Detection Devices: Provide each motorized operable panel partition with automatic safety sensor indicated, that causes operator to immediately shut off motor **OR** stop and reverse direction, **as directed**.
 - a. Sensor Edge: Contact-pressure-sensitive safety edge along partition's leading edge.
 - b. Sensor Mat: Electrically operated, contact-weight-sensitive safety mat in storage pocket area.
 - c. Infrared Sensor System: Designed to detect an obstruction in partition's path and sound an audible alarm, without obstruction contacting partition.
- 7. Limit Switches: Adjustable switches, interlocked with motor controls and set to automatically stop operable panel partition at fully extended and fully stacked positions.
- 8. Emergency Release Mechanism: Quick disconnect-release of electric-motor drive system, permitting manual operation in event of operating failure.

I. Accessories

- 1. Pass Doors: Fabricated to comply with recommendations in ICC/ANSI A117.1 **OR** the U.S. Architectural & Transportation Barriers Compliance Board's ADA-ABA Accessibility Guidelines, **as directed**. Swinging door built into and matching panel materials, **OR** construction, **OR**

- acoustical qualities, **OR** fire rating, **as directed**, finish, and thickness, complete with frames and operating hardware. Hinges finished to match other exposed hardware.
- a. Single Pass Door: **36 by 80 inches (914 by 2032 mm) OR 36 by 84 inches (914 by 2134 mm), as directed**, with the following:
 - b. Double Pass Door: **72 by 80 inches (1829 by 2032 mm) OR 72 by 84 inches (1829 by 2134 mm), as directed**, with the following:
 - 1) Door Seals: Mechanically operated floor seal on panels containing pass doors **OR** Sweep floor seals, **as directed**.
 - 2) Panic **OR** Fire, **as directed**, exit device.
 - 3) Concealed door closer.
 - 4) Door Viewer: Installed with view in direction of swing.
 - 5) Exit Sign: Recessed, self-illuminated.
 - 6) Latchset: Passage set.
 - 7) Lock: Key-operated lock cylinder, keyed to master key system, **as directed**, operable from both sides of door. Include two keys per lock.
OR
Lock: Deadlock to receive cylinder, operable from both sides of door. Refer to Division 12 for lock cylinder and keying requirements.
2. Storage Pocket Door: Full height at end of partition runs to conceal stacked partition; of same materials, finish, construction, thickness, and acoustical qualities as panels; complete with operating hardware and acoustical seals at soffit, floor, and jambs, **as directed**. Hinges in finish to match other exposed hardware.
 - a. Manufacturer's standard method to secure storage pocket door in closed position.
OR
Rim Lock: Key-operated lock cylinder, keyed to master key system, **as directed**, to secure storage pocket door in closed position. Include two keys per lock.
OR
Rim Lock: Deadlock to receive cylinder, to secure storage pocket door in closed position. Refer to Division 12 for lock cylinder and keying requirements.
 3. Electric Interlock: Provide each motorized operable panel partition with electric interlocks at locations indicated, to prevent operation of operable panel partition under the following conditions:
 - a. On storage pocket door, to prevent operation if door is not in fully open position.
 - b. On partitions at location of convergence by another partition, to prevent operation if merging partitions are in place.
 4. Windows: Manufacturer's standard **OR** As indicated, **as directed**.
 5. Work Surfaces: Quantities, placement, and size indicated.
 - a. Surface: Porcelain steel marker/projection surface **OR** Self-healing, tackable, vinyl-coated fabric wall covering, complying with CFFA-W-101-D, Type II, and indicated fire-test-response characteristics; laminated to natural cork tackboard, **as directed**.
 - b. Surface Color: Matching sample **OR** As selected from manufacturer's full range, **as directed**.
 - c. Size: Full width and height of panel **OR** Full width of panel by **48 inches (1219 mm) OR 48 by 48 inches (1219 by 1219 mm) OR** As indicated on Drawings, **as directed**.
 - d. Trim: Aluminum slip-on or snap-on trim with no visible screws or exposed joints and with corners mitered to a neat, hairline joint.
 6. Chalk Tray and Eraser Pocket, **as directed**: Manufacturer's standard.
 - a. Aluminum with mill **OR** clear anodic **OR** color anodic, **as directed**, finish.
 7. Chair Rails: Recessed **OR** Surface mounted, **as directed**, in locations indicated on Drawings.
 8. Vertical Edge Trim: Manufacturer's standard transparent **OR** thin aluminum astragal, **as directed**, trim to protect vertical edges of glass in frameless panels.

1.3 EXECUTION

A. Installation

1. General: Comply with ASTM E 557 except as otherwise required by operable panel partition manufacturer's written installation instructions.
2. Install operable panel partitions and accessories after other finishing operations, including painting, have been completed.
3. Install panels from marked packages in numbered sequence indicated on Shop Drawings.
4. Broken, cracked, chipped, deformed, or unmatched panels are not acceptable.
5. Broken, cracked, deformed, or unmatched gasketing or gasketing with gaps at butted ends is not acceptable.

B. Adjusting

1. Adjust operable panel partitions to operate smoothly, without warping or binding. Lubricate hardware, electric operator, **as directed**, and other moving parts.
2. Adjust pass doors and storage pocket doors, **as directed**, to operate smoothly and easily, without binding or warping. Check and readjust operating hardware. Confirm that latches and locks engage accurately and securely without forcing or binding.

C. Field Quality Control

1. This paragraph is applicable if sound control is critical. Installer shall conduct a light-leakage test at completion of installation, and prior to NIC testing, to correct alignment of vertical joints and top and bottom seals.
2. Light-Leakage Test: Illuminate one side of partition installation and observe vertical joints and top and bottom seals for voids; adjust partitions for acceptable fit.
3. NIC Testing: Engage a qualified testing agency to perform tests and inspections.
4. Testing Methodology: Perform testing of installed operable panel partition for noise isolation according to ASTM E 336, determined by ASTM E 413, and rated for not less than NIC indicated. Adjust and fit partitions to comply with NIC test method requirements.
5. Testing Extent: Testing agency shall randomly select one operable panel partition installation(s) for testing.
6. Repair or replace operable panel partitions that do not comply with requirements.
7. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of repaired, replaced, or additional work with specified requirements.
8. Prepare test and inspection reports.

D. Cleaning

1. Clean soiled surfaces of operable panel partitions to remove dust, loose fibers, fingerprints, adhesives, and other foreign materials according to manufacturer's written instructions.

END OF SECTION 10 22 43 00

SECTION 10 26 13 00 - IMPACT-RESISTANT WALL PROTECTION

1.1 GENERAL

A. Description Of Work

1. This specification covers the furnishing and installation of materials for impact-resistant wall protection. Product shall be as follows or as directed by the Owner. Installation procedures shall be in accordance with the product manufacturer's recommendations. Demolition and removal of materials shall be as required to support the work.

B. Summary

1. Section Includes:
 - a. Wall guards.
 - b. Impact-resistant handrails.
 - c. Bed locators.
 - d. Corner guards.
 - e. Impact-resistant wall coverings.
 - f. Door protection systems.

C. Performance Requirements

1. Structural Performance: Provide handrails capable of withstanding the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:
 - a. Uniform load of 50 lbf/ft. (0.73 kN/m) applied in any direction.
 - b. Concentrated load of 200 lbf (0.89 kN) applied in any direction.
 - c. Uniform and concentrated loads need not be assumed to act concurrently.

D. Submittals

1. Product Data: Include construction details, material descriptions, impact strength, fire-test-response characteristics, dimensions of individual components and profiles, and finishes for each impact-resistant wall protection unit.
2. LEED Submittals:
 - a. Certificates for Credit MR 7: Chain-of-custody certificates certifying that wood rails comply with forest certification requirements. Include evidence that manufacturer is certified for chain of custody by an FSC-accredited certification body.
 - 1) Include statement indicating costs for each certified wood product.
 - b. Product Data for Credit EQ 4.1: For adhesives, including printed statement of VOC content.
 - c. Product Data for Credit EQ 4.4: For particleboard, documentation indicating that products contain no urea formaldehyde.
3. Shop Drawings: For each impact-resistant wall protection unit showing locations and extent. Include sections, details, and attachments to other work.
 - a. For installed products indicated to comply with design loads, include structural analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
4. Samples: For each type of exposed finish required, prepared on Samples of size indicated below. Include Samples of accent strips to verify color selected.
 - a. Wall and Corner Guards: 12 inches (300 mm) long. Include examples of joinery, corners, end caps, top caps, and field splices.
 - b. Handrails: 12 inches (300 mm) long. Include examples of joinery, corners, and field splices.
 - c. Impact-Resistant Wall Covering: 6 by 6 inches (150 by 150 mm) square.
 - d. Door-Surface Protection: 6 by 6 inches (150 by 150 mm) square.
 - e. Door-Edge and -Frame Protectors: 12 inches (300 mm) long.
 - f. Door-Knob and -Lever Protectors: Full-size unit of each type.

5. Qualification Data: For qualified Installer and testing agency.
 6. Material Certificates: For each impact-resistant plastic material, from manufacturer.
 7. Material Test Reports: For each impact-resistant plastic material.
 8. Maintenance Data: For each impact-resistant wall protection unit to include in maintenance manuals.
 - a. Include recommended methods and frequency of maintenance for maintaining optimum condition of plastic covers under anticipated traffic and use conditions. Include precautions against using cleaning materials and methods that may be detrimental to plastic finishes and performance.
 9. Warranty: Sample of special warranty.
- E. Quality Assurance
1. Installer Qualifications: An employer of workers trained and approved by manufacturer.
 2. Source Limitations: Obtain impact-resistant wall protection units from single source from single manufacturer.
 3. Product Options: Drawings indicate size, profiles, and dimensional requirements of impact-resistant wall protection units and are based on the specific system indicated.
 - a. Do not modify intended aesthetic effects, as judged solely by the Owner, except with the Owner's approval. If modifications are proposed, submit comprehensive explanatory data to the Owner for review.
 4. Forest Certification: Fabricate wood rails from wood obtained from forests certified by an FSC-accredited certification body to comply with FSC STD-01-001, "FSC Principles and Criteria for Forest Stewardship."
 5. Surface-Burning Characteristics: Provide impact-resistant, plastic wall protection units with surface-burning characteristics as determined by testing identical products per ASTM E 84, NFPA 255, or UL 723 by UL or another qualified testing agency.
 6. Regulatory Requirements: Comply with applicable provisions in the U.S. Architectural & Transportation Barriers Compliance Board's ADA-ABA Accessibility Guidelines and ICC/ANSI A117.1.
 7. Preinstallation Conference: Conduct conference at Project site.
- F. Delivery, Storage, And Handling
1. Store impact-resistant wall protection units in original undamaged packages and containers inside well-ventilated area protected from weather, moisture, soiling, extreme temperatures, and humidity.
 - a. Maintain room temperature within storage area at not less than 70 deg F (21 deg C) during the period plastic materials are stored.
 - b. Keep plastic sheet material out of direct sunlight.
 - c. Store plastic wall protection components for a minimum of 72 hours, or until plastic material attains a minimum room temperature of 70 deg F (21 deg C).
 - 1) Store corner-guard covers in a vertical position.
 - 2) Store wall-guard, bed-locator and handrail covers in a horizontal position.
- G. Project Conditions
1. Environmental Limitations: Do not deliver or install impact-resistant wall protection units until building is enclosed and weatherproof, wet work is complete and dry, and HVAC system is operating and maintaining temperature at 70 deg F (21 deg C) for not less than 72 hours before beginning installation and for the remainder of the construction period.
- H. Warranty
1. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of impact-resistant wall protection units that fail in materials or workmanship within specified warranty period.
 - a. Failures include, but are not limited to, the following:
 - 1) Structural failures.

- 2) Deterioration of plastic and other materials beyond normal use.
- b. Warranty Period: Five years from date of Final Completion.

1.2 PRODUCTS

A. Materials

1. PVC Plastic: ASTM D 1784, Class 1, textured, chemical- and stain-resistant, high-impact-resistant PVC or acrylic-modified vinyl plastic with integral color throughout; extruded and sheet material, thickness as indicated.
 - a. Impact Resistance: Minimum **25.4 ft-lbf/in. (1356 J/m)** of notch when tested according to ASTM D 256, Test Method A.
 - b. Chemical and Stain Resistance: Tested according to ASTM D 543 **OR** ASTM D 1308.
 - c. Self-extinguishing when tested according to ASTM D 635.
 - d. Flame-Spread Index: 25 or less.
 - e. Smoke-Developed Index: 450 or less.
2. Polycarbonate Plastic Sheet: ASTM D 6098, S-PC01, Class 1 or 2, abrasion resistant; with a minimum impact-resistance rating of **15 ft-lbf/in. (800 J/m)** of notch when tested according to ASTM D 256, Test Method A.
3. Aluminum Extrusions: Alloy and temper recommended by manufacturer for type of use and finish indicated, but with not less than strength and durability properties specified in **ASTM B 221 (ASTM B 221M)** for Alloy 6063-T5.
4. Stainless-Steel Sheet: ASTM A 240/A 240M.
5. Brass: ASTM B 249/B 249M for extruded shapes and ASTM B 36/B 36 M for sheet.
6. Solid Wood: Clear hardwood lumber of species indicated, free of appearance defects, and selected for compatible grain and color.
7. Particleboard: ANSI A208.1, Grade M-2; made with binder containing no urea formaldehyde.
8. Fasteners: Aluminum, nonmagnetic stainless-steel, or other noncorrosive metal screws, bolts, and other fasteners compatible with items being fastened. Use security-type fasteners where exposed to view.
9. Adhesive: As recommended by impact-resistant plastic wall protection manufacturer and with a VOC content of 70 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

B. Wall Guards

1. Crash Rail: Heavy-duty assembly consisting of continuous snap-on plastic cover installed over concealed retainer system; designed to withstand impacts.
 - a. Cover: Extruded rigid plastic, minimum **0.100-inch (2.5-mm)** wall thickness; as follows: **OR** in dimensions and profiles indicated on Drawings, **as directed**.
 - 1) Profile: Flat **OR** Convex, **as directed**.
 - a) Dimensions: Nominal **6 inches high by 1 inch deep (150 mm high by 25 mm deep) OR 8 inches high by 1 inch deep (200 mm high by 25 mm deep), as directed**.
 - b) Surface: Uniform **OR** Uniform with coextruded accent inlay strip in contrasting color **OR** Grooved, **as directed**.
 - i. Accent Inlay Strip: Nominal 2 inches (50 mm) high by length of rail.
 - 2) Color and Texture: As indicated by manufacturer's designations **OR** As selected from manufacturer's full range, **as directed**.
 - b. Continuous Retainer: Minimum **0.080-inch- (2.0-mm-)** thick, one-piece, extruded aluminum.
OR
Retainer Clips: Manufacturer's standard impact-absorbing clips designed for heavy-duty performance.
 - c. Bumper: Continuous rubber or vinyl bumper cushion(s).

- d. End Caps and Corners: Prefabricated, injection-molded plastic; matching color **OR** contrasting with color, **as directed**, cover; field adjustable for close alignment with snap-on cover.
 - e. Accessories: Concealed splices and mounting hardware.
 - f. Mounting: Surface mounted directly to wall **OR** Reveal mounted on bumper cushion(s) **OR** Extended mounting on injection-molded plastic mounting brackets, **as directed**.
2. Bumper Rail: Assembly consisting of continuous snap-on plastic cover installed over concealed, continuous retainer; designed to withstand impacts.
- a. Cover: Extruded rigid plastic, minimum **0.078-inch (2.0-mm)** wall thickness; as follows: **OR** in dimensions and profiles indicated on Drawings, **as directed**.
 - 1) Profile: Half round profile, nominal **1 inch high by 1 inch deep (25 mm high by 25 mm deep)** **OR** Rounded bullnose profile, nominal **4 inches high by 2 inches deep (100 mm high by 50 mm deep)** **OR** Angled profile with rounded-bullnose front edge, nominal **4 inches high by 2 inches deep (100 mm high by 50 mm deep)** **OR** Flat profile, nominal **4 inches high by 1 inch deep (100 mm high by 25 mm deep)**, **as directed**.
 - 2) Color and Texture: As indicated by manufacturer's designations **OR** As selected from manufacturer's full range, **as directed**.
 - b. Continuous Retainer: Minimum **0.080-inch- (2.0-mm-)** thick, one-piece, extruded aluminum.
OR
Retainer Clips: Manufacturer's standard impact-absorbing clips.
 - c. Bumper: Continuous rubber or vinyl bumper cushion(s).
 - d. End Caps and Corners: Prefabricated, injection-molded plastic; matching color **OR** contrasting with color, **as directed**, cover; field adjustable for close alignment with snap-on cover.
 - e. Accessories: Concealed splices and mounting hardware.
 - f. Mounting: Surface mounted directly to wall **OR** Reveal mounted on bumper cushions **OR** Extended mounting on injection-molded plastic mounting brackets, **as directed**.
3. Rub Rail: Assembly consisting of continuous snap-on cover installed over concealed, continuous retainer.
- a. Cover: Extruded rigid plastic **OR** flexible PVC, **as directed**, minimum **0.078-inch (2.0-mm)** wall thickness; as follows: **OR** in dimensions and profiles indicated on Drawings, **as directed**.
 - 1) Profile: Half-round profile, nominal **1-1/8 inches high by 1-1/8 inches deep (30 mm high by 30 mm deep)** **OR** Rounded bullnose profile, nominal **2 inches high by 1 inch deep (50 mm high by 25 mm deep)**, **as directed**.
 - 2) Color and Texture: As indicated by manufacturer's designations **OR** As selected from manufacturer's full range, **as directed**.
 - b. Retainer: Minimum **0.0625-inch- (1.6-mm-)** thick, one-piece, extruded aluminum.
 - c. End Caps and Corners: Prefabricated, injection-molded plastic; color matching cover; field adjustable for close alignment with snap-on cover.
 - d. Accessories: Concealed splices and mounting hardware.
 - e. Mounting: Surface mounted directly to wall **OR** Reveal mounted on bumper cushions, **as directed**.
4. Wood Chair Rail with Bumper: Assembly consisting of continuous sculpted, solid-wood rail, with continuous bumper insert installed in continuous recessed retainer.
- a. Wood Rail: **3-1/2 inches high by 7/8 inch deep (89 mm high by 22 mm deep)** **OR** **5-1/2 inches high by 1-1/2 inches deep (140 mm high by 38 mm deep)** **OR** Size and profile indicated on Drawings, **as directed**.
 - 1) Wood Species: Red oak **OR** Maple **OR** Ash **OR** Beech, **as directed**.
 - 2) Finish: Clear **OR** Stained, **as directed**.
 - 3) Color: As indicated by manufacturer's designations **OR** As selected from manufacturer's full range, **as directed**.

- b. Bumper: Extruded rigid plastic **OR** flexible vinyl, **as directed**, minimum **0.078-inch (2.0-mm)** wall thickness; as follows: **OR** in dimensions and profiles indicated on Drawings, **as directed**.
 - 1) Profile: Half-round profile, nominal **2 inches high by 1 inch deep (50 mm high by 25 mm deep)** **OR** Small rounded profile, nominal **1-1/8 inches high by 1-1/8 inches deep (30 mm high by 30 mm deep)**, **as directed**.
 - 2) Color and Texture: As indicated by manufacturer's designations **OR** As selected from manufacturer's full range, **as directed**.
 - 3) End Caps and Corners: Prefabricated, injection-molded plastic; color matching bumper; field adjustable for close alignment with snap-on bumper.
 - c. Retainer: Minimum **0.0625-inch- (1.6-mm-)** thick, one-piece, extruded aluminum.
 - 1) Finish: Mill **OR** Brass colored, **as directed**.
 - d. Accessories: Concealed splices and mounting hardware.
 - e. Mounting: Surface mounted directly to wall.
 5. Wood Chair Rail: Assembly consisting of continuous sculpted, solid-wood rail.
 - a. Rail: **3-1/2 inches high by 7/8 inch deep (89 mm high by 22 mm deep)** **OR** **5-1/2 inches high by 1-1/2 inches deep (140 mm high by 38 mm deep)** **OR** As indicated on Drawings, **as directed**.
 - 1) Wood Species: Red oak **OR** Maple **OR** Ash **OR** Bamboo, **as directed**.
 - 2) Finish: Clear **OR** Stained, **as directed**.
 - 3) Color: As indicated by manufacturer's designations **OR** As selected from manufacturer's full range, **as directed**.
 - b. Accessories: Concealed splices and mounting hardware.
 - c. Mounting: Surface mounted directly to wall.
 6. Opaque-Plastic Chair Rail: Assembly consisting of continuous snap-on cover installed over continuous retainer.
 - a. Cover: Extruded rigid plastic, minimum **0.070-inch (1.8-mm)** wall thickness; as follows: **OR** in dimensions and profiles indicated on Drawings, **as directed**.
 - 1) Profile: Rounded bullnose profile, nominal **2 inches high by 1 inch deep (50 mm high by 25 mm deep)** **OR** Half-round profile, nominal **1-1/8 inches high by 1-1/8 inches deep (30 mm high by 30 mm deep)**, **as directed**.
 - 2) Color and Texture: As indicated by manufacturer's designations **OR** As selected from manufacturer's full range, **as directed**.
 - b. Retainer: Minimum **0.060-inch- (1.5-mm-)** thick, one-piece, extruded aluminum.
 - c. Bumper: Continuous rubber or vinyl bumper cushion(s).
 - d. End Caps and Corners: Prefabricated, injection-molded plastic; color matching cover; field adjustable for close alignment with snap-on cover.
 - e. Accessories: Concealed splices and mounting hardware.
 - f. Mounting: Surface mounted directly to wall **OR** Reveal mounted on bumper cushions, **as directed**.
 7. Transparent-Plastic Chair Rail: Consisting of clear polycarbonate plastic sheet.
 - a. Height: **3 inches (75 mm)** nominal **OR** **4 inches (100 mm)** nominal **OR** As indicated on Drawings, **as directed**.
 - b. Mounting: Surface mounted using flat-head countersunk screws through factory-drilled mounting holes.
 8. Rub Strip: Consisting of minimum **0.040-inch- (1.0-mm-)** **OR** **0.060-inch- (1.5-mm-)**, **as directed**, thick, plastic sheet wall-covering material.
 - a. Height: **8 inches (200 mm)** nominal.
 - b. Color and Texture: As indicated by manufacturer's designations **OR** As selected from manufacturer's full range, **as directed**.
 - c. Mounting: Surface mounted with adhesive or double-faced adhesive tape.

C. Handrails

 1. Impact-Resistant Plastic Handrails: Assembly consisting of snap-on plastic cover installed over continuous retainer.

- a. Cover: Minimum **0.078-inch- (2.0-mm-)** OR **0.100-inch- (2.5-mm-)**, **as directed**, thick, extruded rigid plastic; as follows: **OR** in dimensions and profiles indicated on Drawings, **as directed**.
 - 1) Single Handrail: Cylindrical tube profile cover with continuous retainer; with mounting brackets supporting bottom of rail.
 - a) Tube Diameter: as directed by the Owner.
 - 2) Bumper Rail: Cover with flat **OR** sculpted with contoured thumb recess on, **as directed**, front side; with **1-1/2-inch- (38-mm-)** diameter gripping surface and finger recess on back side; supported by concealed, continuous retainer and extended mounting brackets.
 - a) Bumper-Rail Dimensions: Nominal **5-1/2 inches high by 1-1/2 inches deep (140 mm high by 38 mm deep)** OR **5-1/2 inches high by 2 inches deep (140 mm high by 50 mm deep)**, **as directed**.
 - b) Bumper Surface: Smooth **OR** Smooth with coextruded accent inlay strip in contrasting color **OR** Grooved, **as directed**.
 - c) Accent Inlay Strip: Nominal **2 inches (50 mm)** high by length of rail.
 - 3) Double Handrail with Bumper-Rail Profile: Two tubes mounted above and below nominal, flat-faced bumper rail; each tube with **1-1/2-inch- (38-mm-)** diameter gripping surface and finger recess on back side; supported by concealed, continuous retainer and extended mounting brackets.
 - a) Bumper-Rail Dimensions: Nominal **4 inches high by 1-1/2 inches deep (100 mm high by 38 mm deep)**.
 - b) Bumper Surface: Smooth **OR** Smooth with coextruded accent inlay strip in contrasting color **OR** Grooved, **as directed**.
 - c) Accent Inlay Strip: Nominal **2 inches (50 mm)** high by length of rail.
 - 4) Color and Texture: As indicated by manufacturer's designations **OR** As selected from manufacturer's full range, **as directed**.
- b. Retainer: Minimum **0.080-inch- (2.0-mm-)** thick, one-piece, extruded aluminum.
- c. Mounting Bracket: Extended mounting on injection-molded plastic **OR** anodized-aluminum, **as directed**, mounting brackets.
- d. End Caps and Corners: Prefabricated, injection-molded plastic; matching color **OR** contrasting with color, **as directed**, cover; field adjustable for close alignment with snap-on cover.
- e. Accessories: Concealed splices, cushions, and mounting hardware.
2. Combination Wood-Plastic Bumper Handrail: Assembly consisting of solid-wood handrail mounted above plastic bumper rail, both mounted on continuous retainer; with reveal between handrail and bumper serving as thumb recess on front side; with **1-1/2-inch- (38-mm-)** diameter gripping surface and finger recess on back side.
 - a. Wood Handrail: **1-1/2 inches (38 mm)** in diameter; with matching end caps and corners.
 - 1) Wood Species: Red oak **OR** Maple **OR** Ash **OR** Beech, **as directed**.
 - 2) Finish: Clear **OR** Stained, **as directed**.
 - 3) Color: As indicated by manufacturer's designations **OR** As selected from manufacturer's full range, **as directed**.
 - b. Bumper: Extruded rigid plastic, minimum **0.078-inch- (2.0-mm-)** OR **0.100-inch- (2.5-mm-)**, **as directed**, wall thickness; as follows: **OR** in dimensions and profiles indicated on Drawings, **as directed**.
 - 1) Profile: Flat **OR** Convex, **as directed**, profile, nominal **4 inches high by 1 inch deep (100 mm high by 25 mm deep)**.
 - 2) Accent Inlay Strip: Nominal **2 inches (50 mm)** high by length of rail.
 - 3) Color and Texture: As indicated by manufacturer's designations **OR** As selected from manufacturer's full range, **as directed**.
 - 4) End Caps and Corners: Prefabricated, injection-molded plastic; color matching bumper; field adjustable for close alignment with snap-on bumper.
 - c. Retainer: Minimum **0.0625-inch- (1.6-mm-)** thick, one-piece, extruded aluminum.
 - d. Reveal: Extruded rigid plastic or vinyl over aluminum retainer.

- 1) Color: Brass **OR** Chrome **OR** As indicated by manufacturer's designations **OR** As selected from manufacturer's full range, **as directed**.
 - e. Accessories: Concealed splices, cushion(s), and mounting hardware.
 3. Wood Handrail with Bumper: Assembly consisting of continuous sculpted, solid-wood handrail, with bumper insert installed in continuous retainer recessed into the face of the wood.
 - a. Wood Handrail: As indicated on Drawings with **1-1/2-inch- (38-mm-)** diameter gripping surface.
 - 1) End Caps, Returns, Corners, and Mounting Brackets: Solid wood that matches rail.
 - 2) Wood Species: Red oak **OR** Maple **OR** Ash **OR** Beech **OR** Bamboo, **as directed**.
 - 3) Finish: Clear **OR** Stained, **as directed**.
 - 4) Color: As indicated by manufacturer's designations **OR** As selected from manufacturer's full range, **as directed**.
 - b. Bumper: Extruded rigid plastic **OR** flexible vinyl, **as directed**, minimum **0.078-inch (2.0-mm)** wall thickness; as follows: **OR** in dimensions and profiles indicated on Drawings, **as directed**.
 - 1) Profile: Half-round profile, nominal **2 inches high by 1 inch deep (50 mm high by 25 mm deep)** **OR** Small rounded profile, nominal **1-1/8 inches high by 1-1/8 inches deep (30 mm high by 30 mm deep)**, **as directed**.
 - 2) Color and Texture: As indicated by manufacturer's designations **OR** As selected from manufacturer's full range, **as directed**.
 - 3) End Caps and Corners: Prefabricated, injection-molded plastic; color matching bumper; field adjustable for close alignment with snap-on bumper.
 - c. Retainer: Minimum **0.0625-inch- (1.6-mm-)** thick, one-piece, extruded aluminum.
 - 1) Finish: Mill **OR** Brass colored, **as directed**.
 - d. Accessories: Concealed splices and mounting hardware.
 4. Solid-Wood Handrail: Assembly consisting of continuous sculpted, solid-wood handrail.
 - a. Handrail: **5-1/2 inches high by 1-1/2 inches deep (140 mm high by 38 mm deep)** **OR** As indicated on Drawings, **as directed**, with **1-1/2-inch- (38-mm-)** diameter gripping surface.
 - 1) End Caps, Returns, Corners, and Mounting Brackets: Solid wood that matches rail.
 - 2) Wood Species: Red oak **OR** Maple **OR** Ash **OR** Beech, **as directed**.
 - 3) Finish: Clear **OR** Stained, **as directed**.
 - 4) Color: As indicated by manufacturer's designations **OR** As selected from manufacturer's full range, **as directed**.
- D. Bed Locators
1. Bed Locators: Assembly consisting of continuous snap-on plastic cover installed over continuous retainer; with two bed-locator end caps and mounting hardware; cover designed to spring back when hit.
 - a. Cover: Extruded rigid plastic, minimum **0.078-inch (2.0-mm)** wall thickness.
 - 1) Profile: Large rounded angled **OR** bullnose, **as directed**, profile, nominal **4 inches high by 2 inches deep (100 mm high by 50 mm deep)**.
 - 2) Color and Texture: As indicated by manufacturer's designations **OR** As selected from manufacturer's full range, **as directed**.
 - b. Retainer: Minimum **0.080-inch- (2.0-mm-)** thick, one-piece, extruded aluminum.
 - c. Bed-Locator End Caps: Prefabricated, injection-molded plastic; color matching cover; field adjustable for close alignment with snap-on cover.
 - d. Mounting Type: Surface mounted on **1/2-inch- (13-mm-)** thick cushion spacers **OR** Extended mounting on injection-molded plastic mounting brackets **OR** Extended mounting on aluminum mounting brackets, **as directed**.
- E. Corner Guards
1. Surface-Mounted, Resilient, Plastic Corner Guards: Assembly consisting of snap-on plastic cover installed over continuous retainer; including mounting hardware; fabricated with 90- or 135-degree turn to match wall condition.

- a. Cover: Extruded rigid plastic, minimum **0.078-inch (2.0-mm) OR 0.100-inch (2.5-mm)**, **as directed**, wall thickness; as follows: **OR** in dimensions and profiles indicated on Drawings, **as directed**.
 - 1) Profile: Nominal **2-inch- (50-mm-)** long leg and **1/4-inch (6-mm)** corner radius **OR 3-inch- (75-mm-)** long leg and **1/4-inch (6-mm)** corner radius **OR 3-inch- (75-mm-)** long leg and **1-1/4-inch (32-mm)** corner radius, **as directed**.
 - 2) Height: **4 feet (1.2 m) OR 8 feet (2.4 m)**, **as directed**.
 - 3) Color and Texture: As indicated by manufacturer's designations **OR** As selected from manufacturer's full range, **as directed**.
- b. Retainer: Minimum **0.060-inch- (1.5-mm-)** thick, one-piece, extruded aluminum **OR** One-piece extruded plastic, **as directed**.
OR
Retainer Clips: Manufacturer's standard impact-absorbing clips.
- c. Top and Bottom Caps: Prefabricated, injection-molded plastic; color matching cover; field adjustable for close alignment with snap-on cover.
2. Flush-Mounted, Resilient, Plastic Corner Guards: Assembly consisting of snap-on plastic cover that is flush with adjacent wall surface, installed over continuous retainer; including mounting hardware; fabricated with 90- or 135-degree turn to match wall condition; full wall height.
 - a. Cover: Extruded rigid plastic, minimum **0.078-inch (2.0-mm) OR 0.100-inch (2.5-mm)**, **as directed**, wall thickness; as follows: **OR** in dimensions and profiles indicated on Drawings, **as directed**.
 - 1) Profile: Nominal **2-inch- (50-mm-)** long leg and **1/4-inch (6-mm)** corner radius **OR 3-inch- (75-mm-)** long leg and **1/4-inch (6-mm)** corner radius **OR 3-inch- (75-mm-)** long leg and **1-1/4-inch (32-mm)** corner radius, **as directed**.
 - 2) Height: **4 feet (1.2 m) OR 8 feet (2.4 m)**, **as directed**.
 - 3) Color and Texture: As indicated by manufacturer's designations **OR** As selected from manufacturer's full range, **as directed**.
 - b. Retainer: Minimum **0.060-inch- (1.5-mm-)** thick, one-piece, extruded aluminum.
OR
Retainer Clips: Manufacturer's standard impact-absorbing clips.
 - c. Aluminum Cove Base: Nominal **4 inches (100 mm) OR 6 inches (150 mm)**, **as directed**, high.
3. Fire-Rated, Resilient, Plastic Corner Guards: Assembly consisting of snap-on plastic cover that is flush with adjacent wall surface, installed over continuous retainer and intumescent fire barrier; including mounting hardware; fabricated with 90- or 135-degree turn to match wall condition; full wall height.
 - a. Fire Rating: 1 hour **OR** 2 hours **OR** Same rating as wall in which corner guard is installed, **as directed**; UL listed and labeled according to UL 2079.
 - b. Cover: Extruded rigid plastic, minimum **0.078-inch (2.0-mm) OR 0.100-inch (2.5-mm)**, **as directed**, wall thickness; as follows: **OR** in dimensions and profiles indicated on Drawings, **as directed**.
 - 1) Leg: Nominal **2 inches (50 mm) OR 3 inches (75 mm)**, **as directed**.
 - 2) Corner Radius: **1/4 inch (6 mm) OR 1-1/4 inches (32 mm)**, **as directed**.
 - 3) Color and Texture: As indicated by manufacturer's designations **OR** As selected from manufacturer's full range, **as directed**.
 - c. Retainer: Minimum **0.070-inch- (1.8-mm-)** thick, one-piece, extruded aluminum.
 - d. Aluminum Cove Base: Nominal **4 inches (100 mm) OR 6 inches (150 mm)**, **as directed**, high.
4. Surface-Mounted, Opaque-Plastic Corner Guards: Fabricated from PVC plastic, acrylic-modified vinyl sheet or opaque polycarbonate sheet; with formed edges; fabricated with 90- or 135-degree turn to match wall condition.
 - a. Wing Size: Nominal **3/4 by 3/4 inch (20 by 20 mm) OR 1-1/8 by 1-1/8 inches (30 by 30 mm) OR 2-1/2 by 2-1/2 inches (65 by 65 mm)**, **as directed**.
 - b. Mounting: Countersunk screws through factory-drilled mounting holes **OR** Adhesive **OR** Double-faced adhesive foam tape, **as directed**.

- c. Color and Texture: As indicated by manufacturer's designations **OR** As selected from manufacturer's full range, **as directed**.
 5. Surface-Mounted, Transparent-Plastic Corner Guards: Fabricated from clear polycarbonate plastic sheet; with formed edges; fabricated with 90- or 135-degree turn to match wall condition.
 - a. Wing Size: Nominal **3/4 by 3/4 inch (20 by 20 mm)** **OR** **1-1/8 by 1-1/8 inches (30 by 30 mm)** **OR** **2-1/2 by 2-1/2 inches (65 by 65 mm)**, **as directed**.
 - b. Thickness: Minimum **0.050 inch (1.3 mm)** **OR** **0.075 inch (1.9 mm)** **OR** **0.100 inch (2.5 mm)**, **as directed**.
 - c. Mounting: Countersunk screws through factory-drilled mounting holes **OR** Corner clips, **as directed**.
 6. Surface-Mounted, Metal Corner Guards: Fabricated from one-piece, formed or extruded metal with formed edges; with 90- or 135-degree turn to match wall condition.
 - a. Material: Stainless steel, Type 304 **OR** Type 430, **as directed**.
 - 1) Thickness: Minimum **0.0500 inch (1.3 mm)** **OR** **0.0625 inch (1.6 mm)** **OR** **0.0781 inch (2.0 mm)**, **as directed**.
 - 2) Finish: Directional satin, No. 4 **OR** Bright annealed, **as directed**.

OR

Material: Extruded aluminum, minimum **0.0625 inch (1.6 mm)** thick, with clear anodic finish.

OR

Material: Brass sheet, minimum **0.0500 inch (1.3 mm)** thick, with buffed, smooth specular **OR** fine satin, **as directed**, finish.
 - b. Wing Size: Nominal **1-1/2 by 1-1/2 inches (38 by 38 mm)** **OR** **2-1/2 by 2-1/2 inches (65 by 65 mm)** **OR** **3-1/2 by 3-1/2 inches (90 by 90 mm)**, **as directed**.
 - c. Corner Radius: **1/8 inch (3 mm)** **OR** **3/4 inch (19 mm)**, **as directed**.
 - d. Mounting: Flat-head, countersunk screws through factory-drilled mounting holes **OR** Oval head, countersunk screws through factory-drilled mounting holes **OR** Double-faced, adhesive foam tape **OR** Adhesive, **as directed**.
- F. End-Wall Guards
 1. Surface-Mounted, Resilient, Plastic End-Wall Guard: Assembly consisting of snap-on plastic cover installed over continuous retainer **OR** continuous retainer at each corner, with end of wall covered by semirigid, impact-resistant sheet wall covering, **as directed**; including mounting hardware.
 - a. Cover: Extruded rigid plastic, minimum **0.078-inch (2.0-mm)** **OR** **0.100-inch (2.5-mm)**, **as directed**, wall thickness; as follows: **OR** in dimensions and profiles indicated on Drawings, **as directed**.
 - 1) Profile: Nominal **2-inch- (50-mm-)** long leg and **1/4-inch (6-mm)** corner radius **OR** **3-inch- (75-mm-)** long leg and **1/4-inch (6-mm)** corner radius **OR** **3-inch- (75-mm-)** long leg and **1-1/4-inch (32-mm)** corner radius, **as directed**.
 - 2) Height: **4 feet (1.2 m)** **OR** **8 feet (2.4 m)**, **as directed**.
 - 3) Color and Texture: As indicated by manufacturer's designations **OR** As selected from manufacturer's full range, **a directed**.
 - b. Retainer: Minimum **0.060-inch- (1.5-mm-)** thick, one-piece, extruded aluminum.
 - c. Top and Bottom Caps: Prefabricated, injection-molded plastic; color matching cover; field adjustable for close alignment with snap-on cover.
 2. Flush-Mounted, Resilient, Plastic End-Wall Guard: Assembly consisting of snap-on plastic cover that is flush with adjacent wall surface and that covers entire end of wall, installed over continuous retainer **OR** continuous retainer at each corner, with end of wall covered by semirigid, impact-resistant sheet wall covering, **as directed**; including mounting hardware.
 - a. Cover: Extruded rigid plastic, minimum **0.078-inch (2.0-mm)** **OR** **0.100-inch (2.5-mm)**, **as directed**, wall thickness; as follows: **OR** in dimensions and profiles indicated on Drawings, **as directed**.
 - 1) Profile: Nominal **2-inch- (50-mm-)** long leg and **1/4-inch (6-mm)** corner radius **OR** **3-inch- (75-mm-)** long leg and **1/4-inch (6-mm)** corner radius **OR** **3-inch- (75-mm-)** long leg and **1-1/4-inch (32-mm)** corner radius, **as directed**.

- 2) Height: **4 feet (1.2 m) OR 8 feet (2.4 m), as directed.**
 - 3) Color and Texture: As indicated by manufacturer's designations **OR** As selected from manufacturer's full range, **as directed.**
 - b. Retainer: Minimum **0.060-inch- (1.5-mm-) thick, one-piece, extruded aluminum.**
 - c. Aluminum Cove Base: Nominal **4 inches (100 mm) OR 6 inches (150 mm), as directed, high.**
 3. Fire-Rated, Resilient, Plastic End-Wall Guard: Assembly consisting of snap-on plastic cover that is flush with adjacent wall surface and that covers entire end of wall, installed over continuous retainer and intumescent fire barrier; including mounting hardware; full wall height.
 - a. Fire Rating: 1 hour **OR 2 hours OR Same rating as wall in which end guard is installed, as directed;** UL listed and labeled according to UL 2079.
 - b. Cover: Extruded rigid plastic, minimum **0.078-inch (2.0-mm) OR 0.100-inch (2.5-mm), as directed, wall thickness; as follows: OR in dimensions and profiles indicated on Drawings, as directed.**
 - 1) Leg: Nominal **2 inches (50 mm) OR 3 inches (75 mm), as directed.**
 - 2) Corner Radius: **1/4 inch (6 mm) OR 1-1/4 inches (32 mm), as directed.**
 - 3) Color and Texture: As indicated by manufacturer's designations **OR** As selected from manufacturer's full range, **as directed.**
 - c. Retainer: Minimum **0.070-inch- (1.8-mm-) thick, one-piece, extruded aluminum.**
 - d. Aluminum Cove Base: Nominal **4 inches (100 mm) OR 6 inches (150 mm), as directed, high.**
 4. Surface-Mounted, Metal, End-Wall Guards: Fabricated from one-piece, formed or extruded metal that covers entire end of wall; with formed edges.
 - a. Material: Stainless steel, Type 304 **OR** Type 430 **as directed.**
 - 1) Thickness: Minimum **0.0500 inch (1.3 mm) OR 0.0625 inch (1.6 mm) OR 0.0781 inch (2.0 mm), as directed.**
 - 2) Finish: Directional satin, No. 4 **OR** Bright annealed, **as directed.**

OR

Material: Extruded aluminum, minimum **0.0625 inch (1.6 mm) thick, with clear anodic finish.**

OR

Material: Brass sheet, minimum **0.0500 inch (1.3 mm) thick, with buffed, smooth specular OR fine satin, as directed, finish.**
 - b. Wing Size: Nominal **1-1/2 by 1-1/2 inches (38 by 38 mm) OR 2-1/2 by 2-1/2 inches (65 by 65 mm) OR 3-1/2 by 3-1/2 inches (90 by 90 mm), as directed.**
 - c. Corner Radius: **1/8 inch (3 mm) OR 3/4 inch (19 mm), as directed.**
 - d. Mounting: Flat-head, countersunk screws through factory-drilled mounting holes **OR** Oval head, countersunk screws through factory-drilled mounting holes **OR** Double-faced, adhesive foam tape **OR** Adhesive, **as directed.**
- G. Impact-Resistant Wall Coverings
1. Impact-Resistant Sheet Wall Covering: Fabricated from plastic sheet wall-covering material.
 - a. Size: **48 by 96 inches (1219 by 2438 mm) for sheet OR 48 by 120 inches (1219 by 3048 mm) for roll OR** As indicated, **as directed.**
 - b. Sheet Thickness: **0.022 inch (0.56 mm) OR 0.028 inch (0.7 mm) OR 0.040 inch (1.0 mm) OR 0.060 inch (1.5 mm) OR 0.080 inch (2.0 mm) OR 0.093 inch (2.4 mm) OR 0.125 inch (3.0 mm), as directed.**
 - c. Color and Texture: As indicated by manufacturer's designations **OR** As selected from manufacturer's full range, **as directed.**
 - d. Height: Full wall **OR** Wainscot **OR** As indicated, **as directed.**
 - e. Trim and Joint Moldings: Extruded rigid plastic that matches sheet wall covering color.
 - f. Mounting: Adhesive.
 2. Prelaminated, Impact-Resistant Wall Panels: Rigid wall panels consisting of impact-resistant plastic sheet wall covering material factory laminated to high-impact-resistant core, with moisture-resistant vapor barrier factory laminated to reverse side of panel for stability.

- a. Composition: **0.028-inch- (0.70-mm-)** thick plastic sheet laminated to **3/8-inch- (9.5-mm-)** thick, particleboard core **OR** **0.04-inch- (1.02-mm-)** thick plastic sheet laminated to **3/8-inch- (9.5-mm-)** thick, particleboard core, **as directed**.
 - b. Sheet Size: **48 by 96 inches (1219 by 2438 mm)** **OR** **48 by 108 inches (1219 by 2743 mm)** **OR** **48 by 120 inches (1219 by 3048 mm)** **OR** As indicated, **as directed**.
 - c. Height: Full wall **OR** Wainscot **OR** As indicated, **as directed**.
 - d. Sheet Edge: Square **OR** Beveled, **as directed**.
 - e. Trim and Joint Moldings: Extruded rigid plastic that matches sheet wall covering color.
 - f. Color and Texture: As indicated by manufacturer's designations **OR** As selected from manufacturer's full range, **as directed**.
 - g. Mounting: Adhesive.
- H. Door Protection Systems
1. General: Comply with BHMA A156.6.
 - a. For fire-rated doors, provide door protection systems that are UL listed and labeled.
 2. Protection Plates: Fabricated from extruded rigid plastic, of thickness indicated.
 3. Full-Height Door-Surface Protection: Minimum **0.040-inch (1.0-mm)** **OR** **0.060-inch (1.5-mm)** **OR** **0.080-inch (2.0-mm)**, **as directed**, wall thickness; with 90-degree bend for door-edge protection.
 - a. Color and Texture: As indicated by manufacturer's designations **OR** As selected from manufacturer's full range, **as directed**.
 - b. Mounting: Adhesive **OR** Countersunk screws through factory-drilled mounting holes **OR** Double-faced adhesive foam tape, **as directed**.
 4. Armor Plates: Minimum **0.040-inch (1.0-mm)** **OR** **0.060-inch (1.5-mm)** **OR** **0.080-inch (2.0-mm)**, **as directed**, wall thickness; beveled four sides.
 - a. Size: **32 inches (813 mm)** **OR** **36 inches (914 mm)** **OR** **40 inches (1016 mm)** **OR** **42 inches (1067 mm)**, **as directed**, high by door width, with allowance for frame stops.
 - b. Color and Texture: As indicated by manufacturer's designations **OR** As selected from manufacturer's full range, **as directed**.
 - c. Mounting: Adhesive **OR** Countersunk screws through factory-drilled mounting holes **OR** Double-faced adhesive foam tape, **as directed**.
 5. Kick Plates: Minimum **0.040-inch (1.0-mm)** **OR** **0.060-inch (1.5-mm)** **OR** **0.080-inch (2.0-mm)**, **as directed** wall thickness; beveled four sides.
 - a. Size: **8 inches (203 mm)** **OR** **10 inches (254 mm)** **OR** **12 inches (305 mm)**, **as directed**, high by door width, with allowance for frame stops.
 - b. Color and Texture: As indicated by manufacturer's designations **OR** As selected from manufacturer's full range, **as directed**.
 - c. Mounting: Adhesive **OR** Countersunk screws through factory-drilled mounting holes **OR** Double-faced adhesive foam tape, **as directed**.
 6. Mop Plates: Minimum **0.040-inch (1.0-mm)** **OR** **0.060-inch (1.5-mm)** **OR** **0.080-inch (2.0-mm)**, **as directed**, wall thickness; beveled four sides.
 - a. Size: **4 inches (102 mm)** **OR** **6 inches (152 mm)**, **as directed**, high by **1 inch (25 mm)** less than door width.
 - b. Color and Texture: As indicated by manufacturer's designations **OR** As selected from manufacturer's full range, **as directed**.
 - c. Mounting: Adhesive **OR** Countersunk screws through factory-drilled mounting holes **OR** Double-faced adhesive foam tape, **as directed**.
 7. Stretcher Plates: Minimum **0.040-inch (1.0-mm)** **OR** **0.060-inch (1.5-mm)** **OR** **0.080-inch (2.0-mm)**, **as directed**, wall thickness; beveled four sides.
 - a. Size: **6 inches (152 mm)** **OR** **8 inches (203 mm)**, **as directed**, high by door width, with allowance for frame stops.
 - b. Color and Texture: As indicated by manufacturer's designations **OR** As selected from manufacturer's full range, **as directed**.
 - c. Mounting: Adhesive **OR** Countersunk screws through factory-drilled mounting holes **OR** Double-faced adhesive foam tape, **as directed**.
 8. Push Plates: Minimum **0.040-inch (1.0-mm)** **OR** **0.060-inch (1.5-mm)** **OR** **0.080-inch (2.0-mm)**, **as directed**, wall thickness; beveled four sides.

- a. Size: 12 inches high by 4 inches wide (305 mm high by 102 mm wide) OR 16 inches high by 4 inches wide (406 mm high by 102 mm wide), as directed.
- b. Color and Texture: As indicated by manufacturer's designations OR As selected from manufacturer's full range, as directed.
- c. Mounting: Adhesive OR Countersunk screws through factory-drilled mounting holes OR Double-faced adhesive foam tape, as directed.
- 9. Door-Edge Protection: Fabricated from extruded rigid plastic, minimum 0.040-inch (1.0-mm) OR 0.060-inch (1.5-mm), as directed, wall thickness; formed to fit over door edge without mortising.
 - a. Shape: L OR U, as directed.
 - b. Color and Texture: As indicated by manufacturer's designations OR As selected from manufacturer's full range, as directed.
 - c. Mounting: Adhesive OR Countersunk screws through factory-drilled mounting holes OR Double-faced adhesive foam tape, as directed.
- 10. Door-Frame Protector: Fabricated from extruded rigid plastic, minimum 0.040-inch (1.0-mm) OR 0.050-inch (1.3-mm) OR 0.060-inch (1.5-mm), as directed, wall thickness; formed to fit entire door-frame profile.
 - a. Height: 36 inches (914 mm) OR 48 inches (1219 mm), as directed.
 - b. Color and Texture: As indicated by manufacturer's designations OR As selected from manufacturer's full range, as directed.
 - c. Mounting: Adhesive OR Countersunk screws through factory-drilled mounting holes OR Double-faced adhesive foam tape, as directed.
- 11. Door-Frame Protector: Assembly consisting of snap-on plastic cover installed over continuous retainer; formed to fit door frame on opposite side of door swing.
 - a. Cover: Extruded rigid plastic, minimum 0.080-inch (2.0-mm) wall thickness; in dimensions and profiles indicated.
 - 1) Height: 36 inches (914 mm) OR 48 inches (1219 mm), as directed.
 - 2) Corner Radius: 1/4 inch (6 mm) OR 1-1/4 inches (32 mm), as directed.
 - 3) Color and Texture: As indicated by manufacturer's designations OR As selected from manufacturer's full range, as directed.
 - b. Retainer: Minimum 0.080-inch- (2.0-mm-) thick, one-piece, extruded aluminum.
- 12. Door-Knob OR Door-Lever, as directed, Protector: Fabricated from injection-molded plastic, minimum 0.060-inch (1.5-mm) wall thickness.
 - a. Color and Texture: As indicated by manufacturer's designations OR As selected from manufacturer's full range, as directed.
 - b. Mounting: Countersunk screws through factory-drilled mounting holes.

I. Fabrication

- 1. Fabricate impact-resistant wall protection units to comply with requirements indicated for design, dimensions, and member sizes, including thicknesses of components.
- 2. Preform curved semirigid, impact-resistant sheet wall covering in factory for radius and sheet thickness as follows:
 - a. Sheet Thickness of 0.040 Inch (1.0 mm): 24-inch (610-mm) radius.
 - b. Sheet Thickness of 0.060 Inch (1.5 mm): 36-inch (914-mm) radius.
- 3. Assemble components in factory to greatest extent possible to minimize field assembly. Disassemble only as necessary for shipping and handling.
- 4. Fabricate components with tight seams and joints with exposed edges rolled. Provide surfaces free of wrinkles, chips, dents, uneven coloration, and other imperfections. Fabricate members and fittings to produce flush, smooth, and rigid hairline joints.
- 5. Miter corners and ends of wood handrails for returns.

J. Metal Finishes

- 1. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
 - a. Remove tool and die marks and stretch lines, or blend into finish.
 - b. Grind and polish surfaces to produce uniform finish, free of cross scratches.

- c. Run grain of directional finishes with long dimension of each piece.
 - d. When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.
 2. Protect finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

1.3 EXECUTION

A. Examination

1. Examine substrates and wall areas, with Installer present, for compliance with requirements for installation tolerances, fire rating, and other conditions affecting performance of work.
2. Examine walls to which impact-resistant wall protection will be attached for blocking, grounds, and other solid backing that have been installed in the locations required for secure attachment of support fasteners.
 - a. For impact-resistant wall protection units attached with adhesive or foam tape, verify compatibility with and suitability of substrates, including compatibility with existing finishes or primers.
3. Proceed with installation only after unsatisfactory conditions have been corrected.

B. Preparation

1. Complete finishing operations, including painting, before installing impact-resistant wall protection system components.
2. Before installation, clean substrate to remove dust, debris, and loose particles.

C. Installation

1. General: Install impact-resistant wall protection units level, plumb, and true to line without distortions. Do not use materials with chips, cracks, voids, stains, or other defects that might be visible in the finished Work.
 - a. Install impact-resistant wall protection units in locations and at mounting heights indicated on Drawings or, if not indicated, at heights indicated on Drawings **OR** as directed.
 - b. Provide splices, mounting hardware, anchors, and other accessories required for a complete installation.
 - 1) Provide anchoring devices to withstand imposed loads.
 - 2) Where splices occur in horizontal runs of more than **20 feet (6.1 m)**, splice aluminum retainers and plastic covers at different locations along the run, but no closer than **12 inches (305 mm)**.
 - 3) Adjust end and top caps as required to ensure tight seams.
2. Impact-Resistant Wall Covering: Install top and edge moldings, corners, and divider bars as required for a complete installation.

D. Cleaning

1. Immediately after completion of installation, clean plastic covers and accessories using a standard, ammonia-based, household cleaning agent.
2. Remove excess adhesive using methods and materials recommended in writing by manufacturer.

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Task	Specification	Specification Description
10 26 13 00	05 50 00 00	Metal Fabrications
10 26 23 13	10 26 13 00	Impact-Resistant Wall Protection

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SECTION 10 28 13 13 - TOILET AND BATH ACCESSORIES

1.1 GENERAL

A. Description Of Work

1. This specification covers the furnishing and installation of materials for toilet and bath accessories. Product shall be as follows or as directed by the Owner. Installation procedures shall be in accordance with the product manufacturer's recommendations. Demolition and removal of materials shall be as required to support the work.

B. Summary

1. This Section includes the following:
 - a. Public-use washroom accessories.
 - b. Public-use shower room accessories.
 - c. Private-use bathroom accessories.
 - d. Healthcare accessories.
 - e. Warm-air dryers.
 - f. Childcare accessories.
 - g. Underlavatory guards.
 - h. Custodial accessories.

C. Submittals

1. Product Data: For each type of product indicated.
2. Product Schedule:
 - a. Identify locations using room designations indicated on Drawings.
 - b. Identify products using designations indicated on Drawings.

D. Warranty

1. Special Mirror Warranty: Manufacturer's standard form in which manufacturer agrees to replace mirrors that develop visible silver spoilage defects and that fail in materials or workmanship within 15 years from date of Final Completion.

1.2 PRODUCTS

A. Materials

1. Stainless Steel: ASTM A 666, Type 304, 0.0312-inch (0.8-mm) minimum nominal thickness, unless otherwise indicated.
2. Brass: ASTM B 19 flat products; ASTM B 16 (ASTM B 16M), rods, shapes, forgings, and flat products with finished edges; or ASTM B 30, castings.
3. Steel Sheet: ASTM A 1008/A 1008M, Designation CS (cold rolled, commercial steel), 0.0359-inch (0.9-mm) minimum nominal thickness.
4. Galvanized Steel Sheet: ASTM A 653/A 653M, with G60 (Z180) hot-dip zinc coating.
5. Galvanized Steel Mounting Devices: ASTM A 153/A 153M, hot-dip galvanized after fabrication.
6. Fasteners: Screws, bolts, and other devices of same material as accessory unit and tamper-and-theft resistant where exposed, and of galvanized steel where concealed.
7. Chrome Plating: ASTM B 456, Service Condition Number SC 2 (moderate service).
8. Mirrors: ASTM C 1503, Mirror Glazing Quality, clear-glass mirrors, nominal 6.0 mm thick.
9. ABS Plastic: Acrylonitrile-butadiene-styrene resin formulation.

B. Public-Use Washroom Accessories

1. Toilet Tissue (Roll) Dispenser:



- a. Description: Roll-in-reserve dispenser with hinged front secured with tumbler lockset **OR** Single-roll dispenser **OR** Double-roll dispenser **OR** Double-roll dispenser with shelf, **as directed**.
 - b. Mounting: Recessed **OR** Partition mounted serving two adjacent toilet compartments **OR** Surface mounted, **as directed**.
 - c. Operation: Noncontrol delivery with standard spindle **OR** Noncontrol delivery with theft-resistant spindle **OR** Spindleless with tension-spring controlled delivery **OR** Spindleless with tension-spring controlled delivery and self-locking device extending through core that prevents core removal until roll is empty **OR** Eccentric-shaped, molded-plastic spindle revolves one-half revolution per dispensing operation for controlled delivery; core cannot be removed until roll is empty, **as directed**.
 - d. Capacity: Designed for 4-1/2- or 5-inch- (114- or 127-mm-) **OR** 5-inch- (127-mm-), **as directed**, diameter tissue rolls.
 - e. Material and Finish: Stainless steel, No. 4 finish (satin) **OR** Chrome-plated zinc alloy (zamac) or steel **OR** Satin-finish aluminum bracket with plastic spindle **OR** ABS plastic, gray, **as directed**.
2. Combination Toilet Tissue Dispenser:
 - a. Description: Combination unit with double-roll toilet tissue dispenser and the following:
 - 1) Removable sanitary-napkin waste receptacle with self-closing disposal-opening cover.
 - 2) Seat-cover dispenser with minimum capacity of 500 **OR** 1000, **as directed**, single or half-fold seat covers.
 - b. Mounting: Recessed **OR** Surface mounted **OR** Partition mounted, dual access with two tissue rolls per compartment **OR** Partition mounted, dual access with two tissue rolls per compartment and with one side that mounts flush with partition of accessible compartment, **as directed**.
 - c. Toilet Tissue Dispenser Capacity: 4-1/2- or 5-inch- (114- or 127-mm-) diameter tissue rolls.
 - d. Toilet Tissue Dispenser Operation: Noncontrol delivery with theft-resistant spindles.
 - e. Material and Finish: Stainless steel, No. 4 finish (satin).
 - f. Lockset: Tumbler type.
 3. Toilet Tissue (Folded) Dispenser:
 - a. Description: Folded-tissue dispenser with cover hinged at bottom.
 - b. Mounting: Surface mounted.
 - c. Minimum Capacity: 1250 single-fold tissues.
 - d. Material and Finish: Stainless steel, No. 4 finish (satin).
 - e. Lockset: Tumbler type.
 - f. Refill Indicators: Pierced slots at front.
 4. Toilet Tissue (Jumbo-Roll) Dispenser:
 - a. Description: One-roll unit **OR** Two-roll unit with sliding panel to expose other roll, **as directed**.
 - b. Mounting: Surface mounted.
 - c. Capacity: 9- or 10-inch- (228- or 254-mm-) diameter rolls.
 - d. Material and Finish: Stainless steel, No. 4 finish (satin) **OR** ABS plastic, gray, **as directed**.
 - e. Lockset: Tumbler type.
 - f. Refill Indicator: Pierced slots at front.
 5. Paper Towel (Folded) Dispenser:
 - a. Mounting: Recessed **OR** Semirecessed **OR** Deck mounted, recessed **OR** Surface mounted, **as directed**.
 - b. Minimum Capacity: 400 C-fold or 525 multifold towels **OR** 600 C-fold or 800 multifold towels **OR** 400 single-fold towels, **as directed**.
 - c. Material and Finish: Stainless steel, No. 4 finish (satin) **OR** ABS plastic, gray, **as directed**.
 - d. Lockset: Tumbler type.
 - e. Refill Indicators: Pierced slots at sides or front.
 6. Paper Towel (Roll) Dispenser:

- a. Description: Lever-actuated mechanism permits controlled delivery of paper rolls in preset lengths per stroke.
 - b. Mounting: Recessed **OR** Semirecessed **OR** Surface mounted, **as directed**.
 - c. Minimum Capacity: 8-inch (203-mm) wide, 800-foot (244-m) long roll.
 - d. Material and Finish: Stainless steel, No. 4 finish (satin) **OR** ABS plastic, gray, **as directed**.
 - e. Lockset: Tumbler type.
7. Waste Receptacle:
- a. Mounting: Open top, recessed **OR** Self-closing disposal-opening cover, recessed **OR** Semirecessed **OR** Surface mounted **OR** Wall mounted for corner installation **OR** Freestanding **OR** Undercounter, **as directed**.
 - b. Minimum Capacity: Capacity in gal. (L) **as directed**.
 - c. Material and Finish: Stainless steel, No. 4 finish (satin).
 - d. Liner: Reusable vinyl liner.
 - e. Lockset: Tumbler type for waste-receptacle.
8. Combination Towel (Folded) Dispenser/Waste Receptacle:
- a. Description: Combination unit for dispensing C-fold or multifold towels, with removable waste receptacle.
 - b. Mounting: Surface mounted **OR** Surface mounted with stainless-steel collar **OR** Recessed **OR** Recessed with projecting receptacle **OR** Semirecessed, **as directed**.
 - 1) Designed for nominal 4-inch (100-mm) **OR** 6-inch (150-mm), **as directed**, wall depth.
 - c. Minimum Towel-Dispenser Capacity: 600 C-fold or 800 multifold paper towels.
 - d. Minimum Waste-Receptacle Capacity: 4 gal. (15 L) **OR** 12 gal. (45.4 L), **as directed**.
 - e. Material and Finish: Stainless steel, No. 4 finish (satin).
 - f. Liner: Reusable, vinyl waste-receptacle liner.
 - g. Lockset: Tumbler type for towel-dispenser compartment and waste receptacle.
9. Combination Towel (Roll) Dispenser/Waste Receptacle:
- a. Description: Combination unit for dispensing preset length of roll paper towels, with removable waste receptacle.
 - b. Mounting: Recessed **OR** Semirecessed **OR** Surface mounted, **as directed**.
 - c. Minimum Towel-Dispenser Capacity: 8-inch (203-mm) wide, 800-foot (244-m) long roll.
 - d. Minimum Waste Receptacle Capacity: 8 gal. (30 L) **OR** 12 gal. (45.4 L) **OR** 15 gal. (56.8 L), **as directed**.
 - e. Material and Finish: Stainless steel, No. 4 finish (satin).
 - f. Liner: Reusable, vinyl waste-receptacle liner.
 - g. Lockset: Tumbler type for towel dispenser compartment and waste receptacle.
10. Multipurpose Soap/Towel Dispenser Unit:
- a. Description: Combination unit for dispensing soap in liquid or lotion **OR** lather, **as directed**, form and folded towels.
 - b. Mounting: Recessed, designed for nominal 4-inch (100-mm) wall depth **OR** Surface mounted with stainless-steel collar, **as directed**.
 - c. Minimum Soap-Dispenser Capacity: 80 oz. (2.36 L).
 - d. Minimum Towel-Dispenser Capacity: 600 C-fold or 800 multifold **OR** 1000 single-fold, **as directed**, towels.
 - e. Material and Finish: Stainless steel, No. 4 finish (satin) for unit body and soap valve.
 - f. Lockset: Tumbler type.
11. Liquid-Soap Dispenser:
- a. Description: Designed for dispensing soap in liquid or lotion **OR** lather, **as directed**, form.
 - b. Mounting: Deck mounted on vanity **OR** Deck mounted on lavatory **OR** Horizontally oriented, recessed **OR** Horizontally oriented, surface mounted **OR** Vertically oriented, surface mounted, **as directed**.
 - c. Capacity: Capacity in oz. (mL), **as directed**.
 - d. Materials: Valve and reservoir materials and finishes, **as directed**.
 - e. Lockset: Tumbler type.
 - f. Refill Indicator: Window type.
12. Grab Bar:

- a. Mounting: Flanges with concealed **OR** exposed, **as directed**, fasteners.
 - b. Material: Stainless steel, **0.05 inch (1.3 mm)** thick.
 - 1) Finish: Smooth, No. 4, satin finish **OR** Smooth, No. 4, satin finish on ends and slip-resistant texture in grip area, **as directed**.
 - c. Outside Diameter: **1-1/4 inches (32 mm)** **OR** **1-1/2 inches (38 mm)**, **as directed**.
 - d. Configuration and Length: As indicated on Drawings **OR** Straight, **36 inches (914 mm)** long, **as directed**.
13. Vendor:
- a. Type: Sanitary napkin **OR** Sanitary napkin and tampon **OR** Condom, **as directed**.
 - b. Mounting: Fully recessed, designed for **4-inch (100-mm)** wall depth, **OR** Semirecessed, **OR** Surface mounted, **as directed**.
 - c. Capacity: **As directed**.
 - d. Operation: No coin (free) **OR** Single coin (25 cents) **OR** Two coin (50 cents), **as directed**.
 - e. Exposed Material and Finish: Stainless steel, No. 4 finish (satin).
 - f. Lockset: Tumbler type with separate lock and key for coin box.
14. Sanitary-Napkin Disposal Unit:
- a. Mounting: Recessed **OR** Partition mounted, dual access **OR** Surface mounted, **as directed**.
 - b. Door or Cover: Self-closing disposal-opening cover and hinged face panel with tumbler lockset.
 - c. Receptacle: Removable.
 - d. Material and Finish: Stainless steel, No. 4 finish (satin) **OR** ABS plastic, gray, **as directed**.
15. Seat-Cover Dispenser:
- a. Mounting: Surface mounted **OR** Recessed **OR** Partition mounted, dual access, **as directed**.
 - b. Minimum Capacity: 250 **OR** 500, **as directed**, seat covers.
 - c. Exposed Material and Finish: Stainless steel, No. 4 finish (satin) **OR** ABS plastic, gray, **as directed**.
 - d. Lockset: Tumbler type.
16. Fold-Down Purse Shelf:
- a. Description: Hinged unit with spring-loaded shelf that automatically returns to vertical position.
 - b. Nominal Size: **15 inches (381 mm)** long by **5-1/2 inches (140 mm)** wide.
 - c. Material and Finish: Chrome-plated cast-zinc alloy (zamac) with stippled finish on tray or stainless steel, No. 4 finish (satin) **OR** Chrome-plated cast-zinc alloy (zamac) with stippled finish on tray and bright chrome finish on edges **OR** Stainless steel, No. 4 finish (satin), **as directed**.
17. Mirror Unit:
- a. Frame: Stainless-steel angle, **0.05 inch (1.3 mm)** thick **OR** Stainless-steel channel **OR** Stainless steel, fixed tilt **OR** Stainless steel, adjustable tilt, **as directed**.
 - 1) Corners: Manufacturer's standard **OR** Mitered and mechanically interlocked **OR** Welded and ground smooth, **as directed**.
 - b. Integral Shelf: **5 inches (127 mm)** deep.
 - c. Hangers: Produce rigid, tamper- and theft-resistant installation, using method indicated below.
 - 1) One-piece, galvanized steel, wall-hanger device with spring-action locking mechanism to hold mirror unit in position with no exposed screws or bolts.
 - 2) Wall bracket of galvanized steel, equipped with concealed locking devices requiring a special tool to remove.
 - d. Size: As indicated on Drawings **OR** **as directed**.
18. Facial Tissue Dispenser:
- a. Mounting: Wall mounted, recessed **OR** Surface mounted, **as directed**.
 - b. Nominal Depth: **2-1/4 inches (57 mm)** **OR** **4 inches (102 mm)**, **as directed**.
 - c. Capacity: 150 double-ply tissues.
 - d. Material and Finish:

- 1) Dispenser Face: Stainless steel, No. 4 finish (satin) **OR** Stainless steel, No. 7 finish (polished), **as directed**.
- 2) Cabinet: Steel with corrosion-resistant finish.

C. Public-Use Shower Room Accessories

1. Shower Curtain Rod:
 - a. Description: **1-inch (25.4-mm)** OD; fabricated from nominal **0.0375-inch- (0.95-mm-)** thick stainless steel **OR** **1-1/4-inch (32-mm)** OD; fabricated from nominal **0.05-inch- (1.3-mm-)** thick stainless steel, **as directed**.
 - b. Mounting Flanges: Stainless-steel flanges designed for exposed fasteners.
 - c. Finish: No. 4 (satin).
2. Shower Curtain:
 - a. Size: Minimum **6 inches (152 mm)** **OR** **12 inches (305 mm)**, **as directed**, wider than opening by **72 inches (1828 mm)** high.
 - b. Material: Vinyl, minimum **0.006-inch- (0.15-mm-)** thick, opaque, matte, **OR** Duck, minimum **8 oz. (227 g)**, white, 100 percent cotton, **OR** Nylon-reinforced vinyl, minimum **10-oz. (284-g)** or **0.008-inch- (0.2-mm-)** thick vinyl, with integral antibacterial agent, **as directed**.
 - c. Color: White **OR** Green **OR** As selected from manufacturer's full range, **as directed**.
 - d. Grommets: Corrosion resistant at minimum **6 inches (152 mm)** o.c. through top hem.
 - e. Shower Curtain Hooks: Chrome-plated or stainless-steel, spring wire curtain hooks with snap fasteners, sized to accommodate specified curtain rod. Provide one hook per curtain grommet.
3. Folding Shower Seat:
 - a. Configuration: L-shaped seat, designed for wheelchair access **OR** Rectangular seat **OR** Triangular, corner-type seat **OR** Stainless-steel seat designed to fold into recessed-mounted, stainless-steel wall box, **as directed**.
 - b. Seat: Phenolic or polymeric composite of slat-type or one-piece construction in color as selected **OR** White vinyl padded seat **OR** Stainless steel, No. 4 finish (satin); **0.05-inch (1.3-mm)** minimum nominal thickness; with single-piece, pan-type construction and edge seams welded and ground smooth, **as directed**.
 - c. Mounting Mechanism: Stainless steel, No. 4 finish (satin).
 - d. Dimensions: **As directed**.
4. Soap Dish:
 - a. Description: With **OR** Without, **as directed**, washcloth bar.
 - b. Mounting: Recessed **OR** Surface mounted, **as directed**.
 - c. Material and Finish: Stainless steel, No. 4 finish (satin) **OR** Ceramic at Cermaic Tile Bathtub surround (See Ceramic Tile Section) **OR** Metal at Porcelain Steel Bathtub Surround (Fastenings: Plated expansion toggle or molly bolts, lead anchors or as required by existing wall conditions), **as directed**.

D. Private-Use Bathroom Accessories

1. Toilet Tissue Dispenser:
 - a. Description: Single-roll dispenser **OR** Double-roll dispenser **OR** Single-roll dispenser with hood **OR** Double-roll dispenser with hood, **as directed**.
 - b. Mounting: Recessed **OR** Surface mounted, **as directed**.
 - c. Capacity: Designed for **4-1/2- or 5-inch- (114- or 127-mm-)** diameter tissue rolls.
 - d. Material and Finish: Solid brass, polished **OR** Polished brass-plated zinc alloy (zamac) **OR** Polished chrome-plated brass **OR** Polished chrome-plated zinc alloy (zamac) **OR** Stainless steel, No. 4 finish (satin) **OR** Stainless steel, No. 7 finish (polished), **as directed**.
2. Shower Curtain Rod:
 - a. Outside Diameter: **1 inch (25.4 mm)** **OR** **1-1/4 inch (32 mm)**, **as directed**.
 - b. Mounting: Flanges with exposed **OR** concealed, **as directed**, fasteners.
 - c. Rod Material and Finish: Solid brass, polished **OR** Polished chrome-plated brass **OR** Stainless steel, No. 4 finish (satin) **OR** Stainless steel, No. 7 finish (polished), **as directed**.

- d. Flange Material and Finish: Polished brass-plated zinc alloy (zamac) **OR** Polished chrome-plated brass **OR** Polished chrome-plated zinc alloy (zamac) **OR** Stainless steel, No. 4 finish (satin) **OR** Stainless steel, No. 7 finish (polished), **as directed**.
 - e. Accessories: Integral chrome-plated brass glide hooks.
3. Soap Dish:
 - a. Description: **As directed**.
 - b. Mounting: Recessed **OR** Surface mounted, **as directed**.
 - c. Material and Finish: Solid brass, polished **OR** Polished brass-plated zinc alloy (zamac) **OR** Polished chrome-plated brass **OR** Polished chrome-plated zinc alloy (zamac) **OR** Stainless steel, No. 4 finish (satin) **OR** Stainless steel, No. 7 finish (polished) **OR** Ceramic at Cermaic Tile Bathtub surround (See Ceramic Tile Section) **OR** Metal at Porcelain Steel Bathtub Surround (Fastenings: Plated expansion toggle or molly bolts, lead anchors or as required by existing wall conditions), **as directed**.
4. Medicine Cabinet:
 - a. Mounting: Recessed, for nominal 4-inch (100-mm) wall depth **OR** Surface mounted, **as directed**.
 - b. Size: 18 by 24 inches (460 by 610 mm).
 - c. Door: Framed mirror door concealing storage cabinet equipped with continuous hinge and spring-buffered, rod-type stop and magnetic door catch.
 - d. Shelves: Three, adjustable.
 - e. Material and Finish:
 - 1) Cabinet: Stainless steel, No. 4 finish (satin) **OR** Steel with corrosion resistant finish, **as directed**.
 - 2) Mirror Frame: **As directed**.
 - 3) Door: **As directed**.
 - 4) Hinge: **As directed**.
 - 5) Shelves: **As directed**.
5. Facial Tissue Dispenser:
 - a. Mounting: Wall mounted, recessed **OR** Surface mounted, **as directed**.
 - b. Depth: 2-5/8 inches (67 mm) **OR** 4 inches (102 mm), **as directed**.
 - c. Material and Finish:
 - 1) Dispenser Face: Polished chrome-plated brass **OR** Polished brass-plated zinc alloy (zamac) **OR** Polished chrome-plated steel **OR** Stainless steel, No. 4 finish (satin) **OR** Stainless steel, No. 7 finish (polished), **as directed**.
 - 2) Cabinet: Steel with corrosion-resistant finish.
6. Robe Hook:
 - a. Description: Double-prong **OR** Single-prong, **as directed**, unit.
 - b. Material and Finish: Solid brass, polished **OR** Polished brass-plated zinc alloy (zamac) **OR** Polished chrome-plated brass **OR** Polished chrome-plated zinc alloy (zamac) **OR** Stainless steel, No. 4 finish (satin) **OR** Stainless steel, No. 7 finish (polished), **as directed**.
7. Toothbrush and Tumbler Holder:
 - a. Description: **As directed**.
 - b. Material and Finish: Solid brass, polished **OR** Polished brass-plated zinc alloy (zamac) **OR** Polished chrome-plated brass **OR** Polished chrome-plated zinc alloy (zamac) **OR** Stainless steel, No. 4 finish (satin) **OR** Stainless steel, No. 7 finish (polished), **as directed**.
8. Towel Bar:
 - a. Description: 3/4-inch- (19-mm-) square tube with rectangular end brackets **OR** 3/4-inch- (19-mm-) round tube with circular end brackets, **as directed**.
 - b. Mounting: Flanges with concealed **OR** exposed, **as directed**, fasteners.
 - c. Length: 18 inches (457 mm), **OR** 24 inches (610 mm), **OR** 30 inches (762 mm), **as directed**.
 - d. Material and Finish: Stainless steel, No. 4 finish (satin) **OR** Stainless steel, No. 7 finish (polished) **OR** Polished aluminum, **as directed**.
9. Towel Pin:

- a. Description: Projecting minimum of **3 inches (75 mm) OR 5 inches (127 mm), as directed**, from wall surface.
- b. Material and Finish: Polished brass-plated zinc alloy (zamac) **OR** Polished chrome-plated brass **OR** Stainless steel, No. 4 finish (satin) **OR** Stainless steel, No. 7 finish (polished), **as directed**.
10. Towel Ring:
 - a. Description: Pin projecting approximately **2-1/2 inches (63 mm)** from wall with square **OR** circular **OR** oval **OR** trapezoidal, **as directed**, ring.
 - b. Pin Material and Finish: Solid brass, polished **OR** Polished brass-plated zinc alloy (zamac) **OR** Polished chrome-plated brass **OR** Polished chrome-plated zinc alloy (zamac) **OR** Stainless steel, No. 4 finish (satin) **OR** Stainless steel, No. 7 finish (polished), **as directed**.
 - c. Ring Material and Finish: Matching pin **OR** Clear plastic, **as directed**.
11. Towel Shelf:
 - a. Description: Surface-mounted, guest-towel shelf with four **3/8-inch- (9-mm-)** diameter **OR** **5/16-inch- (8-mm-)** square, **as directed**, stainless steel tubes mounted in support arms.
 - 1) Towel Bar: **1/4-inch (6-mm-)** diameter **OR** **5/16-inch- (8-mm-)** square, **as directed**, stainless-steel towel bar below shelf.
 - b. Length: **18 inches (457 mm) OR 24 inches (610 mm), as directed**.
 - c. Material and Finish: Polished brass-plated stainless steel tubes mounted in zinc alloy (zamac) support arms **OR** Polished chrome-plated stainless steel tubes mounted in zinc alloy (zamac) support arms **OR** Stainless steel, No. 7 finish (polished), **as directed**.
12. Towel Rack:
 - a. Description: Surface-mounted, guest-towel unit with approximately **1/4-inch- (6-mm-)** diameter wire rings welded to upright wire bracket.
 - b. Capacity: **2 OR 3 OR 4, as directed**, sets of bath towels, hand towels, and washcloths.
 - c. Nominal Height: **11 inches (279 mm) OR 17 inches (432 mm) OR 21 inches (533 mm), as directed**.
 - d. Material and Finish: Polished brass-plated zinc alloy (zamac) **OR** Polished chrome-plated zinc alloy (zamac), **as directed**.
13. Retractable Clothesline:
 - a. Description: Surface-mounted rectangular **OR** circular, **as directed**, housing with minimum **72-inch- (1829-mm-)** long, retractable, spring-actuated, synthetic clothesline and remote retention bracket.
 - b. Material and Finish: Chrome-plated brass **OR** Stainless steel, No. 7 finish (polished), **as directed**.
14. Bottle Opener:
 - a. Description: Surface-mounted unit with standard **OR** vandal-resistant, **as directed**, fasteners.
 - b. Material and Finish: Stainless steel, No. 4 finish (satin) **OR** Stainless steel, No. 7 finish (polished) **OR** Chrome-plated steel, **as directed**.
- E. Healthcare Accessories
 1. Specimen Pass-Through Cabinet:
 - a. Description: With self-closing doors on both sides, lock that prevents doors from both being opened at the same time, and removable stainless-steel tray.
 - b. Nominal Wall Opening: **12 by 11-1/4 inches (305 by 285 mm)**, width times height.
 - c. Material and Finish: Stainless steel, No. 4 finish (satin).
 2. Specimen Pass-Through Box:
 - a. Description: With minimum **12-inch (305-mm)** diameter turntable removable cylinder that revolves on stainless-steel self-lubricating ball bearing plates, and with mechanism to prevent over rotation of cylinder.
 - b. Nominal Wall Opening: **13-1/4 by 14 inches (335 by 355 mm)**, width times height.
 - c. Material and Finish: Stainless steel, No. 4 finish (satin).
 - d. Lockset: Tumbler type.
 3. Bedpan and Urinal Cabinet:

- a. Description: For storing one conventional size bedpan and one urinal bottle; with door that produces **1/2-inch (13-mm)** opening at top and bottom of cabinet to allow air circulation.
 - b. Mounting: Recessed.
 - c. Nominal Wall Opening: **13-1/2 by 26-1/2 by 5 inches (340 by 670 by 130 mm)**, width times height times depth.
 - d. Material and Finish: Stainless steel, No. 4 finish (satin).
 4. Bedpan and Urinal Rack:
 - a. Description: For storing one conventional size bedpan and one urinal bottle.
 - b. Mounting: Surface mounted.
 - c. Size: **12 by 27 inches (300 by 685 mm)**, width times height.
 - d. Material and Finish: Stainless steel, No. 4 finish (satin).
- F. Warm-Air Dryers
1. Warm-Air Dryer:
 - a. Mounting: Recessed **OR** Semirecessed **OR** Surface mounted, **as directed**.
 - b. Operation: Touch-button **OR** Electronic-sensor, **as directed**, activated with timed power cut-off switch.
 - 1) Operation Time: 30 to 40, **OR** 80, **as directed**, seconds.
 - c. Cover Material and Finish: Steel, with white enamel finish **OR** Cast iron, with enamel finish in color selected **OR** Chrome-plated steel **OR** Stainless steel, No. 4 finish (satin) **OR** Molded plastic, gray **OR** Molded plastic, white, **as directed**.
 - d. Electrical Requirements: 115 V, 13 A, 1500 W **OR** 115 V, 15 A, 1725 W **OR** 115 V, 20 A, 2300 W **OR** 208-240 V, 9-10 A, 1900-2300 W, **as directed**.
- G. Childcare Accessories
1. Diaper-Changing Station:
 - a. Description: Horizontal **OR** Vertical, **as directed**, unit that opens by folding down from stored position and with child-protection strap.
 - 1) Engineered to support a minimum of **250-lb (113-kg)** static load when opened.
 - b. Mounting: Surface mounted, with unit projecting not more than **4 inches (100 mm)** from wall when closed **OR** Semirecessed, with unit projecting not more than **1 inch (25 mm)** from wall when closed, **as directed**.
 - c. Operation: By pneumatic shock-absorbing mechanism.
 - d. Material and Finish: High-density polyethylene in manufacturer's standard color **OR** High-density polyethylene with plastic laminate insert in color selected **OR** Stainless steel, No. 4 finish (satin), with replaceable insulated polystyrene tray liner and rounded plastic corners **OR** Stainless steel, No. 4 finish (satin), exterior shell with rounded plastic corners; high-density polyethylene interior in manufacturer's standard color, **as directed**.
 - e. Liner Dispenser: Built in.
 2. Diaper-Pack Vendor:
 - a. Mounting: Surface mounted **OR** Recessed, **as directed**.
 - b. Minimum Capacity: 100 diaper packs.
 - c. Coin Operation: Coin slot preset for 1 U.S. dollar, adjustable up in 25-cent increments.
 - d. Material and Finish: Stainless steel, No. 4 finish (satin).
 3. Child-Protection Seat:
 - a. Description: Unit that opens by folding down from stored position and with child-protection strap.
 - 1) Engineered to support a minimum of **80-lb (36-kg)**, **OR** **150-lb (68-kg)**, **as directed**, static load when opened.
 - b. Mounting: Surface mounted, with unit projecting not more than **4-1/2 inches (114 mm)**, **OR** **6 inches (152 mm)**, **as directed**, from wall when closed.
 - c. Material and Finish: High-density polyethylene in manufacturer's standard color.
- H. Underlavatory Guards
1. Material and Finish: Antimicrobial, molded-plastic, white.

I. Custodial Accessories

1. Utility Shelf:

- a. Description: With exposed edges turned down not less than **1/2 inch (12.7 mm)** and supported by two triangular brackets welded to shelf underside.
- b. Size: **16 inches (406 mm)** long by **6 inches (152 mm)** deep.
- c. Material and Finish: Not less than nominal **0.05-inch- (1.3-mm-)** thick stainless steel, No. 4 finish (satin).

2. Mop and Broom Holder:

- a. Description: Unit with shelf, hooks, holders, and rod suspended beneath shelf.
- b. Length: **36 inches (914 mm)**.
- c. Hooks: Three.
- d. Mop/Broom Holders: Four, spring-loaded, rubber hat, cam type.
- e. Material and Finish: Stainless steel, No. 4 finish (satin).
 - 1) Shelf: Not less than nominal **0.05-inch- (1.3-mm-)** thick stainless steel.
 - 2) Rod: Approximately **1/4-inch- (6-mm-)** diameter stainless steel.

3. Paper Towel (Folded) Dispenser:

- a. Mounting: Recessed **OR** Semirecessed **OR** Surface mounted, **as directed**.
- b. Minimum Capacity: 400 C-fold or 525 multifold towels **OR** 600 C-fold or 800 multifold towels **OR** 400 single-fold towels, **as directed**.
- c. Material and Finish: Stainless steel, No. 4 finish (satin) **OR** ABS plastic, gray, **as directed**.
- d. Lockset: Tumbler type.
- e. Refill Indicators: Pierced slots at sides or front.

4. Paper Towel (Roll) Dispenser:

- a. Description: Lever-actuated mechanism permits controlled delivery of paper rolls in preset lengths per stroke.
- b. Mounting: Recessed **OR** Semirecessed **OR** Surface mounted, **as directed**.
- c. Minimum Capacity: **8-inch (203-mm)** wide, **800-foot (244-m)** long roll.
- d. Material and Finish: Stainless steel, No. 4 finish (satin), **OR** ABS plastic, gray, **as directed**.
- e. Lockset: Tumbler type.

5. Liquid-Soap Dispenser:

- a. Description: Designed for dispensing soap in liquid or lotion **OR** lather, **as directed**, form.
- b. Mounting: Deck mounted on vanity **OR** Deck mounted on lavatory **OR** Horizontally oriented, recessed **OR** Horizontally oriented, surface mounted **OR** Vertically oriented, surface mounted, **as directed**.
- c. Capacity: Capacity in **oz. (mL)**, **as directed**.
- d. Materials: Valve and reservoir materials and finishes, **as directed**.
- e. Lockset: Tumbler type.
- f. Refill Indicator: Window type.

J. Fabrication

1. Keys: Provide universal keys for internal access to accessories for servicing and resupplying. Provide minimum of six keys to Owner's representative.

1.3 EXECUTION

A. Installation

- a. Install accessories according to manufacturers' written instructions, using fasteners appropriate to substrate indicated and recommended by unit manufacturer. Install units level, plumb, and firmly anchored in locations and at heights indicated.
- b. Grab Bars: Install to withstand a downward load of at least **250 lbf (1112 N)**, when tested according to method in ASTM F 446.

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SECTION 10 28 13 13a - DETENTION TOILET ACCESSORIES

1.1 GENERAL

A. Description Of Work

1. This specification covers the furnishing and installation of materials for detention toilet accessories. Product shall be as follows or as directed by the Owner. Installation procedures shall be in accordance with the product manufacturer's recommendations. Demolition and removal of materials shall be as required to support the work.

B. Summary

1. Section Includes:
 - a. Safety hooks.
 - b. Shelves.
 - c. Combination shelves with safety hooks.
 - d. Miscellaneous toilet accessories.
 - e. Stainless-steel mirrors.
 - f. Grab bars.
 - g. Shower seats.

C. Submittals

1. Product Data: For each type of product indicated.
2. LEED Submittals:
 - a. Product Data for Credit EQ 4.1: For security sealants, including printed statement of VOC content.
3. Samples: For each type of detention toilet accessory indicated.
4. Product Schedule: Indicate types, quantities, sizes, and installation locations by room.
5. Coordination Drawings: Drawings showing location of each built-in anchor supporting detention toilet accessories, including anchors to be installed as work of other Sections, drawn to scale and coordinating anchorage with detention toilet accessories.
6. Welding certificates.
7. Maintenance data.
8. Warranties: Sample of special warranties.
9. Other Informational Submittals:
 - a. Examination reports documenting inspection of substrates, areas, and conditions.
 - b. Anchor inspection reports documenting inspections of built-in and cast-in anchors.
 - c. Field quality-control certification signed by Contractor and Detention Specialist.

D. Quality Assurance

1. Welding Qualifications: Qualify procedures and personnel according to the following:
 - a. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
 - b. AWS D1.3, "Structural Welding Code - Sheet Steel."
 - c. AWS D1.6, "Structural Welding Code - Stainless Steel."
2. Preinstallation Conference: Conduct conference at Project site.
3. Coordination Meetings: Conduct coordination meetings at Project site to comply with requirements in Division 01 Section "Special Project Procedures For Detention Facilities".

E. Warranty

1. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace detention toilet accessories that fail in materials or workmanship within two years from date of Final Completion.

1.2 PRODUCTS

A. Materials

1. Cold-Rolled Steel Sheet: ASTM A 1008/A 1008M, CS (Commercial Steel), Type B.
2. Metallic-Coated Steel Sheet: ASTM A 653/A 653M, CS (Commercial Steel), Type B; with **G60 (Z180)** zinc (galvanized) coating designation.
3. Stainless-Steel Sheet: ASTM A 666 or ASTM A 240/A 240M, austenitic stainless steel, Type 304; Type 430 for mirrors.
4. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.
5. Concealed Bolts: ASTM A 307, Grade A unless otherwise indicated.
6. Cast-in-Place Anchors in Concrete: Anchors of type indicated below, fabricated from corrosion-resistant materials capable of sustaining, without failure, a load equal to 4 times the load imposed, as determined by testing per ASTM E 488, conducted by a qualified independent testing agency.
 - a. Threaded or wedge type; galvanized ferrous castings, either ASTM A 47/A 47M malleable iron or ASTM A 27/A 27M cast steel. Provide bolts, washers, and shims as needed, hot-dip galvanized per ASTM A 153/A 153M.
7. Embedded Plate Anchors: Fabricated from steel shapes and plates, minimum **3/16 inch (4.8 mm)** thick; with minimum **1/2-inch- (12.7-mm-)** diameter headed studs welded to back of plate.
8. Proprietary Built-in Masonry Anchors: Fabricated from **0.134-inch (3.41-mm)** nominal-thickness steel sheet **OR 1/4-inch (6.3-mm)** nominal-thickness steel plate **OR 1/2-inch (12.7-mm)** nominal-thickness steel plate, **as directed**, into **6-inch- (152-mm-)** **OR 8-inch- (203-mm-)**, **as directed**, deep blocks matching size of concrete masonry units; with weld nuts attached on inside to receive field-bolted attachments, **as directed**.
 - a. Finish: Factory primed for field painting for anchors with field-welded attachments **OR** Polyester powder coat for anchors with bolted attachments **OR** Epoxy paint for anchors with bolted attachments, **as directed**.
9. Welding Rods and Bare Electrodes: Select according to AWS specifications.

B. Security Sealants

1. Manufacturer's standard, high-modulus, nonsag, two-part, pick-proof, epoxy sealant, with a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24), recommended for sealing nonmoving interior joints in security applications.

C. Security Fasteners

1. Fasteners that are operable only by tools produced by fastener manufacturer or other licensed fabricator for use on specific type of fastener.
2. Provide drive-system type, head style, material, and protective coating as required for assembly, installation, and strength, and as follows:
 - a. Drive-System Types: Pinned Torx-Plus **OR** Pinned Torx, **as directed**.
 - b. Fastener Strength: **120,000 psi (827 MPa)**.
 - c. Socket Button Head Fasteners:
 - 1) Heat-treated alloy steel, **ASTM F 835 (ASTM F 835M)**.
 - 2) Stainless steel, **ASTM F 879 (ASTM F 879M)**, Group 1 CW.
 - d. Socket Flat Countersunk Head Fasteners:
 - 1) Heat-treated alloy steel, **ASTM F 835 (ASTM F 835M)**.
 - 2) Stainless steel, **ASTM F 879 (ASTM F 879M)**, Group 1 CW.
 - e. Socket Head Cap Fasteners:
 - 1) Heat-treated alloy steel, **ASTM A 574 (ASTM A 574M)**.
 - 2) Stainless steel, **ASTM F 837 (ASTM F 837M)**, Group 1 CW.
 - f. Protective Coatings for Heat-Treated Alloy Steel:
 - 1) Zinc and clear trivalent chromium, where indicated.
 - 2) Zinc phosphate with oil, ASTM F 1137, Grade I, or black oxide unless otherwise indicated.

D. Detention Safety Hooks

1. Individual, Curved, Detention Safety Hook: **0.188-inch (4.77-mm)** nominal-thickness, stainless-steel curved hook held by **0.141-inch- (3.58-mm-)** **OR** **0.109-inch- (2.77-mm-)**, **as directed**, thick, stainless-steel bracket punched with not less than 2 holes for fastening with security fastener. Provide friction washer assembly, adjustable with a nonremovable security screw that maintains pressure on hook and allows hook to pivot when load exceeds preset limit. Provide No. 4 finish.
2. Individual, Straight, Detention Safety Hook: **3/8-inch- (9.5-mm-)** **OR** **1/4-inch- (6.3-mm-)**, **as directed**, diameter, stainless-steel straight hook held by **0.109-inch- (2.77-mm-)** **OR** **0.078-inch- (1.98-mm-)**, **as directed**, thick, stainless-steel mounting plate approximately **4 inches (102 mm)** square. Provide pivoting assembly that maintains pressure on hook and snaps down when load exceeds **8 lbf (35.6 N)**. Provide No. 4 finish.
 - a. Mounting: Front mounting with security fasteners **OR** Chase mounting with welded anchor nuts on backplate, **as directed**.
3. Multiple, Curved, Safety Hook Strip: Minimum **5-1/2-inch- (140-mm-)** high backplate by length indicated, formed from **0.125-inch- (3.18-mm-)** **OR** **0.109-inch- (2.77-mm-)** **OR** **0.078-inch- (1.98-mm-)**, **as directed**, thick, stainless-steel sheet. Provide **0.188-inch- (4.77-mm-)** thick, stainless-steel hooks attached to backplate; with each hook having a friction washer assembly, adjustable with a nonremovable security screw that maintains pressure on hook and allows hook to pivot when load exceeds preset limit. Provide No. 4 finish.
 - a. Configuration: **16 inches (406 mm)** long with 2 hooks **OR** **18 inches (457 mm)** long with 4 hooks **OR** **21 inches (533 mm)** long with 4 hooks **OR** **24 inches (610 mm)** long with 3 hooks **OR** **32 inches (813 mm)** long with 4 hooks, **as directed**.
 - b. Mounting: Front mounting with security fasteners **OR** Chase mounting with welded anchor nuts on backplate, **as directed**.
4. Multiple, Straight, Safety Hook Strip: Minimum **5-1/2-inch- (140-mm-)** high backplate by length indicated, formed from **0.141-inch- (3.58-mm-)** **OR** **0.109-inch- (2.77-mm-)** **OR** **0.078-inch- (1.98-mm-)**, **as directed**, thick, stainless-steel sheet. Provide **3/8-inch- (9.5-mm-)** **OR** **1/4-inch- (6.3-mm-)**, **as directed**, diameter, stainless-steel straight hooks attached to backplate. Provide pivoting assembly that maintains pressure on hook and snaps down when load exceeds **8 lbf (35.6 N)**. Provide No. 4 finish.
 - a. Configuration: **16 inches (406 mm)** long with 2 hooks **OR** **18 inches (457 mm)** long with 4 hooks **OR** **24 inches (610 mm)** long with 3 hooks **OR** **32 inches (813 mm)** long with 4 hooks, **as directed**.
 - b. Mounting: Front mounting with security fasteners **OR** Chase mounting with welded anchor nuts on backplate, **as directed**.

E. Detention Shelves

1. Surface-Mounted, Steel Detention Shelf: Minimum **6 inches high by 8 inches (152 mm high by 203 mm)** deep by **16 inches (406 mm)** **OR** **24 inches (610 mm)** **OR** **32 inches (813 mm)**, **as directed**, long; formed from **0.138-inch (3.50-mm)** **OR** **0.108-inch (2.74-mm)**, **as directed**, nominal-thickness, metallic-coated steel sheet; with welded side gussets and minimum **1-inch (25.4-mm)** flanged front edge; with back punched for fastening to wall with security fasteners. Provide factory priming for field-painted **OR** baked-enamel, **as directed**, finish.
2. Surface-Mounted, Stainless-Steel Detention Shelf: Minimum **5-1/2 inches high by 8 inches (140 mm high by 203 mm)** deep by **18 inches (457 mm)** **OR** **24 inches (610 mm)**, **as directed**, long; formed from **0.078-inch- (1.98-mm-)** thick, stainless-steel sheet; with welded side gussets and hemmed front edge. Provide No. 4 finish.
 - a. Mounting: Front mounting with security fasteners **OR** Chase mounting with welded anchor nuts on backplate, **as directed**.
3. Recessed Detention Shelf: Minimum inside dimensions of **16 inches (406 mm)** wide by **5 inches high by 4 inches (127 mm high by 102 mm)** deep; formed from **0.062-inch- (1.57-mm-)** thick, stainless-steel sheet; with **1-inch- (25.4-mm-)** wide flanged front edge. Secure to wall with rear-mounting steel strap and adjustment bolts. Provide No. 4 finish.

F. Combination Detention Shelves With Safety Hooks



1. Steel Detention Shelf with Multiple, Curved Safety Hooks: Minimum **6 inches high by 8 inches (152 mm high by 203 mm)** deep by length indicated, formed from **0.138-inch (3.50-mm) OR 0.108-inch (2.74-mm)**, **as directed**, nominal-thickness, metallic-coated steel sheet, with welded side gussets and hemmed or flanged front edge. Provide **0.138-inch (3.50-mm)** nominal-thickness, zinc-plated-steel curved hooks held by **0.1265-inch- (3.21-mm-)** thick steel brackets welded to backplate, with each hook having a friction washer assembly, adjustable with a nonremovable security screw that maintains pressure on hook and allows hook to pivot when load exceeds preset limit. Provide factory priming for field-painted **OR** baked-enamel, **as directed**, finish.
 - a. Configuration: **16 inches (406 mm)** long with 2 hooks **OR 24 inches (610 mm)** long with 3 hooks **OR 32 inches (813 mm)** long with 4 hooks, **as directed**.
 - b. Mounting: Front mounting with security fasteners **OR** Chase mounting with welded anchor nuts on backplate, **as directed**.
 2. Stainless-Steel Detention Shelf with Multiple, Curved Safety Hooks: Minimum **5-1/2 inches high by 8 inches (140 mm high by 203 mm)** deep by length indicated; formed from **0.078-inch- (1.98-mm-)** thick, stainless-steel sheet; with welded side gussets and hemmed or flanged front edge. Provide **0.141-inch (3.58-mm)** stainless-steel curved hooks held by **0.141-inch- (3.58-mm-)** thick stainless-steel brackets welded to backplate, with each hook having a friction washer assembly, adjustable with a nonremovable security screw that maintains pressure on hook and allows hook to pivot when load exceeds preset limit. Provide No. 4 finish.
 - a. Configuration: **16 inches (406 mm)** long with 2 hooks **OR 18 inches (457 mm)** long with 4 hooks **OR 24 inches (610 mm)** long with 3 hooks **OR 32 inches (813 mm)** long with 4 hooks, **as directed**.
 - b. Mounting: Front mounting with security fasteners **OR** Chase mounting with welded anchor nuts on backplate, **as directed**.
 3. Stainless-Steel Detention Shelf with Multiple, Straight Safety Hooks: Minimum **5-1/2 inches high by 8 inches (140 mm high by 203 mm)** deep by length indicated; formed from **0.078-inch- (1.98-mm-)** thick, stainless-steel sheet; with welded side gussets and hemmed or flanged front edge. Provide **3/8-inch- (9.5-mm-) OR 1/4-inch- (6.3-mm-)**, **as directed**, diameter, stainless-steel straight hooks held by **0.109-inch- (2.77-mm-) OR 0.078-inch- (1.98-mm-)**, **as directed**, thick, stainless-steel mounting plate. Provide pivoting assembly that maintains pressure on hook and snaps down when load exceeds **8 lbf (35.6 N)**. Provide No. 4 finish.
 - a. Configuration: **16 inches (406 mm)** long with 2 hooks **OR 18 inches (457 mm)** long with 4 hooks **OR 24 inches (610 mm)** long with 3 hooks **OR 32 inches (813 mm)** long with 4 hooks, **as directed**.
 - b. Mounting: Front mounting with security fasteners **OR** Chase mounting with welded anchor nuts on backplate, **as directed**.
- G. Miscellaneous Detention Toilet Accessories
1. Recessed, Detention Toilet Tissue Dispenser: Minimum **5-inch diameter by 4-1/2 inches (127-mm diameter by 114 mm)** deep; formed from **0.062-inch- (1.57-mm-)** thick, stainless-steel sheet. Secure to wall with rear-mounting steel strap and adjustment bolts. Provide No. 4 finish.
 - a. Face: **1-inch (25.4-mm)** lip around entire face **OR 7-inch- (178-mm-)** square face flange, **as directed**.
 2. Recessed, Detention Soap Dish: Minimum inside dimensions of **5-3/4 inches wide by 4-1/2 inches high by 2-1/2 inches (146 mm wide by 114 mm high by 64 mm)** deep with **3/4-inch (19-mm)** lip around entire face; formed from **0.062-inch- (1.57-mm-) OR 0.050-inch- (1.27-mm-)**, **as directed**, thick, stainless-steel sheet. Secure to wall with rear-mounting steel strap and adjustment bolts. Provide No. 4 finish.
- H. Detention Mirrors
1. Small, Framed Detention Mirror: Approximately **9-1/2 inches wide by 11 inches (241 mm wide by 279 mm)** high; formed from **0.038-inch- (0.95-mm-)** thick, stainless-steel sheet with fiberboard backing; enclosed in a frame formed from **0.064-inch (1.63-mm)** nominal-thickness, zinc-plated

- steel sheet; with round corners. Fabricate frame with welded and ground corners or from one piece of metal. Provide No. 8 **OR** 4, **as directed**, finish for mirror, chrome plating for frame.
- a. Mounting: Front mounting with security fasteners to **0.168-inch (4.27-mm)** nominal-thickness, metallic-coated steel mounting plate **OR** Chase mounting with welded anchor nuts on backplate, **as directed**.
2. Small, Integrally Framed Detention Mirror: Approximately **9-1/2 inches wide by 11 inches (241 mm wide by 279 mm)** high; with mirror and integral frame formed from a single sheet of **0.038-inch- (0.95-mm-) OR 0.062-inch- (1.57-mm-), as directed**, thick stainless steel; with round corners. Provide No. 8 **OR** 4, **as directed**, finish for mirror, chrome plating for frame.
 - a. Mounting: Front mounting with security fasteners to **0.168-inch (4.27-mm)** nominal-thickness, metallic-coated steel mounting plate **OR** Chase mounting with welded anchor nuts on backplate, **as directed**.
 3. Large, Framed Detention Mirror with Square Corners: Minimum **11 inches wide by 16 inches (279 mm wide by 406 mm)** high; formed from **0.038-inch- (0.95-mm-) OR 0.078-inch- (1.98-mm-), as directed**, thick, stainless-steel sheet with fiberboard backing and No. 8 **OR** No. 4, **as directed**, finish; enclosed in a metal frame.
 - a. Frame: Formed from **0.064-inch (1.63-mm)** nominal-thickness, chrome-plated steel **OR 0.062-inch- (1.57-mm-) thick, stainless-steel OR 0.078-inch- (1.98-mm-) thick, stainless-steel, as directed**, sheet. Fabricate frame with welded and ground corners or from one piece of metal.
 - b. Mounting: Front mounting with security fasteners to **0.168-inch (4.27-mm)** nominal-thickness, metallic-coated steel mounting plate **OR** Chase mounting with welded anchor nuts on backplate, **as directed**.
 4. Large, Framed Detention Mirror with Round Corners: Minimum **11 inches wide by 16 inches (279 mm wide by 406 mm)** high, formed from a single sheet of **0.038-inch- (0.95-mm-) OR 0.078-inch- (1.98-mm-), as directed**, thick stainless steel with No. 8 **OR** No. 4, **as directed**, finish; enclosed in a metal frame.
 - a. Frame: Formed from **0.064-inch (1.63-mm)** nominal-thickness, chrome-plated steel **OR 0.078-inch- (1.98-mm-) thick, stainless-steel, as directed**, sheet. Fabricate frame with welded and ground corners or from one piece of metal.
 - b. Mounting: Front mounting with security fasteners to **0.168-inch (4.27-mm)** nominal-thickness, metallic-coated steel mounting plate **OR** Chase mounting with welded anchor nuts on backplate, **as directed**.
 5. Large, Integrally Framed Detention Mirror with Round Corners: Minimum **11 inches wide by 16 inches (279 mm wide by 406 mm)** high; with mirror and integral frame formed from **0.038-inch- (0.95-mm-) OR 0.062-inch- (1.57-mm-) OR 0.078-inch- (1.98-mm-), as directed**, thick, stainless-steel sheet; with round corners. Provide No. 8 **OR** 4, **as directed**, finish for mirror, chrome plating for frame.
 - a. Mounting: Front mounting with security fasteners to **0.168-inch (4.27-mm)** nominal-thickness, metallic-coated steel mounting plate **OR** Chase mounting with welded anchor nuts on backplate, **as directed**.
- I. Detention Grab Bars
1. Grab Bars: **1-1/2 inches (38.1 mm)** in diameter; formed from **0.038-inch- (0.95-mm-) thick, stainless-steel tubing, with 3-inch- (76.2-mm-) diameter flanges formed from 0.125-inch- (3.18-mm-) thick, stainless steel. Closure plates formed from 0.125-inch- (3.18-mm-) thick, stainless steel. All-welded construction. Provide No. 4 finish.**
 - a. Length: As indicated on Drawings **OR 36 inches (914 mm) long, as directed**.
 - b. Mounting: Front mounting with security fasteners **OR** Chase mounting with welded anchor nuts on backplate, **as directed**.
- J. Detention Shower Seats
1. Shower Seats: Double-pan retractable, recessed shower seat with recessed handle. Approximately **16-inch by 16-inch (406-mm by 406-mm)** overall size formed from **0.062-inch- (1.57-mm-) OR 0.078-inch- (1.98-mm-), as directed**, thick, stainless-steel sheet. Seat pivots on



solid **0.375-inch- (9.5-mm-)** diameter stainless-steel rod and self-latches when closed. Minimum **750 lb. (340 kg)** loading capacity. Provide No. 4 finish.

K. Fabrication

1. Coordinate dimensions and attachment methods of detention toilet accessories with those of adjoining construction to produce integrated assemblies with closely fitting joints and with edges and surfaces aligned unless otherwise indicated.
2. Shear and punch metals cleanly and accurately. Remove burrs.
3. Form edges and corners to be free of sharp edges and rough areas. Fold back exposed edges of unsupported sheet metal to form a **1/2-inch- (12.7-mm-)** wide hem on the concealed side, or ease edges to a radius of approximately **1/32 inch (0.8 mm)** and support with concealed stiffeners.
4. Form metal in maximum lengths to minimize joints. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing work.
5. Weld corners and seams continuously to comply with referenced AWS standard and the following:
 - a. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
 - b. Obtain fusion without undercut or overlap.
 - c. Remove welding flux immediately.
 - d. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.
 - e. Weld before finishing components to greatest extent possible. Remove weld spatter and welding oxides from exposed surfaces by descaling or grinding.
6. Provide for anchorage of type indicated; coordinate with supporting structure. Fabricate and space anchoring devices to secure detention toilet accessories rigidly in place and to support expected loads. Build in straps, plates, and brackets as needed to support and anchor fabricated items to adjoining construction. Reinforce formed-metal units as needed to attach and support other construction.
7. Cut, reinforce, drill, and tap detention toilet accessories to receive hardware, security fasteners, and similar items.
8. Form exposed work true to line and level with accurate angles and surfaces. Grind off and ease edges unless otherwise indicated.
9. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners where possible. Use exposed security fasteners of type indicated or, if not indicated, flat-head (countersunk) security fasteners. Locate joints where least conspicuous.

L. Finishes

1. Finish detention toilet accessories after assembly.
2. Steel Finishes:
 - a. Surface Preparation: Remove mill scale and rust, if present, from uncoated steel, complying with SSPC-SP 5/NACE No. 1, "White Metal Blast Cleaning," or SSPC-SP 8, "Pickling."
 - b. Factory Priming for Field-Painted Finish: Apply manufacturer's standard prime coat immediately after surface preparation and pretreatment.
 - c. Baked-Enamel Finish: Immediately after cleaning and pretreating, apply manufacturer's standard two-coat, baked-enamel finish consisting of prime coat and thermosetting topcoat. Comply with paint manufacturer's written instructions for applying and baking to achieve a minimum dry film thickness of **1.2 mils (0.03 mm)**.
 - 1) Color and Gloss: As indicated by manufacturer's designations **OR** Match sample **OR** As selected from manufacturer's full range, **as directed**.
 - d. Chromium Plating: ASTM B 456, Service Condition Number SC 2 (moderate service), nickel plus chromium electrodeposited on base metal.
3. Stainless-Steel Finishes: Remove tool and die marks and stretch lines or blend into finish.

- a. Grind and polish surfaces to produce uniform, directionally textured, polished finish indicated, free of cross scratches. Run grain with long dimension of each piece.
- b. When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.

1.3 EXECUTION

A. Installation

1. Fastening to In-Place Construction: Provide anchorage devices and fasteners where necessary for securing detention toilet accessories to in-place construction. Include threaded fasteners for concrete and masonry inserts, security fasteners, and other connectors.
2. Provide temporary bracing or anchors in formwork for items that are to be built into concrete or masonry or similar construction.
3. Apply security sealant around perimeter in a continuous ribbon on back of detention toilet accessories before installation.
4. Security Fasteners: Install detention toilet accessories using security fasteners with head style appropriate for installation requirements, strength, and finish of adjacent materials. Provide stainless-steel security fasteners in stainless-steel materials, **as directed**.

B. Field Quality Control

1. Inspect installed products to verify compliance with requirements. Prepare inspection reports and indicate compliance with and deviations from the Contract Documents.
2. Remove and replace detention work where inspections indicate that work does not comply with specified requirements.
3. Perform additional inspections to determine compliance of replaced or additional work. Prepare inspection reports.
4. Prepare field quality-control certification that states installed products and their installation comply with requirements in the Contract Documents.

C. Adjusting And Cleaning

1. Remove temporary labels and protective coatings.
2. Adjust safety hooks to release with application of **8-lbf (35.6-N)** load.
3. Painting: Immediately after erection, clean bolted connections and abraded areas of shop paint, and paint exposed areas with same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.
4. Touchup Painting: Cleaning and touchup painting of bolted connections and abraded areas of shop paint are specified in Division 07..

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Task	Specification	Specification Description
10 28 13 13	01 22 16 00	No Specification Required
10 28 13 63	10 28 13 13	Toilet And Bath Accessories
10 28 13 63	10 28 13 13a	Detention Toilet Accessories

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SECTION 10 28 16 13 - BATH ACCESSORIES

DESCRIPTION OF WORK

This specification covers the furnishing and installation of materials for bath accessories. Products shall be as directed by the Owner. Installation procedures shall be in accordance with the product manufacturer's recommendations. Demolition and removal of materials shall be as required to support the work.

GENERAL

Definitions

1. Supply and Delivery Only: Include supply and delivery to site(s) FOB destination freight prepaid. Unless otherwise specified or scheduled, unloading and handling at site is by the Owner.

Submittals

2. Product Data.
3. Shop Drawings.
4. Quality Assurance/Control Submittals:
 - a. Certificates: Submit manufacturer's written self certification that bath accessories meet or exceed specified requirements.

Quality Assurance

5. Regulatory Requirements: Comply with following:
 - a. Accessibility:
 - 1) Architectural Barriers Act of 1968 as amended (42 USC 4152-4157) and HUD implementing regulations (24 CFR Part 40).
 - a) Uniform Federal Accessibility Standards (UFAS).
 - 2) Section 504 of the Rehabilitation Act of 1973 as amended (29 USC 794) and HUD implementing regulations 24 CFR Part 8.
 - 3) Fair Housing Accessibility Guidelines (24 CFR Chapter 1).
 - 4) Americans with Disabilities Act of 1990 (ADA) (28 CFR Part 35).
6. Mock-ups: Install one complete mock-up of bath accessories in each typical bathroom installation. Comply with Detailed Scope of Work for bathroom renovation mock-up requirements.
 - a. Locations: As directed.
 - b. Approved Mock-ups: Standard for rest of work.
 - c. Approved Mock-ups: May remain part of completed project.

Scheduling

7. Scheduling and Completion: Comply with requirements of Detailed Scope of Work.

PRODUCTS

Bath Accessories

8. Ceramic Soap Dishes at Ceramic Tile Bathtub Surround: See Division 9 Section "Ceramic Tile."
9. Metal Soap Dishes at Porcelain Steel Bathtub Surround:
 - a. Recessed: FS WW-P-541/8B, Type VI, Class 2, heavy duty satin stainless steel.
 - b. Fastenings: Plated expansion toggle or molly bolts, lead anchors or as required by existing wall conditions.



10. Safety Grab Bars: Type 304 stainless steel, minimum 32 mm (1-1/4 inch) OD, maximum 38 mm (1-1/2 inch) OD, 1.2 mm (18 gage) wall thickness in accordance with Uniform Federal Accessibility Standards (UFAS).
 - a. Grab Bar Posts: Stainless steel.
 - b. Post Flanges: Diameter of not less than 68 mm (2-11/16 inches) with center line of screw holes located minimum 13 mm (1/2 inch) from edges of flange.
11. Shower Curtains and Rods: By Bobrick Washroom Equipment, McKinney/Parker, or Leigh Products, or approved equal:
 - a. Rods: Type 304 stainless steel, satin finish, adjustable length type to fit bathtub length, minimum 25 mm (1 inch) OD, minimum 1.0 mm (20 gage) wall thickness, similar to Bobrick No. B-6107 or McKinney/Parker No. 267.
 - b. Flanges: Chrome plated cast brass or stainless steel.
 - c. Shower Curtains: FS L-C-780a, Style I, opaque, matte white vinyl 0.2 mm (0.008 inch) thick, 1 829 mm (72 inches) by 1 829 mm (72 inches) high.
 - 1) Curtains: Germ proof, bacteria proof, and mildew resistant.
 - 2) Curtains: Similar to Bobrick No. 204-2 or McKinney/Parker No. 268SC.
 - d. Curtain Hooks: Stainless steel, Type 304 or nickel plated brass wire, similar to Bobrick No. 204-1 or McKinney/Parker No. 269SH. Provide 12 hooks per curtain.
12. Other Bathroom Accessories: FS WW-P-541/8B, Type 304 stainless steel, satin finish, by Bobrick Washroom Equipment, McKinney/Parker, or Leigh Products, or approved equal:
 - a. Surface Mounted:
 - 1) Medicine Cabinets: Type III, Class 2, Style S, swinging door, minimum 381 mm (15 inches) wide by 610 mm (24 inches) high. Provide complete with magnetic catch, three adjustable shelves, and full length mirror.
 - 2) Towel Bars: Type IV, Class 1, square bar, 610 mm (24 inches) long.
 - 3) Toilet Paper Holders: Type I, Class 1, Mounting S, Style A.
 - 4) Tumbler and Toothbrush Holders: Type VI, Class 4.
 - 5) Lavatory Soap Dishes: Type VI, Class 1.
 - 6) Robe hooks.
 - b. Recessed:
 - 1) Medicine Cabinets: Type III, Class 2, Style R, enamel painted steel, swinging door, minimum 381 mm (15 inches) wide by 610 mm (24 inches) high. Provide complete with magnetic catch, three adjustable shelves, and full length mirror.
 - 2) Toilet Paper Holders: Type I, Class 1, Style K.
 - 3) Lavatory Soap Dishes: Type VI, Class 2.
13. Window Curtains and Rods: Provide over bathroom window openings.
 - a. Rods: Solid steel with brass finish, minimum 10 mm (3/8 inch) diameter.
 - b. Rod Brackets: Two brass-finished brackets with open tops and brass finish.
 - c. Window Curtains: FS L-C-780a, Style II, opaque, matte white vinyl 0.2 mm (0.008 inch) thick.
 - 1) Curtains : Germ proof, bacteria proof, and mildew resistant.
 - 2) Size: To fit bathroom windows.
14. Joint Sealant: Mildew resistant one-component silicone; FS TT-S-001543A, Class A; ASTM C 920, Type S, Grade NS, Class 25, Uses NT, G, and A.
 - a. Color: As selected from manufacturer's standard line.

EXECUTION

Examination

15. Site Verification of Conditions:
 - 1) Field Measurements: Verify field measurements.
 - 2) Existing Conditions: Ensure proper openings and blocking have been installed.

Installation

16. General: Install accessories rigidly and securely to blocking in walls using methods and materials recommended by manufacturer.
 - a. Locations and Mounting Heights: As indicated or directed.
 - b. Comply with Regulatory Requirements.
17. Bath Accessories: Securely install flanges for bath accessories and window curtain rods in accordance with manufacturer's recommendations and approved Shop Drawing.
 - a. Safety Grab Bars: Install 100 mm (4 inch) by 100 mm (4 inch) perforated 1.2 mm (18 gage) galvanized steel plates at each post, flush to wall, by using toggle bolts, molly bolts, or anchors as required by conditions.
 - 1) After installation of wall finish, secure each grab bar flange to perforated plates through wall finish with three - 6 mm (1/4 inch) chrome plated machine screws, screwed into threaded sleeves or tee nuts welded to plates.
 - b. Shower Curtains and Rods: Mount flanges to existing wall with approved expansion type inserts and chrome plated or stainless steel wood screws.
18. Bath Accessories at Bathroom with Porcelain Steel Surround:
 - a. Metal Soap Dishes: Mount to new porcelain enamel panels and anchored securely to existing walls using approved mechanical fastenings.
 - 1) Waterproof with joint sealant between surround panel and dishes.
 - b. China Soap Dishes: Anchor securely, using approved mechanical fastening.
 - c. Safety Grab Bars: After installation of wall panels, secure each grab bar flange to perforated plates through panels with three - 6 mm (1/4 inch) chrome plated machine screws, screwed into threaded sleeves or tee nuts welded to plates.

Cleaning

19. Cleaning: Comply with requirements of Detailed Scope of Work.

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Task	Specification	Specification Description
10 28 16 13	10 28 13 13	Toilet And Bath Accessories
10 28 16 13	10 28 13 13a	Detention Toilet Accessories

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SECTION 10 28 19 16 - PLUMBING FIXTURES

1.1 GENERAL

A. Description Of Work

1. This specification covers the furnishing and installation of materials for plumbing fixtures. Products shall be as follows or as directed by the Owner. Installation procedures shall be in accordance with the products manufacturer's recommendations. Demolition and removal of materials shall be as required to support the work.

B. Summary

1. This Section includes the following conventional plumbing fixtures and related components:
 - a. Faucets for lavatories, bathtubs, bathtub/showers, showers, and sinks.
 - b. Laminar-flow faucet-spout outlets.
 - c. Flushometers.
 - d. Toilet seats.
 - e. Protective shielding guards.
 - f. Fixture supports.
 - g. Interceptors.
 - h. Shower receptors.
 - i. Dishwasher air-gap fittings.
 - j. Disposers.
 - k. Hot-water dispensers.
 - l. Water closets.
 - m. Urinals.
 - n. Bidets.
 - o. Lavatories.
 - p. Commercial sinks.
 - q. Shampoo bowls.
 - r. Wash fountains.
 - s. Bathtubs.
 - t. Individual showers.
 - u. Group showers.
 - v. Whirlpool bathtubs.
 - w. Kitchen sinks.
 - x. Service sinks.
 - y. Service basins.
 - z. Laundry trays.
 - aa. Sacristy sinks.

C. Definitions

1. ABS: Acrylonitrile-butadiene-styrene plastic.
2. Accessible Fixture: Plumbing fixture that can be approached, entered, and used by people with disabilities.
3. Cast Polymer: Cast-filled-polymer-plastic material. This material includes cultured-marble and solid-surface materials.
4. Cultured Marble: Cast-filled-polymer-plastic material with surface coating.
5. Fitting: Device that controls the flow of water into or out of the plumbing fixture. Fittings specified in this Section include supplies and stops, faucets and spouts, shower heads and tub spouts, drains and tailpieces, and traps and waste pipes. Piping and general-duty valves are included where indicated.
6. FRP: Fiberglass-reinforced plastic.
7. PMMA: Polymethyl methacrylate (acrylic) plastic.
8. PVC: Polyvinyl chloride plastic.

9. Solid Surface: Nonporous, homogeneous, cast-polymer-plastic material with heat-, impact-, scratch-, and stain-resistance qualities.

D. Submittals

1. Product Data: For each type of plumbing fixture indicated.
2. LEED Submittal:
 - a. Product Data for Credit WE 2, 3.1, and 3.2: Documentation indicating flow and water consumption requirements.
3. Shop Drawings: Diagram power, signal, and control wiring.
4. Operation and maintenance data
5. Warranty: Special warranty specified in this Section.

E. Quality Assurance

1. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
2. Regulatory Requirements: Comply with requirements in ICC A117.1, "Accessible and Usable Buildings and Facilities" **OR** Public Law 90-480, "Architectural Barriers Act"; and Public Law 101-336, "Americans with Disabilities Act", **as directed**; for plumbing fixtures for people with disabilities.
3. Regulatory Requirements: Comply with requirements in Public Law 102-486, "Energy Policy Act," about water flow and consumption rates for plumbing fixtures.
4. NSF Standard: Comply with NSF 61, "Drinking Water System Components--Health Effects," for fixture materials that will be in contact with potable water.
5. Select combinations of fixtures and trim, faucets, fittings, and other components that are compatible.
6. Comply with the following applicable standards and other requirements specified for plumbing fixtures:
 - a. Enameled, Cast-Iron Fixtures: ASME A112.19.1M.
 - b. Plastic Bathtubs: ANSI Z124.1.
 - c. Plastic Lavatories: ANSI Z124.3.
 - d. Plastic Laundry Trays: ANSI Z124.6.
 - e. Plastic Mop-Service Basins: ANSI Z124.6.
 - f. Plastic Shower Enclosures: ANSI Z124.2.
 - g. Plastic Sinks: ANSI Z124.6.
 - h. Plastic Urinal Fixtures: ANSI Z124.9.
 - i. Plastic Whirlpool Bathtubs: ANSI Z124.1 and ASME A112.19.7M.
 - j. Porcelain-Enameled, Formed-Steel Fixtures: ASME A112.19.4M.
 - k. Slip-Resistant Bathing Surfaces: ASTM F 462.
 - l. Solid-Surface-Material Lavatories and Sinks: ANSI/ICPA SS-1.
 - m. Stainless-Steel Commercial, Handwash Sinks: NSF 2 construction.
 - n. Stainless-Steel Residential Sinks: ASME A112.19.3.
 - o. Vitreous-China Fixtures: ASME A112.19.2M.
 - p. Water-Closet, Flush Valve, Tank Trim: ASME A112.19.5.
 - q. Water-Closet, Flushometer Tank Trim: ASSE 1037.
 - r. Whirlpool Bathtub Fittings: ASME A112.19.8M.
7. Comply with the following applicable standards and other requirements specified for lavatory and sink faucets:
 - a. Backflow Protection Devices for Faucets with Side Spray: ASME A112.18.3M.
 - b. Backflow Protection Devices for Faucets with Hose-Thread Outlet: ASME A112.18.3M.
 - c. Diverter Valves for Faucets with Hose Spray: ASSE 1025.
 - d. Faucets: ASME A112.18.1.
 - e. Hose-Connection Vacuum Breakers: ASSE 1011.
 - f. Hose-Coupling Threads: ASME B1.20.7.
 - g. Integral, Atmospheric Vacuum Breakers: ASSE 1001.

- h. NSF Potable-Water Materials: NSF 61.
 - i. Pipe Threads: ASME B1.20.1.
 - j. Sensor-Actuated Faucets and Electrical Devices: UL 1951.
 - k. Supply Fittings: ASME A112.18.1.
 - l. Brass Waste Fittings: ASME A112.18.2.
 8. Comply with the following applicable standards and other requirements specified for bathtub, bathtub/shower, and shower faucets:
 - a. Backflow Protection Devices for Hand-Held Showers: ASME A112.18.3M.
 - b. Combination, Pressure-Equalizing and Thermostatic-Control Antiscald Faucets: ASSE 1016.
 - c. Deck-Mounted Bath/Shower Transfer Valves: ASME 18.7.
 - d. Faucets: ASME A112.18.1.
 - e. Hand-Held Showers: ASSE 1014.
 - f. High-Temperature-Limit Controls for Thermal-Shock-Preventing Devices: ASTM F 445.
 - g. Hose-Coupling Threads: ASME B1.20.7.
 - h. Manual-Control Antiscald Faucets: ASTM F 444.
 - i. Pipe Threads: ASME B1.20.1.
 - j. Pressure-Equalizing-Control Antiscald Faucets: ASTM F 444 and ASSE 1016.
 - k. Sensor-Actuated Faucets and Electrical Devices: UL 1951.
 - l. Thermostatic-Control Antiscald Faucets: ASTM F 444 and ASSE 1016.
 9. Comply with the following applicable standards and other requirements specified for miscellaneous fittings:
 - a. Atmospheric Vacuum Breakers: ASSE 1001.
 - b. Brass and Copper Supplies: ASME A112.18.1.
 - c. Dishwasher Air-Gap Fittings: ASSE 1021.
 - d. Manual-Operation Flushometers: ASSE 1037.
 - e. Plastic Tubular Fittings: ASTM F 409.
 - f. Brass Waste Fittings: ASME A112.18.2.
 - g. Sensor-Operation Flushometers: ASSE 1037 and UL 1951.
 10. Comply with the following applicable standards and other requirements specified for miscellaneous components:
 - a. Disposers: ASSE 1008 and UL 430.
 - b. Dishwasher Air-Gap Fittings: ASSE 1021.
 - c. Flexible Water Connectors: ASME A112.18.6.
 - d. Floor Drains: ASME A112.6.3.
 - e. Grab Bars: ASTM F 446.
 - f. Hose-Coupling Threads: ASME B1.20.7.
 - g. Hot-Water Dispensers: ASSE 1023 and UL 499.
 - h. Off-Floor Fixture Supports: ASME A112.6.1M.
 - i. Pipe Threads: ASME B1.20.1.
 - j. Plastic Shower Receptors: ANSI Z124.2.
 - k. Plastic Toilet Seats: ANSI Z124.5.
 - l. Supply and Drain Protective Shielding Guards: ICC A117.1.
 - m. Whirlpool Bathtub Equipment: UL 1795.
- F. Warranty
1. Special Warranties: Manufacturer's standard form in which manufacturer agrees to repair or replace components of whirlpools that fail in materials or workmanship within specified warranty period.
 - a. Warranty Period for Commercial Applications: One **OR** Three, **as directed**, year(s) from date of Final Completion.
 - b. Warranty Period for Residential Applications of Shells: Five **OR** 20 **OR** 30, **as directed**, years from date of Final Completion.
 - c. Warranty Period for Residential Applications of Pumps and Blowers: Five **OR** 20, **as directed**, years from date of Final Completion.



- d. Warranty Period for Residential Applications of Electronic Controls: Five years from date of Final Completion.

1.2 PRODUCTS

A. Lavatory Faucets

1. Description: Single-control mixing **OR** Single-control nonmixing **OR** Two-handle mixing, **as directed**, valve. Include hot- and cold-water indicators; coordinate faucet inlets with supplies and fixture holes; coordinate outlet with spout and fixture receptor.
 - a. Body Material: Commercial, solid brass **OR** General-duty, solid brass **OR** General-duty, solid brass or copper or brass underbody with brass cover plate **OR** General-duty, copper or brass underbody with brass cover plate **OR** Residential, nonmetallic underbody with brass cover plate **OR** Residential, nonmetallic underbody with nonmetallic cover plate, **as directed**.
 - b. Finish: Polished chrome plate **OR** Polished brass **OR** Nonmetallic, **as directed**.
 - c. Maximum Flow Rate: 0.5 gpm (1.5 L/min.) **OR** 2.2 gpm (8.3 L/min.) **OR** 2.5 gpm (9.5 L/min.), **as directed**.
OR
Maximum Flow: 0.25 gal. (0.95 L).
 - d. Centers: 3-3/8 inches (86 mm) **OR** 4 inches (102 mm) **OR** 6 inches (152 mm) **OR** 8 inches (203 mm) **OR** Single hole **OR** Adjustable, **as directed**.
 - e. Mounting: Deck, exposed **OR** Deck, concealed **OR** Back/wall, exposed **OR** Back/wall, concealed, **as directed**.
 - f. Valve Handle(s): Lever **OR** Knob **OR** Knob, nonmetallic **OR** Cross, four arm **OR** Wrist blade, 4 inches (102 mm) **OR** Elbow, 6 inches (152 mm) **OR** Push button **OR** Not applicable, **as directed**.
 - g. Inlet(s): NPS 3/8 (DN 10) tubing, plain end **OR** NPS 3/8 (DN 10) tubing, with NPS 1/2 (DN 15) male adaptor **OR** NPS 1/2 (DN 15) male shank **OR** NPS 1/2 (DN 15) female shank, **as directed**.
 - h. Spout: Rigid **OR** Swing **OR** Rigid, gooseneck **OR** Swivel, gooseneck, **as directed**, type.
 - i. Spout Outlet: Aerator **OR** Spray **OR** Laminar flow **OR** Plain end **OR** Spray, **0.5 gpm (1.5 L/min.)**, **as directed**.
 - j. Operation: Compression, manual **OR** Noncompression, manual **OR** Sensor **OR** Self-closing, metering, **as directed**.
 - k. Drain: Not required **OR** Pop up **OR** Stopper with chain **OR** Grid **OR** Lift and turn, **as directed**.
 - l. Tempering Device: Mechanical **OR** Thermostatic **OR** Pressure balance **OR** Not required, **as directed**.

B. Bathtub Faucets

1. Description: Single-control mixing **OR** Two-handle mixing **OR** Three-handle mixing **OR** Push-button, metering, nonmixing, **as directed**, valve. Include hot- and cold-water indicators and tub spout. Coordinate faucet inlets with supplies.
 - a. Body Material: Solid brass.
 - b. Finish: Polished chrome plate **OR** Polished brass, **as directed**.
 - c. Mounting: Deck **OR** Exposed, over rim **OR** Wall, **as directed**.
 - d. Valve Handle(s): Lever **OR** Knob **OR** Knob, nonmetallic **OR** Cross, four arm **OR** Not applicable, **as directed**.
 - e. Bathtub Spout: Chrome-plated brass with diverter, **as directed**.
 - f. Operation: Compression, manual **OR** Noncompression, manual **OR** Sensor, **as directed**.
 - g. Supply Connections: NPS 1/2 (DN 15) **OR** NPS 1/2 (DN 15), union **OR** Sweat, **as directed**.

C. Bathtub/Shower Faucets

1. Description: Single-handle pressure-balance **OR** thermostatic **OR** thermostatic/pressure-balance, **as directed**, valve for bathtub and for shower. Include hot- and cold-water indicators; check stops; tub spout; and shower head, arm, and flange. Coordinate faucet inlets with supplies; coordinate outlet with diverter valve.
 - a. Body Material: Solid brass with nonmetallic trim, **as directed**.
 - b. Finish: Polished chrome plate **OR** Polished brass, **as directed**.
 - c. Maximum Flow Rate: 2.5 gpm (9.5 L/min.), unless otherwise indicated.
 - d. Diverter Valve: Integral **OR** Not integral, **as directed**, with mixing valve.
 - e. Mounting: Wall.
 - f. Bathtub Spout: Chrome-plated brass with diverter, **as directed**.
 - g. Operation: Compression, manual **OR** Noncompression, manual **OR** Sensor, **as directed**.
 - h. Antiscald Device: Integral with mixing valve **OR** Separate unit, **as directed**.
 - i. Check Stops: Check-valve type, integral with or attached to body; on hot- and cold-water supply connections.
 - j. Supply Connections: NPS 1/2 (DN 15) **OR** NPS 1/2 (DN 15), union **OR** Sweat, **as directed**.
 - k. Backflow Protection Device for Hand-Held Shower: Required **OR** Not required, **as directed**.
 - l. Shower Head Type: Ball joint **OR** Without ball joint **OR** Ball joint and head integral with mounting flange **OR** Integral with mounting flange **OR** Hand held, slide-bar mounted **OR** Hand held, hook mounted, **as directed**.
 - m. Shower Head Material: Metallic **OR** Nonmetallic **OR** Combined, metallic and nonmetallic, **as directed**, with chrome-plated finish.
 - n. Spray Pattern: Fixed **OR** Adjustable, **as directed**.
 - o. Integral Volume Control: Required **OR** Not required, **as directed**.
 - p. Shower-Arm Flow-Control Fitting: Not required **OR** 1.5 gpm (5.7 L/min.) **OR** 2.0 gpm (7.6 L/min.), **as directed**.
- D. Shower Faucets
 1. Description: Single-handle pressure-balance **OR** thermostatic **OR** thermostatic and pressure-balance, **as directed**, valve. Include hot- and cold-water indicators; check stops; and shower head, arm, and flange. Coordinate faucet inlets with supplies and outlet with diverter valve.
 - a. Body Material: Solid brass with nonmetallic trim, **as directed**.
 - b. Finish: Polished chrome plate **OR** Polished brass, **as directed**.
 - c. Maximum Flow Rate: 2.5 gpm (9.5 L/min.), unless otherwise indicated.
 - d. Diverter Valve: Not required **OR** Integral with mixing valve **OR** Not integral with mixing valve, **as directed**.
 - e. Mounting: Exposed **OR** Concealed, **as directed**.
 - f. Backflow Protection Device for Hand-Held Shower: Required **OR** Not required, **as directed**.
 - g. Operation: Compression, manual **OR** Noncompression, manual **OR** Sensor, **as directed**.
 - h. Antiscald Device: Integral with mixing valve **OR** Separate unit **OR** Not required, **as directed**.
 - i. Check Stops: Check-valve type, integral with or attached to body; on hot- and cold-water supply connections.
 - j. Supply Connections: NPS 1/2 (DN 15) **OR** NPS 1/2 (DN 15), union **OR** Sweat, **as directed**.
 - k. Shower Head Type: Ball joint **OR** Without ball joint **OR** Ball joint and head integral with mounting flange **OR** Integral with mounting flange **OR** Hand held, slide-bar mounted **OR** Hand held, hook mounted, **as directed**.
 - l. Shower Head Material: Metallic **OR** Nonmetallic **OR** Combined, metallic and nonmetallic, **as directed**, with chrome-plated finish.
 - m. Spray Pattern: Fixed **OR** Adjustable, **as directed**.
 - n. Integral Volume Control: Required **OR** Not required, **as directed**.
 - o. Shower-Arm Flow-Control Fitting: Not required **OR** 1.5 gpm (5.7 L/min.) **OR** 2.0 gpm (7.6 L/min.), **as directed**.



- p. Temperature Indicator: Not required **OR** Integral with faucet, **as directed**.

E. Sink Faucets

1. Description: Kitchen faucet with spray, three-hole fixture **OR** Kitchen faucet with spray, four-hole fixture **OR** Kitchen faucet without spray **OR** Laundry tray faucet **OR** Service sink faucet with stops in shanks, vacuum breaker, hose-thread outlet, and pail hook **OR** Bar sink faucet, **as directed**. Include hot- and cold-water indicators; coordinate faucet inlets with supplies and fixture holes; coordinate outlet with spout and fixture receptor.
 - a. Body Material: Commercial, solid brass **OR** General-duty, solid brass **OR** General-duty, solid brass or copper or brass underbody with brass cover plate **OR** General-duty, copper or brass underbody with brass cover plate **OR** Residential, nonmetallic underbody with brass cover plate **OR** Residential, nonmetallic underbody with nonmetallic cover plate, **as directed**.
 - b. Finish: Polished chrome plate **OR** Polished brass **OR** Nonmetallic **OR** Polished or rough brass **OR** Rough brass, **as directed**.
 - c. Maximum Flow Rate: **2.5 gpm (9.5 L/min.)**, unless otherwise indicated.
 - d. Mixing Valve: Single control **OR** Two-lever handle, **as directed**.
 - e. Backflow Protection Device for Hose Outlet: Required **OR** Not required, **as directed**.
 - f. Backflow Protection Device for Side Spray: Required **OR** Not required, **as directed**.
 - g. Centers: **3-3/8 inches (86 mm)** **OR** **4 inches (102 mm)** **OR** **6 inches (152 mm)** **OR** **8 inches (203 mm)** **OR** Single hole **OR** Adjustable, **as directed**.
 - h. Mounting: Deck **OR** Back/wall, **as directed**, exposed **OR** concealed, **as directed**.
 - i. Handle(s): Lever **OR** Knob **OR** Knob, nonmetallic **OR** Cross, four arm **OR** Wrist blade, **4 inches (102 mm)** **OR** Elbow, **6 inches (152 mm)** **OR** Not applicable, **as directed**.
 - j. Inlet(s): **NPS 3/8 (DN 10)** plain-end tubing **OR** **NPS 3/8 (DN 10)** tubing with **NPS 1/2 (DN 15)** male adapter **OR** **NPS 1/2 (DN 15)** male shank **OR** **NPS 1/2 (DN 15)** female shank, **as directed**.
 - k. Spout Type: Rigid, solid brass **OR** Rigid, solid brass with wall brace **OR** Swing, round tubular **OR** Swing, shaped tube **OR** Swing, solid brass **OR** Rigid gooseneck **OR** Swivel gooseneck, **as directed**.
 - l. Spout Outlet: Aerator **OR** Swivel aerator/spray **OR** Spray **OR** Laminar flow **OR** Hose thread **OR** Plain end, **as directed**.
 - m. Vacuum Breaker: Required **OR** Not required, **as directed**.
 - n. Operation: Compression, manual **OR** Noncompression, manual **OR** Sensor, **as directed**.
 - o. Drain: Not required **OR** Pop up **OR** Stopper with chain **OR** Grid **OR** Lift and turn, **as directed**.

F. Laminar-Flow Faucet-Spout Outlets

1. Description: Chrome-plated-brass faucet-spout outlet that produces non-aerating, laminar stream. Include male or female thread that mates with faucet outlet for attachment to faucets where indicated and flow-rate range that includes flow of faucet.

G. Flushometers

1. Description: Flushometer for urinal-type **OR** water-closet-type, **as directed**, fixture. Include brass body with corrosion-resistant internal components, non-hold-open feature, **as directed**, control stop with check valve, vacuum breaker, copper or brass tubing, and polished chrome-plated finish on exposed parts.
 - a. Internal Design: Diaphragm **OR** Piston, **as directed**, operation.
 - b. Style: Exposed **OR** Concealed, **as directed**.
 - c. Inlet Size: **NPS 3/4 (DN 20)** **OR** **NPS 1 (DN 25)**, **as directed**.
 - d. Trip Mechanism: Oscillating, lever-handle actuator **OR** Mechanical, push-button actuator with stainless-steel access plate **OR** Hydraulic, push-button actuator **OR** Foot-pedal actuator **OR** Hard-wired, electric-sensor actuator **OR** Battery-operated sensor actuator, **as directed**.

- e. Consumption: 0.5 gal./flush (1.9 L/flush) **OR** 1.0 gal./flush (3.8 L/flush) **OR** 1.5 gal./flush (5.7 L/flush) **OR** 1.6 gal./flush (6.0 L/flush) **OR** 3.5 gal./flush (13.3 L/flush), **as directed**.
 - f. Tailpiece Size: NPS 3/4 (DN 20) **OR** NPS 1-1/4 (DN 32) **OR** NPS 1-1/2 (DN 40), **as directed**, and standard, **as directed**, length to top of bowl.
- H. Toilet Seats
1. Description: Toilet seat for water-closet-type fixture.
 - a. Material: Molded, solid plastic with antimicrobial agent, **as directed**.
 - b. Configuration: Closed **OR** Open, **as directed**, front with **OR** without, **as directed**, cover.
 - c. Size: Elongated **OR** Regular, **as directed**.
 - d. Hinge Type: CK, check **OR** SS, self-sustaining **OR** SC, self-sustaining, check **OR** SR, self-raising, **as directed**.
 - e. Class: Residential **OR** Standard commercial **OR** Heavy-duty commercial, **as directed**.
 - f. Color: White **OR** Black, **as directed**.
- I. Protective Shielding Guards
1. Protective Shielding Pipe Covers:
 - a. Description: Manufactured plastic wraps for covering plumbing fixture hot-water supply **OR** hot- and cold-water supplies, **as directed**, and trap and drain piping. Comply with Americans with Disabilities Act (ADA) requirements.
 2. Protective Shielding Piping Enclosures:
 - a. Description: Manufactured plastic enclosure for covering plumbing fixture hot- and cold-water supplies and trap and drain piping. Comply with ADA requirements.
- J. Fixture Supports
1. Water-Closet Supports:
 - a. Description: Combination carrier designed for accessible **OR** standard, **as directed**, mounting height of wall-mounting, water-closet-type fixture. Include single or double, vertical or horizontal, hub-and-spigot or hubless waste fitting as required for piping arrangement; faceplates; couplings with gaskets; feet; and fixture bolts and hardware matching fixture. Include additional extension coupling, faceplate, and feet for installation in wide pipe space.
 2. Urinal Supports:
 - a. Description: Type I, urinal carrier with fixture support plates and coupling with seal and fixture bolts and hardware matching fixture **OR** Type II, urinal carrier with hanger and bearing plates, **as directed**, for wall-mounting, urinal-type fixture. Include steel uprights with feet.
 - b. Accessible-Fixture Support: Include rectangular steel uprights.
 3. Lavatory Supports:
 - a. Description: Type I, lavatory carrier with exposed arms and tie rods **OR** Type II, lavatory carrier with concealed arms and tie rod **OR** Type III, lavatory carrier with hanger plate and tie rod, **as directed**, for wall-mounting, lavatory-type fixture. Include steel uprights with feet.
 - b. Accessible-Fixture Support: Include rectangular steel uprights.
 4. Sink Supports:
 - a. Description: Type I, sink carrier with exposed arms and tie rods **OR** Type II, sink carrier with hanger plate, bearing studs, and tie rod **OR** Type III, sink carrier with hanger plate and exposed arms, **as directed**, for sink-type fixture. Include steel uprights with feet.
- K. Interceptors
1. Hair Interceptors:
 - a. Description: Manufactured unit with removable screen or strainer and removable cover; designed to trap and retain hair.
 - 1) Material: Brass **OR** Stainless-steel, **as directed**, body.
 - 2) Pipe Connections: NPS 1-1/4 (DN 32) **OR** NPS 1-1/2 (DN 40), **as directed**.
 2. Sediment Interceptors:



- a. Description: Manufactured unit with removable screens or strainer and removable cover; designed to trap and retain waste material.
 - 1) Material: Cast-iron or steel body with acid-resistant lining and coating **OR** Carbon-steel body with acid-resistant lining and coating **OR** Stainless-steel, **as directed**.
 - 2) Pipe Connections: **NPS 1-1/2 (DN 40) OR NPS 2 (DN 50), as directed**.
- L. Shower Receptors
 - 1. Description: Cast-polymer **OR** FRP **OR** PMMA **OR** Precast-terrazzo **OR** Solid-surface, **as directed**, base for built-up-type shower fixture.
 - 1) Type: Standard, residential **OR** Handicapped/wheelchair, **as directed**.
 - 2) Size: **32 by 32 inches (813 by 813 mm) OR 36 by 36 inches (914 by 914 mm) OR 32 by 42 inches (813 by 1067 mm) OR 48 by 60 inches (1219 by 1524 mm), as directed**.
 - 3) Color: White.
 - 4) Outlet: Cast-in-floor drain **OR** Drain, **as directed**, with **NPS 1-1/2 (DN 40) OR NPS 2 (DN 50) OR NPS 3 (DN 80), as directed**, outlet.
- M. Dishwasher Air-Gap Fittings
 - 1. Description: Fitting suitable for use with domestic dishwashers and for deck mounting; with plastic body, chrome-plated brass cover, **as directed**; and capacity of at least 5 gpm (0.32 L/s); and inlet pressure of at least 5 psig (35 kPa) at a temperature of at least 140 deg F (60 deg C). Include 5/8-inch- (16-mm-) ID inlet and 7/8-inch- (22-mm-) ID outlet hose connections.
 - 2. Hoses: Rubber and suitable for temperature of at least 140 deg F (60 deg C).
 - a. Inlet Hose: 5/8-inch (16-mm) ID and 48 inches (1219 mm) long.
 - b. Outlet Hose: 7/8-inch (22-mm) ID and 48 inches (1219 mm) long.
- N. Disposers
 - 1. Description: Batch-feed **OR** Continuous-feed, **as directed**, household, food-waste disposer. Include reset button; wall switch; corrosion-resistant chamber with jam-resistant, cutlery- or stainless-steel grinder or shredder; **NPS 1-1/2 (DN 40)** outlet; quick-mounting, stainless-steel sink flange; antisplash guard; and combination cover/stopper.
 - a. Type: Batch-feed **OR** Continuous-feed, **as directed**, household.
 - b. Model: Not applicable **OR** Sound-insulated chamber **OR** Sound-insulated chamber and stainless-steel outer shell, **as directed**.
 - c. Motor: 115-V ac, 1725 rpm, 1/3 **OR** 1/2 **OR** 3/4 **OR** 1, **as directed**, hp with overload protection.
- O. Hot-Water Dispensers
 - 1. Description: Gooseneck spout with lever-handle **OR** Spout with twist-knob or push-button, **as directed**, flow control, household-type dispenser with instant on-off control; insulated, corrosion-resistant-metal storage tank that is open to atmosphere; electric heating element; chrome-plated faucet or spout; removable strainer; thermostat control for water temperature up to 190 deg F (88 deg C); and thermal-overload protection.
 - a. Storage Tank Capacity: 0.5 gal. (1.5 L).
 - b. Heating Element: 750 W minimum, 115-V ac.
- P. Water Closets
 - 1. Water Closets, Wall-Mounting, Back-Outlet Type:
 - a. Description Accessible, wall-mounting **OR** Wall-mounting, **as directed**, back-outlet, vitreous-china fixture designed for flushometer-tank **OR** gravity-type tank **OR** flushometer valve, **as directed**, operation.
 - 1) Style: Close coupled **OR** One piece, **as directed**.
 - a) Bowl Type: Elongated **OR** Round front, **as directed**, with siphon-jet design.
 - b) Design Consumption: **1.6 gal./flush (6 L/flush) OR 3.5 gal./flush (13.3 L/flush), as directed**.

- c) Tank: Gravity type with trim **OR** Flushometer-tank type with trim and pressurized tank, **as directed**. Include cover.
 - d) Trip Mechanism: Lever-handle **OR** Push-button, **as directed**, actuator.
 - e) Color: White.
 - 2) Supply: **NPS 1/2 (DN 15)** chrome-plated brass or copper with wheel-handle **OR** screwdriver **OR** loose-key, **as directed**, stop.
 - 3) Style: Flushometer valve.
 - a) Bowl Type: Elongated **OR** Round front, **as directed**, with siphon-jet **OR** blowout, **as directed**, design.
 - b) Design Consumption: **1.6 gal./flush (6 L/flush)** **OR** **3.5 gal./flush (13.3 L/flush)**, **as directed**.
 - c) Color: White.
 - 4) Fixture Support: Water-closet support <Insert designation> combination carrier.
2. Water Closets, Floor-Mounting, Floor-Outlet Type:
 - a. Description: Accessible, floor-mounting **OR** Floor-mounting, **as directed**, floor-outlet, vitreous-china fixture designed for gravity-type tank **OR** flushometer tank **OR** flushometer valve, **as directed**, operation.
 - 1) Style: Close coupled **OR** One piece, **as directed**.
 - a) Bowl Type: Elongated **OR** Round front, **as directed**, with siphon-jet design. Include bolt caps matching fixture.
 - b) Height: Standard **OR** Accessible **OR** Juvenile **OR** Child, **as directed**.
 - c) Design Consumption: **1 gal./flush (3.8 L/flush)** **OR** **1.6 gal./flush (6 L/flush)** **OR** **3.5 gal./flush (13.3 L/flush)**, **as directed**.
 - d) Tank: Gravity type with trim **OR** Flushometer-tank type with trim and pressurized tank, **as directed**. Include cover.
 - e) Trip Mechanism: Lever-handle **OR** Push-button, **as directed**, actuator.
 - f) Color: White.
 - 2) Supply: **NPS 3/8 (DN 10)** **OR** **NPS 1/2 (DN 15)**, **as directed**, chrome-plated brass or copper with wheel-handle **OR** screwdriver **OR** loose-key, **as directed**, stop.
 - 3) Style: Flushometer valve.
 - a) Bowl Type: Elongated **OR** Round front, **as directed**, with siphon-jet **OR** reverse-trap **OR** blowout **OR** siphon-vortex **OR** siphon-wash **OR** washdown, **as directed**, design. Include bolt caps matching fixture.
 - b) Height: Standard **OR** Accessible **OR** Juvenile **OR** Child, **as directed**.
 - c) Design Consumption: **1.6 gal./flush (6 L/flush)** **OR** **3.5 gal./flush (13.3 L/flush)**, **as directed**.
 - d) Color: White.
 3. Water Closets, Floor-Mounting, Back-Outlet Type:
 - a. Description Accessible, floor-mounting **OR** Floor-mounting, **as directed**, back-outlet, vitreous-china fixture designed for gravity-tank **OR** flushometer-tank **OR** flushometer-valve, **as directed**, operation.
 - 1) Style: Close coupled.
 - a) Bowl Type: Elongated with siphon-jet design. Include bolt caps matching fixture.
 - b) Height: Standard **OR** Accessible, **as directed**.
 - c) Design Consumption: **1.6 gal./flush (6 L/flush)**.
 - d) Tank: Gravity type with trim. Include cover.
 - e) Trip Mechanism: Lever-handle actuator.
 - f) Color: White.
 - 2) Supply: **NPS 1/2 (DN 15)** chrome-plated brass or copper with wheel-handle **OR** screwdriver **OR** loose-key, **as directed**, stop.
 - 3) Style: Flushometer valve.
 - a) Bowl Type: Elongated with siphon-jet design. Include bolt caps matching fixture.
 - b) Height: Standard **OR** Accessible, **as directed**.



- c) Design Consumption: **1.6 gal./flush (6 L/flush) OR 3.5 gal./flush (13.3 L/flush), as directed.**
- d) Color: White.
- 4) Wall Support: Manufactured waste fitting with seal and fixture bolts.

Q. Urinals

1. Urinals, Wall-Mounting, Back-Outlet Type:
 - a. Description: Accessible, wall-mounting **OR** Wall-mounting, **as directed**, back-outlet, vitreous-china fixture designed for flushometer valve operation.
 - 1) Type: Blowout **OR** Siphon jet **OR** Blowout with extended shields **OR** Siphon jet with extended shields **OR** Washout with extended shields, **as directed**.
 - 2) Strainer or Trapway: Integral cast strainer **OR** Separate removable strainer **OR** Open trapway, **as directed**, with integral trap.
 - 3) Design Consumption: **0.5 gal./flush (1.9 L/flush) OR 1 gal./flush (3.8 L/flush) OR 1.5 gal./flush (5.7 L/flush), as directed.**
 - 4) Color: White.
 - 5) Supply Spud Size: **NPS 3/4 (DN 20) OR NPS 1-1/4 (DN 32) OR NPS 1-1/2 (DN 40), as directed.**
 - 6) Outlet Size: **NPS 1-1/2 (DN 40) OR NPS 2 (DN 50) OR NPS 3 (DN 80), as directed.**
 - 7) Fixture Support: Urinal chair carrier.
2. Urinals, Wall-Mounting, Bottom-Outlet Type:
 - a. Description: Accessible, wall-mounting **OR** Wall-mounting, **as directed**, bottom-outlet, vitreous-china fixture designed for flushometer valve operation.
 - 1) Type: Washout **OR** Washdown, **as directed**.
 - 2) Strainer or Trapway: Integral cast strainer **OR** Separate removable strainer **OR** Open trapway, **as directed**.
 - 3) Design Consumption: **0.5 gal./flush (1.9 L/flush) OR 1 gal./flush (3.8 L/flush), as directed.**
 - 4) Color: White.
 - 5) Supply Spud Size: **NPS 3/4 (DN 20).**
 - 6) Outlet Size: **NPS 1-1/2 (DN 40).**
 - 7) Drain Piping: **NPS 1-1/2 (DN 40)** chrome-plated, cast-brass P-trap; **0.045-inch- (1.1-mm-)** thick tubular brass waste to wall; and wall escutcheon.
 - 8) Flushing Device: Fixture manufacturer's standard matching fixture.
 - 9) Flushometer: **As directed.**
 - 10) Fixture Support: Urinal chair carrier.
3. Urinals, Stall-Type, Bottom-Outlet:
 - a. Description: Stall-type, bottom-outlet, vitreous-china fixture designed for flushometer valve operation.
4. Urinals, Wall-Mounting, Bottom-Outlet, Trough-Type:
 - a. Description: Wall-mounting, bottom-outlet, trough-type, enameled, cast-iron fixture modified for flushometer valve operation.
 - 1) Style: Similar to wash sink with back and without pedestal.
 - 2) Size: **36 inches (915 mm) OR 48 inches (1219 mm) OR 60 inches (1525 mm) OR 72 inches (1830 mm), as directed.**
 - 3) Color: White.
 - 4) Drain: Separate removable dome strainer.
 - 5) Design Consumption: Not applicable.
 - 6) Supply: **NPS 1/2 (DN 15).**
 - 7) Outlet Size: **NPS 1-1/2 (DN 40).**
 - 8) Drain Piping: **NPS 1-1/2 (DN 40)** chrome-plated, cast-brass P-trap; **0.045-inch- (1.1-mm-)** thick tubular brass waste to wall; and wall escutcheon.
 - 9) Flushing Device: Fixture manufacturer's standard, with washdown pipe, matching fixture.

- 10) Fixture Support: Sink chair carrier.
5. Urinals, Wall-Mounting, Back-Outlet Dry Type:
 - a. Description Accessible, wall-mounting **OR** Wall-mounting, **as directed**, back-outlet dry, plastic **OR** vitreous-china, **as directed**, fixture designed for liquid-trap-seal operation.
 - 1) Type: Without water supply.
 - 2) Trap-Seal Method: Proprietary cartridge or trap system.
 - 3) Color: White.
 - 4) Outlet Size: **NPS 1-1/2 (DN 40) OR NPS 2 (DN 50), as directed.** Include transition coupling, if required.
 - 5) Trap-Sealing Liquid: Proprietary.
 - 6) Fixture Support: Urinal chair carrier.
- R. Bidets
 1. Description: Floor-mounting, vitreous-china fixture with fittings.
 - a. Type: With spray **OR** flushing rim **OR** spray and flushing rim, **as directed**, and overflow. Include bolt caps matching fixture.
 - b. Faucet Hole Punching: One **OR** Two **OR** Three **OR** Four **OR** No, **as directed**, hole(s).
 - c. Color: White.
 - d. Faucet: Fixture manufacturer's standard, or two-valve supply, provided by fixture supplier, with vacuum breaker, diverter, submerged spray, **OR** over-rim filling, **as directed**, pop-up waste, and chrome-plated finish.
 - e. Supplies: NPS 3/8 (DN 10) **OR** NPS 1/2 (DN 15), **as directed**, chrome-plated copper with stops.
 - f. Drain Piping: NPS 1-1/4 (DN 32) chrome-plated, cast-brass P-trap; 0.032-inch- (0.8-mm-) **OR** 0.045-inch- (1.1-mm-), **as directed**, thick tubular brass waste to wall; and wall escutcheon.
- S. Lavatories
 1. Lavatories, Wall-Mounting Type:
 - a. Description: Accessible, wall-mounting **OR** Wall-mounting **OR** Wall-and-pedestal-mounting, **as directed**, enameled, cast-iron **OR** vitreous-china, **as directed**, fixture.
 - 1) Type: With back **OR** Ledge back **OR** Shelf back **OR** Slab **OR** Pedestal, **as directed**.
 - 2) Size: **18 by 15 inches (457 by 381 mm) OR 19 by 16 inches (483 by 406 mm) OR 20 by 18 inches (508 by 457 mm) OR 24 by 20 inches (610 by 508 mm), as directed**, rectangular.
 - 3) Faucet Hole Punching: One hole **OR** Three holes, **2-inch (51-mm) centers OR Three holes, 4-inch (102-mm) centers, as directed.**
 - 4) Faucet Hole Location: Top **OR** Front wall **OR** Inclined panel, **as directed**.
 - 5) Pedestal: Not required **OR** Required, **as directed**.
 - 6) Color: White.
 - 7) Faucet: Lavatory with pop-up waste **OR** for separate drain, **as directed**.
 - 8) Supplies: **NPS 3/8 (DN 10)** chrome-plated copper with stops.
 - 9) Drain: See faucet **OR** Grid **OR** Grid with offset waste, **as directed**.
 - a) Location: Not applicable **OR** Near back of bowl, **as directed**.
 - 10) Drain Piping: **NPS 1-1/4 (DN 32) OR NPS 1-1/4 by NPS 1-1/2 (DN 32 by DN 40), as directed**, chrome-plated, cast-brass P-trap; **NPS 1-1/4 (DN 32) OR NPS 1-1/2 (DN 40), as directed, 0.032-inch- (0.8-mm-) OR 0.045-inch- (1.1-mm-), as directed**, thick tubular brass waste to wall; and wall escutcheon.
OR
Drain Piping: Schedule 40 ABS **OR** PVC, **as directed**, **NPS 1-1/4 (DN 32) OR NPS 1-1/4 by NPS 1-1/2 (DN 32 by DN 40), as directed**, P-trap; **NPS 1-1/4 (DN 32) OR NPS 1-1/2 (DN 40), as directed**, tubular waste to wall; and wall escutcheon.
 - a) Exception: Omit P-trap if hair interceptor is required.
 - 11) Hair Interceptor: Not required.
 - 12) Protective Shielding Guard(s): **As directed**.

- 13) Fixture Support: Lavatory.
2. Lavatories, Counter-Mounting Type:
- a. Description: Accessible **OR** Counter-mounting **OR** Undercounter-mounting, **as directed**, enameled, cast-iron **OR** FRP **OR** PMMA **OR** porcelain-enameled, formed-steel **OR** solid-surface **OR** stainless-steel **OR** vitreous-china, **as directed** fixture.
 - 1) Type: Flat rim with ledge **OR** Self-rimming, **as directed**.
 - 2) Rectangular Lavatory Size: **18 by 15 inches** (457 by 381 mm) **OR** **19 by 16 inches** (483 by 406 mm) **OR** **20 by 18 inches** (508 by 457 mm) **OR** **24 by 20 inches** (610 by 508 mm), **as directed**.
 - 3) Oval Lavatory Size: **19 by 16 inches** (483 by 406 mm) **OR** **20 by 17 inches** (508 by 432 mm), **as directed**.
 - 4) Round Lavatory Size: **18 inches** (457 mm) **OR** **19 inches** (483 mm), **as directed**, in diameter.
 - 5) Faucet Hole Punching: One hole **OR** Three holes, **2-inch** (51-mm) centers **OR** Three holes, **4-inch** (102-mm) centers, **as directed**.
 - 6) Faucet Hole Location: Top **OR** Front wall **OR** Inclined panel, **as directed**.
 - 7) Color: White.
 - 8) Faucet: Lavatory with pop-up waste **OR** for separate drain, **as directed**.
 - 9) Supplies: **NPS 3/8 (DN 10)** chrome-plated copper with stops.
 - 10) Drain: See faucet **OR** Grid **OR** Grid with offset waste, **as directed**.
 - a) Location: Not applicable **OR** Near back of bowl, **as directed**.
 - 11) Drain Piping: **NPS 1-1/4 (DN 32)** **OR** **NPS 1-1/4 by NPS 1-1/2 (DN 32 by DN 40)**, **as directed**, chrome-plated, cast-brass P-trap; **NPS 1-1/4 (DN 32)** **OR** **NPS 1-1/2 (DN 40)**, **as directed**, **0.032-inch- (0.8-mm-)** **OR** **0.045-inch- (1.1-mm-)**, **as directed**, thick tubular brass waste to wall; and wall escutcheon.
OR
 Drain Piping: Schedule 40 ABS **OR** PVC, **as directed**, **NPS 1-1/4 (DN 32)** **OR** **NPS 1-1/4 by NPS 1-1/2 (DN 32 by DN 40)**, **as directed**, P-trap; **NPS 1-1/4 (DN 32)** **OR** **NPS 1-1/2 (DN 40)**, **as directed**, tubular waste to wall; and wall escutcheon.
 - a) Exception: Omit P-trap if hair interceptor is required.
 - 12) Hair Interceptor: Not required.
 - 13) Protective Shielding Guard(s): **As directed**.
3. Lavatories, Countertop With Integral Bowl Type:
- a. Description: Countertop **OR** Accessible countertop, **as directed**, with integral bowl fixtures for mounting on base unit.
 - 1) Backsplash: Integral with countertop **OR** Separate, same material as countertop **OR** Not required, **as directed**.
 - 2) Overall Rectangular Top Size: **25 by 17 inches** (635 by 432 mm) **OR** **31 by 19 inches** (787 by 483 mm) **OR** **49 by 22 inches** (1245 by 559 mm) **OR** **73 by 22 inches** (1854 by 559 mm), **as directed**, with 1 **OR** 2 **OR** 3 **OR** 4, **as directed**, bowl(s).
 - a) Bowl Size: Oval **19 by 16 inches** (483 by 406 mm) **OR** **20 by 17 inches** (508 by 432 mm), **as directed**.
 - 3) Faucet Hole Punching: One hole **OR** Three holes, **2-inch** (51-mm) centers **OR** Three holes, **4-inch** (102-mm) centers, **as directed**.
 - 4) Faucet Hole Location: Countertop.
 - 5) Color: White.
 - 6) Faucet(s): Lavatory with pop-up waste **OR** with separate drain, **as directed**, for each bowl.
 - 7) Supplies: **NPS 3/8 (DN 10)** chrome-plated copper with stops.
 - 8) Drain(s): See faucets **OR** Grid **OR** Grid with offset waste, **as directed**.
 - a) Location: Not applicable **OR** Near back of bowl, **as directed**.
 - 9) Drain Piping: **NPS 1-1/4 (DN 32)** **OR** **NPS 1-1/4 by NPS 1-1/2 (DN 32 by DN 40)**, **as directed**, chrome-plated, cast-brass P-trap; **NPS 1-1/4 (DN 32)** **OR** **NPS 1-1/2 (DN 40)**, **as directed**, **0.032-inch- (0.8-mm-)** **OR** **0.045-inch- (1.1-mm-)**, **as directed**, thick tubular brass waste to wall; and wall escutcheon.

- OR**
 Drain Piping: Schedule 40 ABS **OR** PVC, **as directed**, NPS 1-1/4 (DN 32) **OR** NPS 1-1/4 by NPS 1-1/2 (DN 32 by DN 40), **as directed**, P-trap; NPS 1-1/4 (DN 32) **OR** NPS 1-1/2 (DN 40), **as directed**, tubular waste to wall; and wall escutcheon.
- 10) Hair Interceptor(s): **As directed** for bowls as indicated.
 - 11) Protective Shielding Guard(s): **As directed** for bowls as indicated.
4. Lavatories, For Wheelchair-Bound Persons:
- a. Description: Accessible, wall-mounting, vitreous-china fixture designed for people in wheelchairs.
 - 1) Type: Ledge back **OR** Shelf back **OR** Slab, **as directed**.
 - 2) Size: 20 by 26 inches (508 by 660 mm) minimum; rectangular.
 - 3) Faucet Hole Punching: One hole **OR** Three holes, 2-inch (51-mm) centers **OR** Three holes, 4-inch (102-mm) centers **OR** Three holes, 8-inch (203-mm) centers **OR** Three holes, 12-inch (305-mm) centers, **as directed**.
 - 4) Color: White.
 - 5) Faucet: Lavatory for separate drain.
 - 6) Supplies: NPS 3/8 (DN 10) chrome-plated copper with stops.
 - 7) Drain: Grid **OR** Grid with offset waste, **as directed**.
 - 8) Drain Piping: NPS 1-1/4 (DN 32) **OR** NPS 1-1/4 by NPS 1-1/2 (DN 32 by DN 40), **as directed**, chrome-plated, cast-brass P-trap; NPS 1-1/4 (DN 32) **OR** NPS 1-1/2 (DN 40), **as directed**, 0.045-inch- (1.1-mm-) thick tubular brass waste to wall; and wall escutcheon.

OR
 Drain Piping: Schedule 40 ABS **OR** PVC, **as directed**, NPS 1-1/4 (DN 32) **OR** NPS 1-1/4 by NPS 1-1/2 (DN 32 by DN 40), **as directed**, P-trap; NPS 1-1/4 (DN 32) **OR** NPS 1-1/2 (DN 40), **as directed**, tubular waste to wall; and wall escutcheon.
 - 9) Fixture Support: Lavatory.
- T. Commercial Sinks
1. Commercial Sinks, Counter-Mounting Type:
 - a. Description: One-compartment **OR** Two-compartment **OR** Three-compartment, **as directed**, counter-mounting, stainless-steel commercial sink with backsplash.
 - 1) Metal Thickness: 0.050 inch (1.3 mm).
 - 2) Compartment (for single-compartment sink):
 - a) Drain: Grid with NPS 1-1/2 (DN 40) tailpiece and twist drain **OR** Grid with NPS 2 (DN 50) tailpiece and twist drain **OR** NPS 1-1/2 (DN 40) tailpiece with stopper **OR** NPS 1-1/2 (DN 40) tailpiece with pop-up waste, **as directed**.
 - i. Location: Centered in compartment **OR** Near back of compartment **OR** Near left side of compartment **OR** Near right side of compartment, **as directed**.
 - 3) Each Compartment (for multiple-compartment sink):
 - a) Drains: Grid with NPS 1-1/2 (DN 40) tailpiece and twist drain **OR** Grid with NPS 2 (DN 50) tailpiece and twist drain **OR** NPS 1-1/2 (DN 40) tailpiece with stopper **OR** NPS 1-1/2 (DN 40) tailpiece with pop-up waste, **as directed**.
 - i. Location: Centered in compartment **OR** Near back of compartment, **as directed**.
 - 4) Faucet(s): Sink.
 - a) Number Required: One **OR** Two, **as directed**.
 - b) Mounting: Deck.
 - 5) Supplies: NPS 1/2 (DN 15) **OR** NPS 3/4 (DN 20), **as directed**, chrome-plated copper with stops or shutoff valves.
 - 6) Drain Piping: NPS 1-1/2 (DN 40) **OR** NPS 2 (DN 50), **as directed**, chrome-plated, cast-brass P-trap; 0.045-inch- (1.1-mm-) thick tubular brass **OR** copper pipe, **as directed**, waste to wall; continuous waste, **as directed**; and wall escutcheon(s).
 2. Commercial Sinks, Freestanding Type:



- a. Description: One-compartment **OR** Two-compartment **OR** Three-compartment, **as directed**, freestanding, stainless-steel commercial sink with backsplash.
 - 1) Metal Thickness: **0.050 inch (1.3 mm) OR 0.063 inch (1.6 mm)**, **as directed**.
 - 2) Compartment (for single-compartment sink):
 - a) Drain: Grid with **NPS 1-1/2 (DN 40)** tailpiece and twist drain **OR** Grid with **NPS 2 (DN 50)** tailpiece and twist drain **OR NPS 1-1/2 (DN 40)** tailpiece with stopper **OR NPS 1-1/2 (DN 40)** tailpiece with pop-up waste, **as directed**.
 - i. Location: Centered in compartment **OR** Near back of compartment **OR** Near left side of compartment **OR** Near right side of compartment, **as directed**.
 - 3) Each Compartment (for multiple-compartment sink):
 - a) Drains: Grid with **NPS 1-1/2 (DN 40)** tailpiece and twist drain **OR** Grid with **NPS 2 (DN 50)** tailpiece and twist drain **OR NPS 1-1/2 (DN 40)** tailpiece with stopper **OR NPS 1-1/2 (DN 40)** tailpiece with pop-up waste, **as directed**.
 - i. Location: Centered in compartment **OR** Near back of compartment, **as directed**.
 - 4) Drainboard(s): Not required **OR** Both **OR** Left **OR** Right, **as directed**, side(s).
 - a) Dimensions Each: Not applicable.
 - 5) Supports: Adjustable-length, steel legs.
 - 6) Faucet(s): Sink.
 - a) Number Required: One **OR** Two, **as directed**.
 - b) Mounting: In backsplash.
 - 7) Supplies: **NPS 1/2 (DN 15) OR NPS 3/4 (DN 20)**, **as directed**, chrome-plated copper with stops or shutoff valves.
 - 8) Drain Piping: **NPS 1-1/2 (DN 40) OR NPS 2 (DN 50)**, **as directed**, chrome-plated, cast-brass P-trap; **0.045-inch- (1.1-mm-)** thick tubular brass **OR** copper pipe, **as directed**, waste to wall; continuous waste, **as directed**; and wall escutcheon(s).

3. Commercial Sinks, Handwash Type:

- a. Description: Wall-mounting, stainless-steel, commercial, handwash-sink fixture.
 - 1) Type: Basin with radius corners, back for faucet, and support brackets.
 - 2) Size: Approximately **17 by 16 by 5 inches (432 by 406 by 127 mm)**.
 - 3) Faucet: Back-mounting, chrome-plated, solid-brass, gooseneck type with individual valves.
 - 4) Supplies: **NPS 1/2 (DN 15)** chrome-plated copper with stops.
 - 5) Drain: Grid.
 - 6) Drain Piping: **NPS 1-1/2 (DN 40)** chrome-plated, cast-brass P-trap; **0.045-inch- (1.1-mm-)** thick tubular brass waste to wall; and wall escutcheon.
 - 7) Fixture Support: Sink for wall-mounting installation.

U. Shampoo Bowls

- 1. Description: Enameled, cast-iron **OR** PMMA, **as directed**, fixture shaped for head rest. Include vacuum breaker, faucet, hose and spray, drain, and mounting brackets.
 - a. Color: White.
 - b. Supplies: **NPS 3/8 (DN 10) OR NPS 1/2 (DN 15)**, **as directed**, chrome-plated copper with stops.
 - c. Drain Piping: **NPS 1-1/2 (DN 40)** chrome-plated, cast-brass P-trap; **0.045-inch- (1.1-mm-)** thick tubular brass waste to wall; and wall escutcheon.
OR
Drain Piping: Schedule 40 ABS **OR** PVC, **as directed**, **NPS 1-1/2 (DN 40)** P-trap; tubular waste to wall; and wall escutcheon.
 - d. Hair Interceptor: **As directed**
 - e. Fixture Support for Counter Mounting: Brackets or forms.
OR
Fixture Support for Wall Mounting: Sink.

V. Wash Fountains

1. Wash Fountains, Freestanding Type:

- a. Description: Accessible, Circular, freestanding-design, wash-up fixture.
- 1) Arrangement: Wash-up stations facing central spray head.
 - 2) Receptor Material: Precast terrazzo **OR** Stainless steel **OR** Solid surface, **as directed**, on base.
 - 3) Receptor Color or Finish: Not applicable.
 - 4) Size: **36- to 39-inch (914- to 990-mm)** **OR** **54-inch (1370-mm)**, **as directed**, diameter.
 - 5) Number of Stations: Two **OR** Three **OR** Four **OR** Five **OR** Six **OR** Eight, **as directed**.
 - 6) Control: Collective **OR** Individual, **as directed**, push-button **OR** foot-pedal **OR** sensor, **as directed**, actuation with thermostatic valve and check stops or field-installed check valves.
 - 7) Liquid Soap Dispensers: Manual **OR** Sensor, **as directed**, for each station.
 - 8) Mounting: Floor.
 - 9) Supplies: **NPS 3/4 (DN 20)** **OR** **NPS 1 (DN 25)**, **as directed**, copper tubing with ball, gate, or globe valves from bottom **OR** top, **as directed**.
 - 10) Shroud: Not required **OR** Stainless steel of size to cover supplies and vent piping, **as directed**.
 - 11) Drain: Grid with **NPS 2 (DN 50)** tailpiece.
 - 12) Trap Fitting: Not required **OR** **NPS 2 (DN 50)** trap with waste and vent connections, **as directed**.
 - 13) Drain Piping: **NPS 1-1/2 (DN 40)**, **OR** **NPS 2 (DN 50)**, **as directed**, waste to floor.
 - 14) Vent Piping: Not required **OR** **NPS 1-1/2 (DN 40)** to ceiling, **as directed**.

2. Wash Fountains, Semicircular Or Corner Type:

- a. Description: Accessible, Semicircular **OR** Corner, **as directed**, design, wash-up fixture.
- 1) Arrangement: Wash-up stations facing central spray head.
 - 2) Receptor Material: Precast terrazzo **OR** Stainless steel **OR** Solid surface, **as directed**, on base.
 - 3) Receptor Color or Finish: Not applicable.
 - 4) Size: **36- to 39-inch (914- to 990-mm)** **OR** **54-inch (1370-mm)**, **as directed**, diameter.
 - 5) Number of Stations: Two **OR** Three **OR** Four, **as directed**.
 - 6) Control: Collective **OR** Individual, **as directed**, push-button **OR** foot-pedal **OR** sensor, **as directed**, actuation with thermostatic valve and check stops or field-installed check valves.
 - 7) Liquid Soap Dispensers: Manual **OR** Sensor, **as directed**, for each station.
 - 8) Mounting: Floor and flush-to-wall with wall bracket.
 - 9) Supplies: **NPS 1/2 (DN 15)** **OR** **NPS 3/4 (DN 20)**, **as directed**, copper tubing with ball, gate, or globe valves.
 - 10) Drain: Grid with **NPS 1-1/2 (DN 40)** **OR** **NPS 2 (DN 50)**, **as directed**, tailpiece.
 - 11) Drain Piping: **NPS 1-1/2 (DN 40)** **OR** **NPS 2 (DN 50)**, **as directed**, P-trap, waste to wall, and wall flange.

3. Wash Fountains, Wall-Mounting Type:

- a. Description: Accessible, **as directed**, Flush-to-wall, **as directed**, linear design, wash-up fixture.
- 1) Arrangement: Wash-up stations facing spray heads.
 - 2) Receptor Material: Precast terrazzo **OR** Stainless steel **OR** Solid surface, **as directed**, on base.
 - 3) Receptor Color or Finish: Not applicable.
 - 4) Number of Stations: One **OR** Two **OR** Three **OR** Four, **as directed**.
 - 5) Control: Collective **OR** Individual, **as directed**, push-button **OR** sensor, **as directed**, actuation with thermostatic valve and check stops or field-installed check valves.
 - 6) Liquid Soap Dispensers: Manual **OR** Sensor, **as directed**, for each station.

- 7) Mounting: Floor mounting with bracket for attaching to wall.
- 8) Faucet(s): Push-button **OR** Sensor-actuated, **as directed**, mixing valve with check stops.
- 9) Supplies: **NPS 1/2 (DN 15)** copper tubing with ball, gate, or globe valves.
- 10) Drain: Grid with **NPS 1-1/2 (DN 40)** tailpiece.
- 11) Drain Piping: **NPS 1-1/2 (DN 40)** P-trap, waste to wall, and wall flange.

W. Bathtubs

- 1. Description: Enameled, cast-iron **OR** FRP **OR** PMMA **OR** Porcelain-enameled, formed-steel, **as directed**, fixture.
 - a. Bathing Surface: Slip resistant.
 - b. Size: **48 by 30 inches (1220 by 765 mm)** **OR** **60 by 30 inches (1525 by 765 mm)** **OR** **66 by 30 inches (1680 by 765 mm)**, **as directed**, with front apron **OR** drop-in type, **as directed**.
 - c. Color: White.
 - d. Drain Location: Left **OR** Right, **as directed**, end.
 - e. Accessibility Options: Include grab bar and bench.
 - f. Faucet: Bathtub **OR** Bathtub/shower, **as directed**.
 - g. Supplies: **NPS 1/2 (DN 15)** copper tubing with ball, gate, or globe valves.
 - h. Drain: **NPS 1-1/2 (DN 40)**; chrome-plated exposed parts; brass pop-up waste and overflow.
 - i. Drain Piping: **NPS 1-1/2 (DN 40)** cast-brass P-trap and waste.
OR
Drain Piping: Schedule 40 ABS **OR** PVC, **as directed**, **NPS 1-1/2 (DN 40)** P-trap and waste.

X. Individual Showers

- 1. Individual Showers, Enclosure Type:
 - a. Description: Accessible, **as directed**, FRP **OR** PMMA, **as directed**, shower enclosure with slip-resistant bathing surface and shower rod with curtain.
 - 1) Size: **36 by 34 inches (915 by 865 mm)** **OR** **42 by 36 inches (1065 by 915 mm)** **OR** **43 by 39 inches (1090 by 990 mm)** **OR** **48 by 34 inches (1220 by 865 mm)** **OR** **52 by 36 inches (1320 by 915 mm)** **OR** **60 by 36 inches (1525 by 915 mm)** **OR** **72 by 36 inches (1830 by 915 mm)**, **as directed**.
 - 2) Surround: One piece or sealed, multiple piece, **as directed**.
OR
Surround: One piece.
 - 3) Color: White.
 - 4) Drain Location: Left side **OR** Center **OR** Right side, **as directed**.
 - 5) Accessibility Options: Include grab bar and bench.
 - 6) Faucet: Shower.
 - 7) Drain: Grid, **NPS 2 (DN 50)**.
- 2. Individual Showers, Built-Up Type:
 - a. Description: Components for built-up shower.
 - 1) Receptor: Not required.
- 3. Individual Showers, Cabinet Type:
 - a. Description: Factory-fabricated, accessible, **as directed**, cabinet type with faucet and receptor.
 - 1) Size: **30 by 30 inches (760 by 760 mm)** **OR** **32 by 32 inches (815 by 815 mm)** **OR** **36 by 36 inches (915 by 915 mm)** **OR** **36 by 39 inches (915 by 990 mm)** **OR** **45 by 39 inches (1145 by 990 mm)**, **as directed**.
 - 2) Material: Steel **OR** Composite **OR** Plastic, **as directed**, front **OR** corner **OR** front and rear, **as directed**, access.
 - 3) Color: Not applicable.
 - 4) Accessibility Options: Grab bar and bench.
 - 5) Faucet: Shower.

- 6) Supplies: **NPS 1/2 (DN 15)** copper tubing with ball, gate, or globe valves, **as directed**.
- 7) Drain: Grid, **NPS 2 (DN 50)**.

Y. Group Showers

1. Group Showers, Column Type:

- a. Description: Stainless-steel column fixture with two **OR** three **OR** four **OR** five **OR** six, **as directed**, individual showers.
 - 1) Height to Shower Heads: **66 inches (1675 mm) OR 72 inches (1830 mm)**, **as directed**.
 - 2) Control: Thermostatic **OR** Pressure-balance, **as directed**, valve with individual hot-and cold-water mixing valve operation.
OR
Control: Thermostatic valve with individual tempered-water supply and push-button **OR** sensor, **as directed**, operation.
 - 3) Flow Control: **2 gpm (7.6 L/min.) OR 2.5 gpm (9.5 L/min.)**, **as directed**, for each shower head.
 - 4) Liquid Soap Dispenser: For each shower.
 - 5) Mounting: Floor flange.
 - 6) Supplies: **NPS 3/4 (DN 20) OR NPS 1 (DN 25)**, **as directed**, copper tubing with ball, gate, or globe valves from bottom **OR** top, **as directed**.
 - 7) Shroud: Not required **OR** Stainless steel of size to cover supplies and vent piping, **as directed**.
 - 8) Drain Fitting: **NPS 3 (DN 80) OR NPS 4 (DN 100)**, **as directed**, outlet with **NPS 2 (DN 50)** vent, integral with base of column.
 - 9) Vent Piping: Not required **OR NPS 2 (DN 50)** to ceiling, **as directed**.

2. Group Showers, Wall-Mounting Type:

- a. Description: Wall-mounting fixture with stainless-steel surface enclosure with two **OR** three, **as directed**, individual showers.
 - 1) Control: Thermostatic **OR** Pressure-balance, **as directed**, valve with individual hot-and cold-water mixing valve operation.
OR
Control: Thermostatic valve with individual tempered-water supply and push-button **OR** sensor, **as directed**, operation.
 - 2) Flow Control: **2 gpm (7.6 L/min.) OR 2.5 gpm (9.5 L/min.)**, **as directed**, for each shower head.
 - 3) Liquid Soap Dispenser: For each shower.
 - 4) Mounting: Wall bracket.
 - 5) Supplies: **NPS 3/4 (DN 20)** copper tubing with ball, gate, or globe valves.

3. Group Showers, Freestanding, Plastic Type:

- a. Description: Freestanding, plastic group-shower fixture.
 - 1) Number of Shower Stations: One **OR** Two **OR** Three **OR** Four, **as directed**, with individual self-closing control valve(s).
 - 2) Number of Foot Wash Stations: One **OR** Two, **as directed**, with individual self-closing control valve(s).
 - 3) Hose Bibb: Not **OR** One, **as directed**, required.
 - 4) Control-Valve Mounting Height: **50 inches (1270 mm) OR 48 inches (1219 mm)**, **as directed**.
 - 5) Material: Cast-filled-polymer plastic.
 - 6) Color: Gray.
 - 7) Internal Piping: Factory installed.
 - 8) Mounting: Base flange with bolt holes.

4. Group Showers, Freestanding, Steel Type:

- a. Description: Freestanding, steel group-shower fixture.
 - 1) Number of Shower Stations: One **OR** Two, **as directed**, with individual self-closing control valve(s).



- 2) Number of Foot Wash Stations: One **OR** Two, **as directed**, with individual self-closing control valve(s).
- 3) Material: Painted steel pipe.
- 4) Color: Blue.
- 5) Internal Piping: Factory installed.
- 6) Mounting: Base flange with bolt holes.

Z. Whirlpool Bathtubs

1. Whirlpool Bathtubs, Water-Circulation Hydromassage Type:

- a. Description: Packaged, enameled, cast-iron **OR** FRP **OR** PMMA **OR** porcelain-enameled, formed-steel, **as directed**, hydromassage bathtub with air-entrained-water jet nozzles and water circulation.
 - 1) Seating Capacity: One **OR** Two, **as directed**, person(s).
 - 2) Bathing Surface: Slip resistant.
 - 3) Size: 60 by 30 inches (1525 by 765 mm) **OR** 66 by 30 inches (1680 by 765 mm) **OR** 60 by 42 inches (1525 by 1065 mm), **as directed**.
 - 4) Base for Drop-in Unit: <Insert description> with access panel.
OR
Apron: Matching unit, covering exposed front and sides, and with access panel.
 - 5) Color: White.
 - 6) Drain Location: Left **OR** Right, **as directed**, end.
 - 7) Controls: For pump, timer, **as directed**, and water heater, **as directed**.
 - 8) Faucet: Fixture manufacturer's individual valves **OR** mixing valve, **as directed**, with over-rim tub filler.
 - 9) Supplies: NPS 1/2 (DN 15) copper tubing with ball, gate, or globe valves.
 - 10) Drain: NPS 1-1/2 (DN 40); chrome-plated exposed parts; brass pop-up waste and overflow.
 - 11) Drain Piping: NPS 1-1/2 (DN 40) cast-brass P-trap and waste.
OR
Drain Piping: Schedule 40 ABS **OR** PVC, **as directed**, NPS 1-1/2 (DN 40) P-trap and waste.
 - 12) Water-Circulating System: Electric circulating pump and plastic piping.
 - 13) Water Heater: Electric, inline, **as directed**.

2. Whirlpool Bathtubs, Airmassage Type:

- a. Description: Packaged, PMMA airmassage bathtub with air-injection nozzles.
 - 1) Seating Capacity: One **OR** Two, **as directed**, person(s).
 - 2) Bathing Surface: Slip resistant.
 - 3) Size: 60 by 30 inches (1525 by 765 mm) **OR** 66 by 30 inches (1680 by 765 mm) **OR** 60 by 42 inches (1525 by 1065 mm), **as directed**.
 - 4) Base for Drop-in Unit: <Insert description> with access panel.
OR
Apron: Matching unit, covering exposed front and sides, and with access panel.
 - 5) Color: White.
 - 6) Drain Location: Left **OR** Right, **as directed**, end.
 - 7) Controls: For blower, timer, **as directed**, and water heater, **as directed**.
 - 8) Faucet: Fixture manufacturer's individual valves **OR** mixing valve, **as directed**, with over-rim tub filler.
 - 9) Supplies: NPS 1/2 (DN 15) copper tubing with ball, gate, or globe valves.
 - 10) Drain: NPS 1-1/2 (DN 40); chrome-plated exposed parts; brass pop-up waste and overflow.
 - 11) Drain Piping: NPS 1-1/2 (DN 40) cast-brass P-trap and waste.
OR
Drain Piping: Schedule 40 ABS **OR** PVC, **as directed**, NPS 1-1/2 (DN 40) P-trap and waste.

- 12) Air-Injection System: Electric, blower **OR** combination blower/heater, **as directed**, and plastic piping.

AA. Kitchen Sinks

1. Kitchen Sinks:

- a. Description: One-bowl **OR** Two-bowl **OR** Three-bowl, **as directed**, residential, counter-mounting, enameled, cast-iron **OR** PMMA **OR** porcelain-enameled, formed-steel **OR** solid-surface **OR** stainless-steel, **as directed**, kitchen sink.
- 1) Metal Thickness: **0.038 inch (1.0 mm) OR 0.050 inch (1.3 mm)**, **as directed**.
 - 2) Bowl (single bowl):
 - a) Drain: **3-1/2-inch (89-mm)** crumb cup **OR** grid **OR** grid with offset waste **OR** outlet for disposer, **as directed**.
 - i. Location: Centered in bowl **OR** Near back of bowl, **as directed**.
 - 3) Left Bowl:
 - a) Drain: **3-1/2-inch (89-mm)** crumb cup **OR** grid **OR** grid with offset waste **OR** outlet for disposer, **as directed**.
 - i. Location: Centered in bowl **OR** Near back of bowl, **as directed**.
 - 4) Right Bowl:
 - a) Drain: **3-1/2-inch (89-mm)** crumb cup **OR** grid **OR** grid with offset waste **OR** outlet for disposer, **as directed**.
 - i. Location: Centered in bowl **OR** Near back of bowl, **as directed**.
 - 5) Center Bowl:
 - a) Drain: **1-1/2-inch (38-mm) OR 3-1/2-inch (89-mm)**, **as directed**, crumb cup **OR** grid **OR** grid with offset waste, **as directed**.
 - i. Location: Centered in bowl.
 - 6) Supplies: **NPS 1/2 (DN 15)** chrome-plated copper with stops.
 - 7) Drain Piping: **NPS 1-1/2 (DN 40)** chrome-plated, cast-brass P-trap; **0.045-inch- (1.1-mm-)** thick tubular brass waste to wall; continuous waste, **as directed**; and wall escutcheon(s).
OR
Drain Piping: Schedule 40 ABS **OR** PVC, **as directed**, **NPS 1-1/2 (DN 40)** P-trap; tubular waste to wall; continuous waste, **as directed**; and wall escutcheon(s).
 - 8) Disposer: Not required.
 - 9) Dishwasher Air-Gap Fitting: Required **OR** Not required, **as directed**.
 - 10) Hot-Water Dispenser: Not required.

2. Bar Sinks:

- a. Description: Single-bowl, residential, counter-mounting, enameled, cast-iron **OR** PMMA **OR** stainless-steel **OR** porcelain-enameled, cast-iron **OR** solid-surface, **as directed**, bar sink.
- 1) Supplies: **NPS 3/8 (DN 10) OR NPS 1/2 (DN 15)**, **as directed**, chrome-plated copper with stops.
 - 2) Drain: **1-1/2-inch (38-mm) OR 3-1/2-inch (89-mm)**, **as directed**, crumb cup **OR** grid **OR** grid with offset waste, **as directed**.
 - 3) Drain Piping: **NPS 1-1/2 (DN 40)** chrome-plated, cast-brass P-trap; **0.045-inch- (1.1-mm-)** thick tubular brass waste to wall; and wall escutcheon.
OR
Drain Piping: Schedule 40 ABS **OR** PVC, **as directed**, **NPS 1-1/2 (DN 40)** P-trap; tubular waste to wall; and wall escutcheon.
 - 4) Protective Shielding Guard(s): **As directed**.

BB. Service Sinks

1. Service Sinks, Standard Type:

- a. Description: Trap-standard- and wall-mounting, enameled, cast-iron fixture with roll-rim **OR** vitreous-china fixture, **as directed**, with plain **OR** two faucet holes in, **as directed**, back and rim guard on front and sides.

- 1) Size (cast-iron fixture): **22 by 18 inches (560 by 460 mm) OR 24 by 20 inches (610 by 510 mm), as directed.**
 - 2) Size (vitreous-china fixture): **19 by 16 inches (480 by 405 mm) OR 22 by 20 inches (560 by 510 mm), as directed.**
 - 3) Color: White.
 - 4) Faucet: Sink type. Polished OR rough, as directed, chrome-plated, solid-brass faucet. Include integral stops in shanks, vacuum breaker, hose-thread outlet, and pail hook. Provide type with wall brace if faucet will be mounted above back.
 - 5) Drain: Grid with **NPS 2 (DN 50) OR NPS 3 (DN 80), as directed**, outlet.
 - 6) Trap Standard: **NPS 2 (DN 50) OR NPS 3 (DN 80), as directed**, enameled, cast iron with cleanout and floor flange.
 - 7) Fixture Support: Sink.
2. Service Sinks, Floor-Mounting Type:
- a. Description: Floor-mounting, enameled, cast-iron fixture with front apron, raised back, and coated, wire rim guard. (This type of service sink requires a drainage piping trap under the fixture. This trap is not part of fixture fittings)
 - 1) Size: **28 by 28 inches (710 by 710 mm).**
 - 2) Color: White.
 - 3) Faucet: Sink type. Polished OR rough, as directed, chrome-plated, solid-brass faucet with wall brace. Include integral stops in shanks, vacuum breaker, hose-thread outlet, and pail hook..
 - 4) Drain: Grid with **NPS 2 (DN 50) OR NPS 3 (DN 80), as directed**, outlet.

CC. Service Basins

1. Description: Flush-to-wall, floor-mounting, precast terrazzo **OR** cast-polymer, **as directed**, fixture with rim guard. (This type of fixture requires a drainage piping trap under the fixture. This trap is not part of fixture fittings.)
 - a. Shape: Square **OR** Rectangular **OR** Five sided **OR** Radial front, **as directed**.
 - b. Size: 24 by 24 inches (610 by 610 mm) **OR** 28 by 28 inches (710 by 710 mm) **OR** 24 by 36 inches (610 by 915 mm) **OR** 32 by 32 inches (815 by 815 mm) **OR** 36 by 36 inches (915 by 915 mm), **as directed**.
 - c. Height: 6 inches (150 mm) **OR** 10 inches (255 mm) **OR** 12 inches (305 mm) **OR** 12 inches (305 mm) with dropped front, **as directed**.
 - d. Tiling Flange: Not required **OR** On one side **OR** On two sides **OR** On three sides, **as directed**.
 - e. Rim Guard: On front **OR** all, **as directed**, top surfaces.
 - f. Color: Not applicable.
 - g. Faucet: Sink type. Polished OR rough, as directed, chrome-plated, solid-brass faucet with wall brace. Include integral stops in shanks, vacuum breaker, hose-thread outlet, and pail hook.
 - h. Drain: Grid with NPS 2 (DN 50) **OR** NPS 3 (DN 80), **as directed**, outlet.

DD. Laundry Trays

1. Description: Stand-mounting **OR** Counter-mounting, **as directed**, enameled, cast-iron **OR** plastic, **as directed**, laundry trays.
 - a. Size: 24 by 21 inches (610 by 535 mm) **OR** 25 by 22 inches (635 by 560 mm), **as directed**.
 - b. Color: Not applicable.
 - c. Faucet: Sink type, polished, chrome-plated, solid brass, for fixture-ledge **OR** wall **OR** counter, **as directed**, mounting.
 - d. Supplies: NPS 1/2 (DN 15) chrome-plated copper with stops **OR** copper tubing with ball, gate, or globe valves, **as directed**.
 - e. Drain: Grid with NPS 1-1/2 (DN 40) outlet.
 - f. Drain Piping: NPS 1-1/2 (DN 40) chrome-plated, cast-brass P-trap; 0.045-inch- (1.1-mm-) thick tubular brass waste to wall; and wall escutcheon.

OR

Drain Piping: Schedule 40 ABS **OR** PVC, **as directed**, NPS 1-1/2 (DN 40) P-trap; tubular waste to wall; and wall escutcheon.

- g. Stand: Not required **OR** Painted steel, **as directed**.

EE. Sacristy Sinks

1. Description: Two-bowl, counter-mounting, stainless-steel fixture.
 - a. Size: Approximately 22 by 42 inches (560 by 1070 mm).
 - b. Cover: Hinged with lock on left **OR** right, **as directed**, bowl.
 - c. Supplies: NPS 1/2 (DN 15) chrome-plated copper with stops.
 - d. Drains: One with stopper and one with grid.
 - e. Drain Piping: NPS 1-1/2 (DN 40) chrome-plated, tubular-brass waste. Include one trap, one direct waste without trap, separate waste piping, and wall flanges.

1.3 EXECUTION

A. Installation

1. Assemble plumbing fixtures, trim, fittings, and other components according to manufacturers' written instructions.
2. Install off-floor supports, affixed to building substrate, for wall-mounting fixtures.
 - a. Use carrier supports with waste fitting and seal for back-outlet fixtures.
 - b. Use carrier supports without waste fitting for fixtures with tubular waste piping.
 - c. Use chair-type carrier supports with rectangular steel uprights for accessible fixtures.
3. Install back-outlet, wall-mounting fixtures onto waste fitting seals and attach to supports.
4. Install floor-mounting fixtures on closet flanges or other attachments to piping or building substrate.
5. Install wall-mounting fixtures with tubular waste piping attached to supports.
6. Install floor-mounting, back-outlet water closets attached to building floor substrate and wall bracket and onto waste fitting seals.
7. Install counter-mounting fixtures in and attached to casework.
8. Install fixtures level and plumb according to roughing-in drawings.
9. Install water-supply piping with stop on each supply to each fixture to be connected to water distribution piping. Attach supplies to supports or substrate within pipe spaces behind fixtures. Install stops in locations where they can be easily reached for operation.
 - a. Exception: Use ball, gate, or globe valves if supply stops are not specified with fixture. Valves are specified in Division 22 Section "General-duty Valves For Plumbing Piping".
10. Install trap and tubular waste piping on drain outlet of each fixture to be directly connected to sanitary drainage system.
11. Install tubular waste piping on drain outlet of each fixture to be indirectly connected to drainage system.
12. Install flushometer valves for accessible water closets and urinals with handle mounted on wide side of compartment. Install other actuators in locations that are easy for people with disabilities to reach.
13. Install tanks for accessible, tank-type water closets with lever handle mounted on wide side of compartment.
14. Install toilet seats on water closets.
15. Install trap-seal liquid in dry urinals.
16. Install faucet-spout fittings with specified flow rates and patterns in faucet spouts if faucets are not available with required rates and patterns. Include adapters if required.
17. Install water-supply flow-control fittings with specified flow rates in fixture supplies at stop valves.
18. Install faucet flow-control fittings with specified flow rates and patterns in faucet spouts if faucets are not available with required rates and patterns. Include adapters if required.
19. Install shower flow-control fittings with specified maximum flow rates in shower arms.
20. Install traps on fixture outlets.
 - a. Exception: Omit trap on fixtures with integral traps.

- b. Exception: Omit trap on indirect wastes, unless otherwise indicated.
21. Install disposer in outlet of each sink indicated to have disposer. Install switch where indicated or in wall adjacent to sink if location is not indicated.
 22. Install dishwasher air-gap fitting at each sink indicated to have air-gap fitting. Install in sink deck **OR** on countertop at sink, **as directed**. Connect inlet hose to dishwasher and outlet hose to disposer.
 23. Install hot-water dispensers in back top surface of sink or in countertop with spout over sink.
 24. Install escutcheons at piping wall ceiling penetrations in exposed, finished locations and within cabinets and millwork. Use deep-pattern escutcheons if required to conceal protruding fittings. Escutcheons are specified in Division 22 Section "Common Work Results For Plumbing".
 25. Set bathtubs, shower receptors, and service basins in leveling bed of cement grout. Grout is specified in Division 22 Section "Common Work Results For Plumbing".
 26. Seal joints between fixtures and walls, floors, and countertops using sanitary-type, one-part, mildew-resistant silicone sealant. Match sealant color to fixture color. Sealants are specified in Division 07 Section "Joint Sealants".

B. Connections

1. Piping installation requirements are specified in other Division 14. Drawings indicate general arrangement of piping, fittings, and specialties.
2. Connect fixtures with water supplies, stops, and risers, and with traps, soil, waste, and vent piping. Use size fittings required to match fixtures.
3. Ground equipment according to Division 26 Section "Grounding And Bonding For Electrical Systems".
4. Connect wiring according to Division 26 Section "Low-voltage Electrical Power Conductors And Cables".

C. Field Quality Control

1. Verify that installed plumbing fixtures are categories and types specified for locations where installed.
2. Check that plumbing fixtures are complete with trim, faucets, fittings, and other specified components.
3. Inspect installed plumbing fixtures for damage. Replace damaged fixtures and components.
4. Test installed fixtures after water systems are pressurized for proper operation. Replace malfunctioning fixtures and components, then retest. Repeat procedure until units operate properly.
5. Install fresh batteries in sensor-operated mechanisms.

D. Adjusting

1. Operate and adjust faucets and controls. Replace damaged and malfunctioning fixtures, fittings, and controls.
2. Operate and adjust disposers, hot-water dispensers, and controls. Replace damaged and malfunctioning units and controls.
3. Adjust water pressure at faucets and flushometer valves to produce proper flow and stream.
4. Replace washers and seals of leaking and dripping faucets and stops.
5. Install fresh batteries in sensor-operated mechanisms.

E. Cleaning

1. Clean fixtures, faucets, and other fittings with manufacturers' recommended cleaning methods and materials. Do the following:
 - a. Remove faucet spouts and strainers, remove sediment and debris, and reinstall strainers and spouts.
 - b. Remove sediment and debris from drains.
2. After completing installation of exposed, factory-finished fixtures, faucets, and fittings, inspect exposed finishes and repair damaged finishes.

- F. Protection
1. Provide protective covering for installed fixtures and fittings.
 2. Do not allow use of plumbing fixtures for temporary facilities unless approved in writing by the Owner.

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Task	Specification	Specification Description
10 28 19 19	10 28 19 16	Plumbing Fixtures

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SECTION 10 44 13 00 - FIRE PROTECTION CABINETS

1.1 GENERAL

A. Description Of Work:

1. This specification covers the furnishing and installation of materials for fire extinguisher cabinets. Product shall be as follows or as directed by the Owner. Installation procedures shall be in accordance with the product manufacturer's recommendations. Demolition and removal of materials shall be as required to support the work.

B. Summary

1. Section Includes:
 - a. Fire protection cabinets for the following:
 - 1) Portable fire extinguishers.
 - 2) Fire hose valves.
 - 3) Fire hoses and racks.

C. Submittals

1. Product Data: For each type of product indicated.
2. Show location of knockouts for hose valves.
3. Shop Drawings: For fire protection cabinets. Include plans, elevations, sections, details, and attachments to other work.
4. Samples: For each type of fire protection cabinet indicated.
5. Maintenance Data.

D. Quality Assurance

1. Fire-Rated, Fire Protection Cabinets: Listed and labeled to comply with requirements in ASTM E 814 for fire-resistance rating of walls where they are installed.
2. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

E. Coordination

1. Coordinate size of fire protection cabinets to ensure that type and capacity of fire extinguishers indicated are accommodated.
2. Coordinate size of fire protection cabinets to ensure that type and capacity of fire hoses, hose valves, and hose racks indicated are accommodated.
3. Coordinate sizes and locations of fire protection cabinets with wall depths.

F. Sequencing

1. Apply decals **OR** vinyl lettering, **as directed**, on field-painted, fire protection cabinets after painting is complete.

1.2 PRODUCTS

A. Materials

1. Cold-Rolled Steel Sheet: ASTM A 1008/A 1008M, Commercial Steel (CS), Type B.
2. Aluminum: Alloy and temper recommended by aluminum producer and manufacturer for type of use and finish indicated, and as follows:
 - a. Sheet: **ASTM B 209 (ASTM B 209M)**.
 - b. Extruded Shapes: **ASTM B 221 (ASTM B 221M)**.
3. Stainless-Steel Sheet: ASTM A 666, Type 304.
4. Copper-Alloy Brass Sheet: ASTM B 36/B 36M, alloy UNS No. C26000 (cartridge brass, 70 percent copper).



5. Copper-Alloy Bronze Sheet: ASTM B 36/B 36M, alloy UNS No. C28000 (muntz metal, 60 percent copper).
6. Clear Float Glass: ASTM C 1036, Type I, Class 1, Quality q3, 3 **OR** 6, **as directed**, mm thick.
7. Tempered Float Glass: ASTM C 1048, Kind FT, Condition A, Type I, Quality q3, 3 mm thick, Class 1 (clear) **OR** Class 2 (tinted, heat absorbing, and light reducing), bronze tint, **as directed**.
8. Break Glass: Clear annealed float glass, ASTM C 1036, Type I, Class 1, Quality q3, 1.5 mm thick, single strength.
9. Tempered Break Glass: ASTM C 1048, Kind FT, Condition A, Type I, Quality q3, 1.5 mm thick.
10. Wire Glass: ASTM C 1036, Type II, Class 1, Form 1, Quality q8, Mesh m1 (diamond), 6 mm thick.
11. Transparent Acrylic Sheet: ASTM D 4802, Category A-1 (cell-cast sheet), 1.5 **OR** 3 **OR** 6, **as directed**, mm thick, with Finish 1 (smooth or polished) **OR** Finish 2 (patterned, textured), **as directed**.
12. Acrylic Bubble: One piece.

B. Fire Protection Cabinet

1. Cabinet Type: Suitable for fire extinguisher **OR** extinguisher and hose valve **OR** hose, rack, valve, and extinguisher **OR** hose, rack, and valve **OR** hose valve, **as directed**.
2. Cabinet Construction: Nonrated **OR** 1-hour fire rated **OR** 2-hour fire rated, **as directed**.
 - a. Fire-Rated Cabinets: Construct fire-rated cabinets with double walls fabricated from **0.0428-inch- (1.1-mm-)** thick, cold-rolled steel sheet lined with minimum **5/8-inch- (16-mm-)** thick, fire-barrier material. Provide factory-drilled mounting holes.
3. Cabinet Material: Steel **OR** Aluminum **OR** Stainless-steel, **as directed**, sheet.
 - a. Shelf: Same metal and finish as cabinet.
4. Recessed Cabinet: Cabinet box recessed in walls of sufficient depth to suit style of trim indicated.
 - a. Trimless with Concealed Flange: Surface of surrounding wall finishes flush with exterior finished surface of cabinet frame and door, without overlapping trim attached to cabinet. Provide recessed flange, of same material as box, attached to box to act as plaster stop **OR** drywall bead, **as directed**.
 - b. Trimless with Hidden Flange: Flange of same metal and finish as box overlaps surrounding wall finish and is concealed from view by an overlapping door.
 - c. Exposed Flat Trim: One-piece combination trim and perimeter door frame overlapping surrounding wall surface with exposed trim face and wall return at outer edge (backbend).
5. Semirecessed Cabinet: Cabinet box partially recessed in walls of sufficient depth to suit style of trim indicated; with one-piece combination trim and perimeter door frame overlapping surrounding wall surface with exposed trim face and wall return at outer edge (backbend). Provide where walls are of insufficient depth for recessed cabinets but are of sufficient depth to accommodate semirecessed cabinet installation.
 - a. Square-Edge Trim: **1-1/4- to 1-1/2-inch (32- to 38-mm)** backbend depth.
 - b. Rolled-Edge Trim: **2-1/2-inch (64-mm) OR 4-inch (102-mm) OR 4-1/2-inch (114-mm)**, **as directed**, backbend depth.
6. Surface-Mounted Cabinet: Cabinet box fully exposed and mounted directly on wall with no trim. Provide where walls are of insufficient depth for semirecessed cabinet installation.
7. Cabinet Trim Material: Steel sheet **OR** Aluminum sheet **OR** Extruded-aluminum shapes **OR** Stainless-steel sheet **OR** Copper-alloy brass sheet **OR** Copper-alloy bronze sheet **OR** Same material and finish as door, **as directed**.
8. Door Material: Steel sheet **OR** Aluminum sheet **OR** Extruded-aluminum shapes **OR** Stainless-steel sheet **OR** Copper-alloy brass sheet **OR** Copper-alloy bronze sheet, **as directed**.
9. Door Style: Fully glazed, frameless, backless, acrylic panel **OR** Fully glazed panel with frame **OR** Full bubble, frameless **OR** Full bubble with frame **OR** Full bubble with frameless, rotating turntable **OR** Horizontal duo panel with frame **OR** Vertical duo panel with frame **OR** Center glass panel with frame **OR** Solid opaque panel with frame **OR** Flush opaque panel, frameless, with no exposed hinges, **as directed**.

10. Door Glazing: Clear float glass **OR** Tempered float glass (clear) **OR** Tempered float glass (bronze tint) **OR** Break glass **OR** Tempered break glass **OR** Wire glass **OR** Mirror glass **OR** Acrylic sheet **OR** Break acrylic bubble **OR** Molded acrylic bubble, **as directed**.
 - a. Acrylic Sheet Color: Clear **OR** Bronze, **as directed**, transparent acrylic sheet.
 - b. Acrylic Sheet Color: Clear transparent acrylic sheet painted white **OR** red **OR** black, **as directed**, on unexposed side.
 - c. Acrylic Bubble Color: Clear **OR** Bronze **OR** Red, **as directed**, transparent.
11. Door Hardware: Manufacturer's standard door-operating hardware of proper type for cabinet type, trim style, and door material and style indicated.
 - a. Provide projecting lever handle with cam-action latch **OR** projecting door pull and friction latch **OR** recessed door pull and friction latch **OR** manufacturer's standard, **as directed**.
 - b. Provide continuous hinge, of same material and finish as trim, **OR** concealed hinge **OR** pivot hinge **OR** manufacturer's standard hinge, **as directed**, permitting door to open 180 degrees.
12. Accessories:
 - a. Mounting Bracket: Manufacturer's standard steel, designed to secure fire extinguisher to fire protection cabinet, of sizes required for types and capacities of fire extinguishers indicated, with plated or baked-enamel finish.
 - b. Break-Glass Strike: Manufacturer's standard metal strike, complete with chain and mounting clip, secured to cabinet.
 - c. Lettered Door Handle: One-piece, cast-iron door handle with the word "FIRE" embossed into face.
 - d. Door Lock: Cam lock that allows door to be opened during emergency by pulling sharply on door handle **OR** Cylinder lock, keyed alike to other cabinets, **as directed**.
 - e. Identification: Lettering complying with authorities having jurisdiction for letter style, size, spacing, and location. Locate as directed.
 - 1) Identify fire extinguisher in fire protection cabinet with the words "FIRE EXTINGUISHER."
 - a) Location: Applied to cabinet door **OR** cabinet glazing **OR** location indicated on Drawings, **as directed**.
 - b) Application Process: Silk-screened **OR** Engraved **OR** Etched **OR** Decals **OR** Pressure-sensitive vinyl letters, **as directed**.
 - c) Lettering Color: Red **OR** Black **OR** White, **as directed**.
 - d) Orientation: Vertical **OR** Horizontal **OR** As indicated on Drawings, **as directed**.
 - f. Alarm: Manufacturer's standard alarm that actuates when fire protection cabinet door is opened and that is powered by batteries **OR** low voltage, complete with transformer, **as directed**.
13. Finishes:
 - a. Manufacturer's standard baked-enamel paint for the following:
 - 1) Exterior of cabinet door **OR** trim, **OR** door, and trim, **as directed**, except for those surfaces indicated to receive another finish.
 - 2) Interior of cabinet and door, **as directed**.
 - b. Aluminum: Clear anodic **OR** Color anodic **OR** Baked enamel or powder coat, **as directed**.
 - c. Steel: Factory primed for field painting **OR** Baked enamel or powder coat, **as directed**.
 - d. Stainless Steel: No. 2B **OR** No. 4 **OR** No. 6 **OR** No. 7 **OR** No. 8, **as directed**.
 - e. Copper Alloy, Brass: Buffed **OR** Hand rubbed **OR** Hand rubbed, lacquered **OR** Medium satin **OR** Fine matte **OR** Statuary conversion **OR** Patina conversion, **as directed**.
 - f. Copper Alloy, Bronze: Buffed **OR** Hand rubbed **OR** Hand rubbed, lacquered **OR** Medium satin **OR** Fine matte **OR** Statuary conversion **OR** Patina conversion, **as directed**.

C. Security Fire Protection Cabinet

1. Cabinet Type: Suitable for fire extinguisher **OR** extinguisher and hose valve **OR** hose, rack, valve, and extinguisher **OR** hose, rack, and valve **OR** hose valve, **as directed**.
2. Cabinet Construction: Nonrated **OR** 1-hour fire rated **OR** 2-hour fire rated, **as directed**.

- a. Fire-Rated Cabinets: Construct fire-rated cabinets with double walls lined with minimum **5/8-inch- (16-mm-)** thick, fire-barrier material.
3. Cabinet Material: **0.0677-inch- (1.7-mm-)** thick steel **OR** **0.0966-inch- (2.5-mm-)** thick steel **OR** **0.0781-inch- (2.0-mm-)** thick, stainless-steel, **as directed**, sheet.
 - a. Shelf: Same metal and finish as cabinet.
4. Recessed Cabinet: Cabinet box recessed in walls of sufficient depth to suit style of trim indicated.
 - a. Exposed Flat Trim: One-piece combination trim and perimeter door frame overlapping surrounding wall surface with exposed trim face and wall return at outer edge (backbend).
5. Semirecessed Cabinet: Cabinet box partially recessed in walls of sufficient depth to suit style of trim indicated; with one-piece combination trim and perimeter door frame overlapping surrounding wall surface with exposed trim face and wall return at outer edge (backbend). Provide where walls are of insufficient depth for recessed cabinets but are of sufficient depth to accommodate semirecessed cabinet installation.
 - a. Square-Edge Trim: **1-1/4- to 1-1/2-inch (32- to 38-mm)** backbend depth.
 - b. Rolled-Edge Trim: **2-1/2-inch (64-mm)** backbend depth.
6. Surface-Mounted Cabinet: Cabinet box fully exposed and mounted directly on wall; with no trim. Provide where walls are of insufficient depth for semirecessed cabinet installation.
7. Cabinet Trim Material: Steel sheet **OR** Stainless-steel sheet **OR** Same material and finish as door, **as directed**.
8. Door Material: **0.0966-inch- (2.5-mm-)** thick steel **OR** **0.0781-inch- (2.0-mm-)** thick, stainless-steel **OR** **0.1094-inch- (2.8-mm-)** thick, stainless-steel, **as directed**, sheet.
9. Door Style: Solid opaque panel with frame.
10. Door Hardware: Manufacturer's standard door-operating hardware of proper type for cabinet type, trim style, and door material and style indicated, and as follows:
 - a. Recessed door pull.
 - b. Continuous Hinge: Same material and finish as trim, permitting door to open 180 degrees.
 - c. Mechanical Deadlock: Lockbolt retracted and extended by five-tumbler paracentric **OR** mogul, **as directed**, cylinder; keyed one side.
 - 1) Lockbolt: **1-1/2 inches high by 3/4 inch (38 mm high by 19 mm)** thick; **5/8-inch (16-mm)** throw.
 - d. Mechanical Deadlock: As specified in Division 08 Section "Detention Door Hardware".
 - e. Mechanical Snaplatch: Automatic snaplatch when closed; latchbolt retracted by five-tumbler paracentric **OR** mogul, **as directed**, cylinder; keyed one side.
 - 1) Lockbolt: **1 inch high by 7/16 inch (25 mm high by 11 mm)** thick; **5/16-inch (8-mm)** throw.
 - f. Mechanical Snaplatch: As specified in Division 08 Section "Detention Door Hardware".
11. Accessories:
 - a. Mounting Bracket: Manufacturer's standard steel, designed to secure fire extinguisher to security fire protection cabinet, of sizes required for types and capacities of fire extinguishers indicated, with plated or baked-enamel finish.
 - b. Identification: Lettering complying with authorities having jurisdiction for letter style, size, spacing, and location. Locate as directed.
 - 1) Identify fire extinguisher in security fire protection cabinet with the words "FIRE EXTINGUISHER."
 - a) Location: Applied to cabinet door **OR** location indicated on Drawings, **as directed**.
 - b) Application Process: Silk-screened **OR** Engraved **OR** Etched **OR** Decals **OR** Pressure-sensitive vinyl letters, **as directed**.
 - c) Lettering Color: Red **OR** Black **OR** White, **as directed**.
 - d) Orientation: Vertical **OR** Horizontal **OR** As indicated on Drawings, **as directed**.
 - c. Keys to Door Locks: Three per lock.
12. Finishes:
 - a. Manufacturer's standard baked-enamel paint for the following:

- 1) Exterior of cabinet door **OR** trim, **OR** door, and trim, **as directed**, except for those surfaces indicated to receive another finish.
 - 2) Interior of cabinet and door, **as directed**.
 - b. Steel: Factory primed for field painting **OR** Baked enamel or powder coat, **as directed**.
 - c. Stainless Steel: No. 4 finish.
- D. Fabrication
1. Fire Protection Cabinets: Provide manufacturer's standard box (tub) with trim, frame, door, and hardware to suit cabinet type, trim style, and door style indicated.
 - a. Weld joints and grind smooth.
 - b. Provide factory-drilled mounting holes.
 - c. Prepare doors and frames to receive locks.
 - d. Install door locks at factory.
 2. Cabinet Doors: Fabricate doors according to manufacturer's standards, from materials indicated and coordinated with cabinet types and trim styles selected.
 - a. Fabricate door frames with tubular stiles and rails and hollow-metal design, minimum **1/2 inch (13 mm)** thick.
 - b. Fabricate door frames of one-piece construction with edges flanged.
 - c. Miter and weld perimeter door frames.
 3. Cabinet Trim: Fabricate cabinet trim in one piece with corners mitered, welded, and ground smooth.
- E. General Finish Requirements
1. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
 2. Protect mechanical finishes on exposed surfaces of fire protection cabinets from damage by applying a strippable, temporary protective covering before shipping.
 3. Finish fire protection cabinets after assembly.
 4. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.
- F. Aluminum Finishes
1. Clear Anodic Finish: AAMA 611, AA-M12C22A41, Class I, 0.018 mm **OR** AA-M12C22A31, Class II, 0.010 mm, **as directed**, or thicker.
 2. Color Anodic Finish: AAMA 611, AA-M12C22A42/A44, Class I, 0.018 mm **OR** AA-M12C22A32/A34, Class II, 0.010 mm, **as directed**, or thicker.
 - a. Color: Light bronze **OR** Medium bronze **OR** Dark bronze **OR** Black, **as directed**.
 - b. Color: As selected from full range of industry colors and color densities, **as directed**.
 3. Baked-Enamel or Powder-Coat Finish: AAMA 2603 except with a minimum dry film thickness of **1.5 mils (0.04 mm)**. Comply with coating manufacturer's written instructions for cleaning, conversion coating, and applying and baking finish.
 - a. Color and Gloss: As indicated by manufacturer's designations **OR** As selected from manufacturer's full range, **as directed**.
- G. Steel Finishes
1. Surface Preparation: Remove mill scale and rust, if present, from uncoated steel, complying with SSPC-SP 5/NACE No. 1, "White Metal Blast Cleaning" **OR** SSPC-SP 8, "Pickling", **as directed**. After cleaning, apply a conversion coating suited to the organic coating to be applied over it, **as directed**.
 2. Factory Prime Finish: Apply manufacturer's standard, fast-curing, lead- and chromate-free, universal primer immediately after surface preparation and pretreatment.
 3. Baked-Enamel or Powder-Coat Finish: Immediately after cleaning and pretreating, apply manufacturer's standard two-coat, baked-on finish consisting of prime coat and thermosetting topcoat. Comply with coating manufacturer's written instructions for applying and baking to achieve a minimum dry film thickness of **2 mils (0.05 mm)**.



- a. Color and Gloss: As indicated by manufacturer's designations **OR** As selected from manufacturer's full range, **as directed**.

H. Stainless-Steel Finishes

1. Surface Preparation: Remove tool and die marks and stretch lines, or blend into finish.
2. Polished Finishes: Grind and polish surfaces to produce uniform finish, free of cross scratches.
 - a. Run grain of directional finishes with long dimension of each piece.
 - b. When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.
 - c. Directional Satin Finish: No. 4.
 - d. Dull Satin Finish: No. 6.
 - e. Reflective, Directional Polish: No. 7.
 - f. Mirrorlike Reflective, Nondirectional Polish: No. 8.
3. Bright, Cold-Rolled, Unpolished Finish: No. 2B.

I. Copper-Alloy Finishes

1. Buffed Finish, Lacquered: M21-O6x (Mechanical Finish: buffed, smooth specular; Coating: clear organic, air drying, as specified below).
 - a. Clear, Organic Coating: Lacquer specified for copper alloys, applied by air spray in 2 coats per manufacturer's written instructions, with interim drying, to a total thickness of **1 mil (0.025 mm)**.
2. Hand-Rubbed Finish, Lacquered: M31-M34-O6x (Mechanical Finish: directionally textured, fine satin; Mechanical Finish: directionally textured, hand rubbed; Coating: clear organic, air drying, as specified below).
 - a. Clear, Organic Coating: Lacquer specified for copper alloys, applied by air spray in 2 coats per manufacturer's written instructions, with interim drying, to a total thickness of **1 mil (0.025 mm)**.
3. Statuary Conversion Coating over Satin Finish: M31-C55 (Mechanical Finish: directionally textured, fine satin; Chemical Finish: conversion coating, sulfide).
 - a. Color: Match sample.
4. Patina Conversion Coating: CDA-M36-C12-C52 (Mechanical Finish: directionally textured, uniform; Chemical Finish: nonetched cleaned, degreased; Chemical Finish: conversion coating, ammonium sulfate).
 - a. Color: Match sample.

1.3 EXECUTION

A. Preparation

1. Prepare recesses for recessed and semirecessed fire protection cabinets as required by type and size of cabinet and trim style.

B. Installation

1. General: Install fire protection cabinets in locations and at mounting heights indicated or, if not indicated, at heights indicated below: or, if not indicated, at heights acceptable to authorities having jurisdiction.
 - a. Fire Protection Cabinets: **54 inches (1372 mm)** above finished floor to top of cabinet.
2. Fire Protection Cabinets: Fasten cabinets to structure, square and plumb.
 - a. Unless otherwise indicated, provide recessed fire protection cabinets. If wall thickness is not adequate for recessed cabinets, provide semirecessed fire protection cabinets.
 - b. Provide inside latch and lock for break-glass panels.
 - c. Fasten mounting brackets to inside surface of fire protection cabinets, square and plumb.
 - d. Fire-Rated, Hose and Valve **OR** Hose-Valve, **as directed**, Cabinets:
 - 1) Install cabinet with not more than **1/16-inch (1.6-mm)** tolerance between pipe OD and knockout OD. Center pipe within knockout.

- 2) Seal through penetrations with firestopping sealant as specified in Division 07 Section "Penetration Firestopping".
3. Identification: Apply decals **OR** vinyl lettering, **as directed**, at locations indicated.
- C. Adjusting And Cleaning
 1. Remove temporary protective coverings and strippable films, if any, as fire protection cabinets are installed unless otherwise indicated in manufacturer's written installation instructions.
 2. Adjust fire protection cabinet doors to operate easily without binding. Verify that integral locking devices operate properly.
 3. On completion of fire protection cabinet installation, clean interior and exterior surfaces as recommended by manufacturer.
 4. Touch up marred finishes, or replace fire protection cabinets that cannot be restored to factory-finished appearance. Use only materials and procedures recommended or furnished by fire protection cabinet and mounting bracket manufacturers.
 5. Replace fire protection cabinets that have been damaged or have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

END OF SECTION 10 44 13 00

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SECTION 10 44 16 13 - FIRE EXTINGUISHERS

1.1 GENERAL

A. Description Of Work:

1. This specification covers the furnishing and installation of materials for fire extinguishers. Product shall be as follows or as directed by the Owner. Installation procedures shall be in accordance with the product manufacturer's recommendations. Demolition and removal of materials shall be as required to support the work.

B. Summary

1. Section includes portable, hand-carried and wheeled fire extinguishers and mounting brackets for fire extinguishers.
2. Owner-Furnished Material: Hand-carried **OR** Wheeled, **as directed**, fire extinguishers.

C. Submittals

1. Product Data: For each type of product indicated.
2. Operation and maintenance data.
3. Warranty: Sample of special warranty.

D. Quality Assurance

1. NFPA Compliance: Fabricate and label fire extinguishers to comply with NFPA 10, "Portable Fire Extinguishers."
2. Fire Extinguishers: Listed and labeled for type, rating, and classification by an independent testing agency acceptable to authorities having jurisdiction.
3. Preinstallation Conference: Conduct conference at Project site.
4. Coordinate type and capacity of fire extinguishers with fire protection cabinets to ensure fit and function.

E. Warranty

1. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace fire extinguishers that fail in materials or workmanship within six years from date of Final Completion.
 - a. Failures include, but are not limited to, the following:
 - 1) Failure of hydrostatic test according to NFPA 10.
 - 2) Faulty operation of valves or release levers.

1.2 PRODUCTS

A. Portable, Hand-Carried Fire Extinguishers

1. Fire Extinguishers: Type, size, and capacity for each fire protection cabinet **OR** mounting bracket **OR** fire protection cabinet and mounting bracket, **as directed**, indicated.
 - a. Valves: Manufacturer's standard **OR** Nickel-plated, polished brass body, **as directed**.
 - b. Handles and Levers: Manufacturer's standard **OR** Stainless steel, **as directed**.
 - c. Instruction Labels: Include pictorial marking system complying with NFPA 10, Appendix B and bar coding for documenting fire extinguisher location, inspections, maintenance, and recharging.
2. Stored-Pressure Water Type: UL-rated 2-A, **2.5-gal. (9.5-L)** nominal capacity, with water in stainless-steel container; with pressure-indicating gage.
3. Stored-Pressure Antifreeze Water Type: UL-rated 2-A, **2.5-gal. (9.5-L)** nominal capacity, with water and approved antifreeze solution mixed for temperatures as low as **minus 40 deg F (minus 40 deg C)** in stainless-steel container; with pressure-indicating gage.

4. Stored-Pressure Water-Mist Type: UL-rated 2-A:C, **2.5-gal. (9.5-L)** nominal capacity, with water in enameled-steel container; with pressure-indicating gage.
5. Pressurized, AFFF-Foam Type: UL-rated 2-A:10-B, **1.6-gal. (6-L)** **OR** 3-A:20-B, **2.5-gal. (9.5-L)**, **as directed**, nominal capacity, with AFFF foam in stainless-steel container; with pressure-indicating gage.
6. Pressurized, FFFP-Foam Type: UL-rated 3-A:20-B, **2.5-gal. (9.5-L)** nominal capacity, with FFFP foam in stainless-steel container; with pressure-indicating gage.
7. Wet-Chemical Type: UL-rated 2-A:1-B:C:K, **1.6-gal. (6-L)** **OR** **2.5-gal. (9.5-L)**, **as directed**, nominal capacity, with potassium acetate-based **OR** citrate-based **OR** carbonate-based, **as directed**, chemical in stainless-steel container; with pressure-indicating gage.
8. Regular Dry-Chemical Type: UL-rated **<Insert capacity>** nominal capacity, with sodium bicarbonate-based dry chemical in manufacturer's standard enameled container.
9. Regular Dry-Chemical Type in Steel Container: UL-rated 2-B:C, **1-lb (0.4-kg)** **OR** 10-B:C, **2.5-lb (1.1-kg)** **OR** 10-B:C, **5-lb (2.3-kg)** **OR** 40-B:C, **5.5-lb (2.5-kg)** **OR** 40-B:C, **6-lb (2.7-kg)** **OR** 60-B:C, **10-lb (4.5-kg)** **OR** 120-B:C, **20-lb (9.1-kg)**, **as directed**, nominal capacity, with sodium bicarbonate-based dry chemical in enameled-steel container.
10. Regular Dry-Chemical Type in Aluminum Container: UL-rated 2-B:C, **1-lb (0.4-kg)** **OR** 10-B:C, **2.5-lb (1.1-kg)** **OR** 10-B:C, **5-lb (2.3-kg)** **OR** 40-B:C, **5.5-lb (2.5-kg)** **OR** 60-B:C, **10-lb (4.5-kg)** **OR** 120-B:C, **20-lb (9.1-kg)**, **as directed**, nominal capacity, with sodium bicarbonate-based dry chemical in enameled-aluminum container.
11. Regular Dry-Chemical Type in Brass Container: UL-rated 40-B:C, **6-lb (2.7-kg)** **OR** 60-B:C, **10-lb (4.5-kg)** **OR** 120-B:C, **20-lb (9.1-kg)**, **as directed**, nominal capacity, with sodium bicarbonate-based dry chemical in chrome-plated brass container.
12. Multipurpose Dry-Chemical Type: UL-rated **<Insert capacity>** nominal capacity, with monoammonium phosphate-based dry chemical in manufacturer's standard enameled container.
13. Multipurpose Dry-Chemical Type in Steel Container: UL-rated 1-A:10-B:C, **2.5-lb (1.1-kg)** **OR** 2-A:10-B:C, **5-lb (2.3-kg)** **OR** 3-A:40-B:C, **5-lb (2.3-kg)** **OR** 3-A:40-B:C, **6-lb (2.7-kg)** **OR** 4-A:60-B:C, **10-lb (4.5-kg)** **OR** 20-A:120-B:C, **20-lb (9.1-kg)**, **as directed**, nominal capacity, with monoammonium phosphate-based dry chemical in enameled-steel container.
14. Multipurpose Dry-Chemical Type in Aluminum Container: UL-rated 1-A:10-B:C, **2.5-lb (1.1-kg)** **OR** 2-A:10-B:C, **5-lb (2.3-kg)** **OR** 3-A:40-B:C, **5-lb (2.3-kg)** **OR** 3-A:40-B:C, **6-lb (2.7-kg)** **OR** 4-A:60-B:C, **10-lb (4.5-kg)** **OR** 20-A:120-B:C, **20-lb (9.1-kg)**, **as directed**, nominal capacity, with monoammonium phosphate-based dry chemical in enameled-aluminum container.
15. Multipurpose Dry-Chemical Type in Brass Container: UL-rated 2-A:10-B:C, **5-lb (2.3-kg)** **OR** 3-A:40-B:C, **6-lb (2.7-kg)** **OR** 4-A:60-B:C, **10-lb (4.5-kg)** **OR** 4-A:80-B:C, **10-lb (4.5-kg)** **OR** 20-A:120-B:C, **20-lb (9.1-kg)**, **as directed**, nominal capacity, with monoammonium phosphate-based dry chemical in chrome-plated brass container.
16. Purple-K Dry-Chemical Type in Aluminum Container: UL-rated 10-B:C, **2.5-lb (1.1-kg)** **OR** 30-B:C, **5-lb (2.3-kg)** **OR** 120-B:C, **20-lb (9.1-kg)**, **as directed**, nominal capacity, with potassium bicarbonate-based dry chemical in enameled-aluminum container.
17. Purple-K Dry-Chemical Type in Brass Container: UL-rated 80-B:C, **10-lb (4.5-kg)** **OR** 120-B:C, **20-lb (9.1-kg)**, **as directed**, nominal capacity, with potassium bicarbonate-based dry chemical in chrome-plated brass container.
18. Carbon Dioxide Type: UL-rated 5-B:C, **5-lb (2.3-kg)** **OR** 10-B:C, **10-lb (4.5-kg)** **OR** 10-B:C, **15-lb (6.8-kg)** **OR** 10-B:C, **20-lb (9.1-kg)**, **as directed**, nominal capacity, with carbon dioxide in manufacturer's standard enameled-metal **OR** enameled-steel **OR** enameled-aluminum, **as directed** container.
19. Dry-Powder Type: FMG-approved, **as directed**, UL-rated Class D, **30-lb (13.6-kg)** nominal capacity, with sodium chloride-based **OR** copper-based, **as directed**, powder in enameled-steel container; with pressure-indicating gage.
20. Halon Type: UL-rated 5-B:C, **2.5-lb (1.1-kg)** **OR** 10-B:C, **5-lb (2.3-kg)**, **as directed**, nominal capacity, in enameled-steel container; with pressure-indicating gage.
21. Clean-Agent Type in Aluminum Container: UL-rated 1-B:C, **1.4-lb (0.6-kg)** **OR** 2-B:C, **2.5-lb (1.1-kg)** **OR** 5-B:C, **5-lb (2.3-kg)**, **as directed**, nominal capacity, with HCFC Blend B agent and inert material in enameled-aluminum container; with pressure-indicating gage.

22. Clean-Agent Type in Brass Container: UL-rated 1-A:10-B:C, **11-lb (5-kg)** OR 2-A:10-B:C, **15.5-lb (7-kg)**, **as directed**, nominal capacity, with HCFC Blend B agent and inert material in chrome-plated brass container; with pressure-indicating gage.
23. Clean-Agent Type in Steel Container: UL-rated 5-B:C, **4.75-lb (2.2-kg)** OR 1-A:10-B:C, **10-lb (4.5-kg)** OR 2-A:10-B:C, **14-lb (6.4-kg)**, **as directed**, nominal capacity, with HFC blend agent and inert material in enameled-steel container; with pressure-indicating gage.

B. Mounting Brackets

1. Mounting Brackets: Manufacturer's standard galvanized, **as directed**, steel, designed to secure fire extinguisher to wall or structure, of sizes required for types and capacities of fire extinguishers indicated, with plated or red OR black, **as directed**, baked-enamel finish.
2. Identification: Lettering complying with authorities having jurisdiction for letter style, size, spacing, and location.
 - a. Identify bracket-mounted fire extinguishers with the words "FIRE EXTINGUISHER" in red letter decals applied to mounting surface.
 - 1) Orientation: Vertical OR Horizontal, **as directed**.

C. Wheeled Fire Extinguishers

1. Wheeled Fire Extinguishers: Type, size, and capacity for locations indicated, complete with carriage.
 - a. Carriage: Fabricated from enameled-steel pipe, complete with hanger assembly, long-range nozzle, hose, and semipneumatic solid-rubber tires OR wide-rim wheels, **as directed**.
 - 1) Hose: **15 feet (4.6 m)** OR **50 feet (15.2 m)** OR **100 feet (30.5 m)**, **as directed**.
2. Pressurized, FFFP-Foam Type: UL-rated 20-A:160-B, **33-gal. (125-L)** nominal capacity, with FFFP foam in stainless-steel container.
3. Regular Dry-Chemical Type: UL-rated 160-B:C, **50-lb (23-kg)** OR 240-B:C, **150-lb (68-kg)** OR 160-B:C, **250-lb (113-kg)**, **as directed**, nominal capacity, with sodium bicarbonate-based dry chemical in regulated-pressure OR stored-pressure OR direct-pressure, **as directed**, enameled-steel container.
4. Multipurpose Dry-Chemical Type: UL-rated 20-A:160-B:C, **30-lb (13.6-kg)** OR 30-A:160-B:C, **50-lb (23-kg)** OR 40-A:240-B:C, **125-lb (57-kg)** OR 40-A:160-B:C, **250-lb (113-kg)**, **as directed**, nominal capacity, with monoammonium phosphate-based dry chemical in regulated-pressure OR stored-pressure OR direct-pressure, **as directed**, enameled-steel OR enameled-aluminum, **as directed**, container.
5. Purple-K Dry-Chemical Type: UL-rated 160-B:C, **50-lb (23-kg)** OR 320-B:C, **125-lb (57-kg)** OR 160-B:C, **250-lb (113-kg)**, **as directed**, nominal capacity, with potassium bicarbonate-based dry chemical in regulated-pressure OR stored-pressure OR direct-pressure, **as directed**, enameled-steel container.
6. Carbon Dioxide Type: UL-rated 20-B:C, **50-lb (23-kg)** OR 20-B:C, **100-lb (45-kg)**, **as directed**, nominal capacity, with carbon dioxide in manufacturer's standard enameled-metal OR enameled-steel OR enameled-aluminum, **as directed**, container.
7. Dry-Powder Type: FMG-approved, **as directed**, UL-rated Class D, sodium chloride-based powder, **150-lb (68-kg)** OR copper-based powder, **250-lb (113-kg)**, **as directed**, nominal capacity, in regulated-pressure, enameled-steel container; with pressure-indicating gage.
8. Clean-Agent Type: UL-rated 4-A:40-B:C, **65-lb (29-kg)** OR 10-A:80-B:C, **150-lb (68-kg)**, **as directed**, nominal capacity, with HCFC Blend B agent and inert material in stored-pressure, enameled-steel container; with pressure-indicating gage.

1.3 EXECUTION

A. Installation

1. General: Install fire extinguishers and mounting brackets in locations indicated and in compliance with requirements of authorities having jurisdiction.



- a. Mounting Brackets: 54 inches (1372 mm) above finished floor to top of fire extinguisher. If NFPA 10 is the governing code, maximum mounting height for fire extinguishers weighing 40 lb (18 kg) or less shall be 60 inches (1524 mm); for those weighing more, maximum mounting height shall be 42 inches (1067 mm).
2. Mounting Brackets: Fasten mounting brackets to surfaces, square and plumb, at locations indicated.

END OF SECTION 10 44 16 13

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Task	Specification	Specification Description
10 44 16 13	01 22 16 00	No Specification Required
10 44 16 13	10 44 13 00	Fire Protection Cabinets

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SECTION 10 51 13 00 - WIRE BASKET LOCKERS

1.1 GENERAL

A. Description Of Work

1. This specification covers the furnishing and installation of materials for wire basket lockers. Product shall be as follows or as directed by the Owner. Installation procedures shall be in accordance with the product manufacturer's recommendations. Demolition and removal of materials shall be as required to support the work.

B. Submittals

1. Shop Drawings: Submitted shop drawings showing individual locker construction and overall dimensions, including complete installation instructions.

C. Product Handling

1. Store locker components flat until assembly. Protect all finishes from soiling and damage during handling.

D. Warranty

1. Manufacturer shall warranty lockers for a period of 10 years against rust and other types of corrosion, or breakage of any of the baskets and shelves under normal use.

1.2 PRODUCTS

A. Materials

1. Wire Basket Racks:
 - a. Shelving: Shelving units shall consist of minimum 13 ga. steel angle posts punched for bolting shelves.
 - b. Sway Braces: Minimum 12 ga. steel for back and sides of unit.
 - c. Shelves: Minimum 20 ga. formed steel, with down turned flanges at the back to act as backstop and to prevent removal from rear.
 - d. Dividers: Minimum 20 ga., 3-inches in height, with an attaching flange formed at right angles. Dividers shall be bolted to shelves.
 - e. Padlock Attachment: Provide minimum 14 ga. padlock staple attachment at the front edge of each shelf located to match the locking loop formed in the basket rim.
 - f. Casters (Option): 3-inch dia., swivel-type mobility casters bolted to each corner post.
 - g. Number Plates: Aluminum number plates with 3/8" high black letters. Rivet plates to shelf face at each basket opening.
2. Baskets:
 - a. Baskets shall be 12" x 13" x 8" **OR** 9" x 13" x 8", **as directed**, all wire or wire mesh or perforated steel front type. Provide number plates specified above on the front of each basket.
 - b. Pilfer Guards (Option): Provide sheet steel pilfer guard designed for field attachment to the top of the basket to cover the first 3" of depth.
3. Finish:
 - a. Baskets and pilfer guards: electroplating with bright zinc chromate.
 - b. Basket rack posts, shelves, and braces: In color selected from manufacturer's standard colors.

B. Fabrication

1. Locker components shall be fabricated square and rigid with a finish free of scratches and chips. All sides, tops, bottoms, and shelves shall be coated on both sides with a protective masking.



1.3 EXECUTION

A. Installation

1. Install lockers at the location shown in accordance with the manufacturer's instructions for plumb, level, rigid, and flush installations.
2. Anchor the units to wall studs through the locker back and to the floor using #8 pan head wood screws. Furring must be installed between lockers and wall of installations.

END OF SECTION 10 51 13 00

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Task	Specification	Specification Description
10 51 13 00	01 22 16 00	No Specification Required
10 51 13 00	10 01 50 11	Metal Lockers

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SECTION 10 51 26 00 - SOLID PLASTIC LOCKERS

1.1 GENERAL

A. Description Of Work

1. This specification covers the furnishing and installation of materials for solid plastic lockers. Product shall be as follows or as directed by the Owner. Installation procedures shall be in accordance with the product manufacturer's recommendations. Demolition and removal of materials shall be as required to support the work.

B. Submittals

1. Shop Drawings: Submitted shop drawings showing individual locker construction and overall dimensions, including complete installation instructions.

C. Product Handling

1. Store locker components flat until assembly. Protect all finishes from soiling and damage during handling.

D. Warranty

1. Manufacturer shall warranty lockers for a period of 10 years against rust and other types of corrosion, delamination, or breakage of any of the plastic panels, doors, and shelves under normal use.

1.2 PRODUCTS

- A. Materials: Sides, tops, bottoms, rears, doors, and shelves shall be made from high impact, high density polyethylene (HDPE) formed under high pressure into solid plastic components 3/8" thick with homogeneous color throughout. All panels, doors, and shelves will match in color.

1. Material testing: All solid plastic components shall resist deterioration and discoloration when subjected to any of the following:

Acetic Acid 80%
Acetone
Ammonia Liquid
Ammonium Phosphate
Bleach 12%
Borax
Brine
Caustic Soda
Chlorine Water
Citric Acid
Copper Chloride
Core Oils
Hydrochloric Acid 40%
Hydrogen Peroxide 30%
Isopropyl Alcohol
Lactic Acid 25%
Lime Sulfur
Nicotine
Potassium Bromide
Soaps
Sodium Bicarbonate
Trisodium Phosphate
Urea and Urine

Vinegar

(Testing in accordance with corrosion testing procedure established by the United States Plastic Corporation)

2. Continuous latch, capable of accepting various locking mechanisms, shall be securely fastened to the entire length of the door, providing a continuous security latch.
3. Door hinge shall be made from plastic with no steel or metal parts. Door hinge shall be continuous and integrated into the full length of the door and main locker body.
4. Coat hooks shall be made from chrome plated steel and attached with tempered screws.
5. All components shall have a smooth "orange peel" finish. All components shall be of the same color and selected from the manufacturer's full color line.

B. Fabrication

1. Locker components shall be fabricated square and rigid with a finish free of scratches and chips. All sides, tops, bottoms, backs, doors, and shelves shall be coated on both sides with a protective masking.
2. Solid plastic locker components shall snap together for easy assembly and shall provide a solid and secure construction. Adjacent lockers shall share a common side panel. Locker units shall be manufactured for assembly in a group of no more than five adjacent lockers.

1.3 EXECUTION

A. Installation

1. Install lockers at the location shown in accordance with the manufacturer's instructions for plumb, level, rigid, and flush installations.
2. Anchor the units to wall studs through the locker back and to the floor using #8 pan head wood screws. Furring must be installed between lockers and wall of installations.
3. Lockers can be either floor-mounted or installed on a 4" high base. Hardware and instructions for either method shall be provided by the manufacturer.
4. Number plates shall be available for field or factory mounting.

END OF SECTION 10 51 26 00



Task	Specification	Specification Description
10 51 53 00	01 22 16 00	No Specification Required

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SECTION 10 55 23 23 - POSTAL SPECIALTIES

1.1 GENERAL

A. Description Of Work:

1. This specification covers the furnishing and installation of materials for postal specialties. Product shall be as follows or as directed by the Owner. Installation procedures shall be in accordance with the product manufacturer's recommendations. Demolition and removal of materials shall be as required to support the work.

B. Summary

1. Section Includes:

- a. USPS-approved horizontal mail receptacles.
- b. Private-delivery horizontal mail receptacles.
- c. Private postal-facility horizontal mail receptacles.
- d. Vertical mail receptacles.
- e. USPS-approved cluster box units (CBUs).
- f. Neighborhood delivery and collection box units (NDCBUs).
- g. USPS-approved parcel lockers.
- h. USPS-approved collection boxes.
- i. Private collection boxes.
- j. Data distribution boxes.
- k. Mail chutes.
- l. Accessories:
 - 1) Directory for mail receptacles.
 - 2) Key keeper.
 - 3) Key cabinet.
 - 4) Mail-sorting collection unit.
 - 5) Letter drops.
 - 6) Package depository.

C. Submittals

1. Product Data: For each type of product indicated.
2. Shop Drawings: For postal specialties. Include plans, elevations, sections, details, identification sequence for compartments, and attachments to other work.
3. Samples: For each exposed product and for each color and texture specified.
4. Product certificates, including written approval by Postmaster General, as applicable.
5. Maintenance data.
6. Other Informational Submittals: Final USPS local postmaster approval for installed postal specialties to be served by USPS.

D. Quality Assurance

1. Source Limitations for Each Type of Postal Specialty: For USPS-approved products, use only those included on current lists of USPS manufacturers and models.
2. Preinstallation Conference: Conduct conference at Project site.

E. Delivery, Storage, And Handling

1. Deliver lock keys to the Owner by registered mail or overnight package service with a record of each corresponding lock and key number.
2. Deliver combination-lock combinations to the Owner by registered mail or overnight package service with a record of each corresponding lock and combination.

F. Warranty



1. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of postal specialties that fail in materials or workmanship within five years from date of Final Completion.

1.2 PRODUCTS

A. Materials

1. Aluminum: Manufacturer's standard alloy and temper for type of use and finish indicated, and as follows:
 - a. Sheet and Plate: **ASTM B 209 (ASTM B 209M)**.
 - b. Extruded Shapes: **ASTM B 221 (ASTM B 221M)**.
2. Steel Sheet: Cold rolled, ASTM A 1008/A 1008M, Commercial Steel (CS), Type B, exposed matte finish where exposed.
3. Metallic-Coated Steel Sheet: Galvanized-steel sheet, ASTM A 653/A 653M, **G60 (Z180)** coating designation, extra smooth where exposed; or electrolytic zinc-coated steel sheet, ASTM A 879/A 879M, Coating Designation **08Z (24G)**.
4. Stainless-Steel Sheet: ASTM A 666, Type 304.
5. Brass Sheet: ASTM B 36/B 36M, manufacturer's standard copper alloy.
6. Zinc Sheet or Plate: ASTM B 69, manufacturer's standard sheet or plate and zinc alloy.
7. Die-Cast Aluminum: ASTM B 85, manufacturer's standard aluminum alloy.
8. Die-Cast Brass: ASTM B 176, manufacturer's standard copper alloy.
9. Die-Cast Zinc: ASTM B 86, manufacturer's standard zinc alloy.
10. Steel Anchor Bolts, Nuts, and Washers: ASTM F 1554, Grade 36 or 55, hot-dip galvanized.
11. Stainless-Steel Anchor Bolts, Nuts, and Washers: ASTM A 193/A 193M, Grade B8M, Type 316.
12. Bituminous Coating: Cold-applied asphalt emulsion complying with ASTM D 1187.

B. USPS-Approved Horizontal Mail Receptacles

1. Front-Loading, USPS-Approved Horizontal Mail Receptacles: Consisting of multiple compartments with fixed, solid compartment backs, enclosed within recessed wall box. Provide access to compartments for distributing incoming mail from front of unit by unlocking master lock and swinging side-hinged master door to provide accessibility to entire group of compartments. Provide access to each compartment for removing mail by swinging compartment door. Comply with USPS-STD-4C **OR** USPS-STD-4B+, **as directed**.
 - a. Mail Delivery: USPS **OR** Private, **as directed**.
 - b. Compartments: Number and size as follows: **OR** As indicated on Drawings, of the following sizes: **OR** As indicated on Drawings, **as directed**.
 - 1) Type I: A group of mail receptacles in single-column configuration with single master door, three – eight mail compartments not less than **3 inches high by 12 inches wide by 15 inches deep (76 mm high by 305 mm wide by 381 mm deep)**, one outgoing mail collection compartment prepared for master-door lock, and one parcel compartment **15 inches high by 12 inches wide by 15 inches deep (381 mm high by 305 mm wide by 381 mm deep)**.
 - 2) Type II: A group of mail receptacles in double-column configuration with double master door, three - sixteen mail compartments not less than **3 inches high by 12 inches wide by 15 inches deep (76 mm high by 305 mm wide by 381 mm deep)**, one outgoing mail collection compartment prepared for master-door lock, and one **OR** two, **as directed**, parcel compartment(s): **15 inches high by 12 inches wide by 15 inches deep (381 mm high by 305 mm wide by 381 mm deep)** and **18 inches high by 12 inches wide by 15 inches deep (457 mm high by 305 mm wide by 381 mm deep)**.
 - 3) Type III: A group of mail receptacles in double-column configuration with single master door, three - sixteen mail compartments not less than **3 inches high by 12 inches wide by 15 inches deep (76 mm high by 305 mm wide by 381 mm deep)**, one outgoing mail collection compartment prepared for master-door lock, and one **OR** two, **as directed**, parcel compartment(s): **15 inches high by 12 inches wide by 15**

- inches deep (381 mm high by 305 mm wide by 381 mm deep) and 18 inches high by 12 inches wide by 15 inches deep (457 mm high by 305 mm wide by 381 mm deep).
- 4) Type VI (No Parcel Compartment): A group of mail receptacles in single-column configuration with single master door, three – ninemail compartments not less than 3 inches high by 12 inches wide by 15 inches deep (76 mm high by 305 mm wide by 381 mm deep), and one outgoing mail collection compartment prepared for master-door lock.
 - 5) Type VIII (No Parcel Compartment): A group of mail receptacles in double-column configuration with double master door, three – nineteen mail compartments not less than 3 inches high by 12 inches wide by 15 inches deep (76 mm high by 305 mm wide by 381 mm deep), and one outgoing mail collection compartment prepared for master-door lock.
- c. Compartments: Number and size as follows: **OR** Number as indicated on Drawings, of the following sizes: **OR** Number and size as indicated on Drawings, **as directed**.
- 1) Type A: Provide compartments with inside dimensions not less than 5 inches high by 6 inches wide by 15 inches deep (127 mm high by 152 mm wide by 381 mm deep).
 - 2) Type B: Provide compartments with inside dimensions not less than 5 inches high by 12-1/2 inches wide by 15 inches deep (127 mm high by 318 mm wide by 381 mm deep).
 - 3) Type C: Provide compartments with inside dimensions not less than 10-1/2 inches high by 6 inches wide by 15 inches deep (267 mm high by 152 mm wide by 381 mm deep).
 - 4) Type D: Provide compartments with inside dimensions not less than 10-1/2 inches high by 12-1/2 inches wide by 15 inches deep (267 mm high by 318 mm wide by 381 mm deep).
 - 5) Type E: Provide compartments with inside dimensions not less than 16 inches high by 12-1/2 inches wide by 15 inches deep (406 mm high by 318 mm wide by 381 mm deep).
- d. Front-Loading Master Door: Fabricated from extruded aluminum and braced and framed to hold compartment doors; prepared to receive master-door lock.
- 1) Master-Door Lock: Door prepared to receive lock provided by local postmaster, for units served by USPS.
OR
Master-Door Lock: Cylinder lock keyed to building keying system; with two **OR** three, **as directed**, keys. Provide cylinders specified in Division 08 Section "Door Hardware".
- e. Compartment Doors: Fabricated from extruded aluminum. Equip each with lock and tenant identification as required by cited standard. Provide mail slot in the compartment with master-door lock, **as directed**.
- 1) Compartment-Door Locks (for units served by USPS): Comply with USPS-L-1172C, PSIN O910, for locks and keys, or equivalent as approved by USPS; with three keys for each compartment door. Key each compartment differently.
 - 2) Compartment-Door Locks: Five-pin tumbler, cylinder cam **OR** spring-latch-type, **as directed**, locks capable of at least 1000 key changes; with two **OR** three, **as directed**, keys for each compartment door. Key each compartment differently.
 - 3) Compartment-Door Locks: Removable core locks, furnished by the Owner and installed as Work of this Section.
 - 4) Compartment-Door Locks: Spring-latch-type lock designed to accommodate cylinders keyed to building keying system; with two **OR** three, **as directed**, keys for each compartment door. Provide cylinders specified in Division 08 Section "Door Hardware".
 - 5) Compartment-Door Locks: Three-digit, single-dial, combination locks with spring latch and automatic throw off. Set each compartment with different combination.
- f. Frames: Fabricated from extruded aluminum or aluminum sheet; ganged and nested units, with cardholder and blank cards for tenant's identification within each compartment.



- g. Snap-on Trim: Fabricated from same material and finish as compartment doors.
- h. Concealed Components and Mounting Frames: Aluminum or steel sheet with manufacturer's standard finish.
- i. Exposed Aluminum Finish: Finish surfaces exposed to view as follows:
 - 1) Anodic Finish: Clear **OR** Brass **OR** Dark bronze **OR** As indicated by manufacturer's designations **OR** As selected from manufacturer's full range, **as directed**.
 - 2) Baked-Enamel or Powder-Coated Finish: Silver **OR** Black **OR** Medium bronze **OR** Dark bronze **OR** Gold **OR** Color as indicated by manufacturer's designations **OR** Color as selected from manufacturer's full range, **as directed**.
- 2. Rear-Loading, USPS-Approved Horizontal Mail Receptacles: Consisting of multiple compartments enclosed within recessed wall box. Provide access to compartments for distributing incoming mail from rear of unit with accessibility to entire group of compartments. Provide access to each compartment for removing mail by swinging compartment door. Comply with USPS-STD-4C **OR** USPS-STD-4B+, **as directed**.
 - a. Mail Delivery: USPS **OR** Private, **as directed**.
 - b. Compartments: Number and size as follows: **OR** As indicated on Drawings, of the following sizes: **OR** As indicated on Drawings, **as directed**.
 - 1) Type IV: A group of mail receptacles in single-column configuration with a rear-access cover, three - eight mail compartments not less than **3 inches high by 12 inches wide by 15 inches deep** (76 mm high by 305 mm wide by 381 mm deep), one outgoing mail collection compartment, and one parcel compartment **15 inches high by 12 inches wide by 15 inches deep** (381 mm high by 305 mm wide by 381 mm deep).
 - 2) Type V: A group of mail receptacles in double-column configuration with a rear-access cover, three - sixteen mail compartments not less than **3 inches high by 12 inches wide by 15 inches deep** (76 mm high by **OR** 305 mm wide by 381 mm deep), one outgoing mail collection compartment, and one **OR** two, **as directed**, parcel compartment(s) **15 inches high by 12 inches wide by 15 inches deep** (381 mm high by 305 mm wide by 381 mm deep) and **18 inches high by 12 inches wide by 15 inches deep** (457 mm high by 305 mm wide by 381 mm deep).
 - 3) Type VII (No Parcel Compartment): A group of mail receptacles in single-column configuration with a rear-access cover, three - nine mail compartments not less than **3 inches high by 12 inches wide by 15 inches deep** (76 mm high by 305 mm wide by 381 mm deep), and one outgoing mail collection compartment.
 - 4) Type IX (No Parcel Compartment): A group of mail receptacles in double-column configuration with a rear-access cover, three - nineteen mail compartments not less than **3 inches high by 12 inches wide by 15 inches deep** (76 mm high by 305 mm wide by 381 mm deep), and one outgoing mail collection compartment.
 - c. Compartments: Number and size as follows: **OR** Number as indicated on Drawings, of the following sizes: **OR** Number and size as indicated on Drawings, **as directed**.
 - 1) Type A: Provide compartments with inside dimensions not less than **5 inches high by 6 inches wide by 15 inches deep** (127 mm high by 152 mm wide by 381 mm deep).
 - 2) Type B: Provide compartments with inside dimensions not less than **5 inches high by 12-1/2 inches wide by 15 inches deep** (127 mm high by 318 mm wide by 381 mm deep).
 - 3) Type C: Provide compartments with inside dimensions not less than **10-1/2 inches high by 6 inches wide by 15 inches deep** (267 mm high by 152 mm wide by 381 mm deep).
 - 4) Type D: Provide compartments with inside dimensions not less than **10-1/2 inches high by 12-1/2 inches wide by 15 inches deep** (267 mm high by 318 mm wide by 381 mm deep).
 - 5) Type E: Provide compartments with inside dimensions not less than **16 inches high by 12-1/2 inches wide by 15 inches deep** (406 mm high by 318 mm wide by 381 mm deep).

- d. Rear-Loading Cover: Not required **OR** Lift-off rear cover fabricated from extruded aluminum or aluminum sheet, finished to match front of unit, **as directed**.
OR
Rear-Loading Door: Side hinged, fabricated from extruded aluminum or aluminum sheet, finished to match front of unit; with full-length, stainless-steel piano hinge on one side and positive-latching **OR** locking, **as directed**, mechanism on the other.
 - 1) Rear-Door Lock (for units served by USPS if lock is required): Door prepared to receive lock provided by local postmaster.
OR
Rear-Door Lock: Cylinder lock keyed to building keying system; with two **OR** three, **as directed**, keys. Provide cylinders specified in Division 08 Section "Door Hardware".
- e. Compartment Doors: Fabricated from extruded aluminum. Equip each with lock and tenant identification as required by cited standard. Provide one compartment with outgoing mail slot, **as directed**.
 - 1) Compartment-Door Locks (for units served by USPS): Comply with USPS-L-1172C, PSIN O910, for locks and keys, or equivalent as approved by USPS; with three keys for each compartment door. Key each compartment differently.
 - 2) Compartment-Door Locks: Five-pin tumbler, cylinder cam **OR** spring-latch-type, **as directed**, locks capable of at least 1000 key changes; with two **OR** three, **as directed**, keys for each compartment door. Key each compartment differently.
 - 3) Compartment-Door Locks: Removable core locks, furnished by the Owner and installed as Work of this Section.
 - 4) Compartment-Door Locks: Spring-latch-type lock designed to accommodate cylinders keyed to building keying system; with two **OR** three, **as directed**, keys for each compartment door. Provide cylinders specified in Division 08 Section "Door Hardware".
 - 5) Compartment-Door Locks: Three-digit, single-dial, combination locks with spring latch and automatic throw off. Set each compartment with different combination.
- f. Frames: Fabricated from extruded aluminum or aluminum sheet; ganged and nested units, with cardholder and blank cards for tenant's identification behind each compartment.
- g. Snap-on Trim: Fabricated from same material and finish as compartment doors.
- h. Concealed Components and Mounting Frames: Aluminum or steel sheet with manufacturer's standard finish.
- i. Exposed Aluminum Finish: Finish surfaces exposed to view as follows:
 - 1) Anodic Finish: Clear **OR** Brass **OR** Dark bronze **OR** As indicated by manufacturer's designations **OR** As selected from manufacturer's full range, **as directed**.
 - 2) Baked-Enamel or Powder-Coated Finish: Silver **OR** Black **OR** Medium bronze **OR** Dark bronze **OR** Gold **OR** Color as indicated by manufacturer's designations **OR** Color as selected from manufacturer's full range, **as directed**.

C. Private-Delivery Horizontal Mail Receptacles

- 1. Front-Loading, Private-Delivery Horizontal Mail Receptacles: Consisting of multiple compartments with fixed, solid compartment backs, enclosed within recessed wall box. Provide access to compartments for distributing incoming mail from front of unit by unlocking master lock and swinging side-hinged master door to provide accessibility to entire group of compartments. Provide access to each compartment for removing mail by swinging compartment door.
 - a. Front-Loading Master Door: Fabricated from extruded aluminum and braced and framed to hold compartment doors; with master-door lock and concealed, full-length, stainless-steel piano hinge on one side. Fabricate master door to remain open while mail is deposited.
 - 1) Master-Door Lock: Manufacturer's standard five-pin tumbler, cylinder lock; with two **OR** three, **as directed**, keys.
OR



- Master-Door Lock: Cylinder lock keyed to building keying system; with two **OR** three, **as directed**, keys. Provide cylinders specified in Division 08 Section "Door Hardware".
- b. Compartments and Doors: Manufacturer's standard compartments with extruded aluminum doors. Equip each with lock, tenant identification, and concealed, full-length, flush hinge on one side. Provide one compartment prepared for master-door lock and with outgoing mail slot, **as directed**.
- 1) Compartments: Number and size as follows: **OR** As indicated on Drawings, of the following sizes: **OR** As indicated on Drawings, **as directed**.
 - a) Size 1: Provide compartments with inside dimensions not less than **3 inches high by 6 inches wide by 15 inches deep** (76 mm high by 152 mm wide by 381 mm deep).
 - b) Size 2: Provide compartments with inside dimensions not less than **5 inches high by 3-1/2 inches wide by 15 inches deep** (127 mm high by 89 mm wide by 381 mm deep).
 - c) Size 3: Provide compartments with inside dimensions not less than **5 inches high by 7-1/2 inches wide by 15 inches deep** (127 mm high by 191 mm wide by 381 mm deep).
 - d) Size 4: Provide compartments with inside dimensions not less than **10-1/2 inches high by 3-1/2 inches wide by 15 inches deep** (267 mm high by 89 mm wide by 381 mm deep).
 - e) Size 5: Provide compartments with inside dimensions not less than **10-1/2 inches high by 7-1/2 inches wide by 15 inches deep** (267 mm high by 191 mm wide by 381 mm deep).
 - 2) Tenant Identification: **2-inch-wide by 5/8-inch-** (51-mm-wide by 16-mm-) high, clear-plastic cardholder set in recessed slot in face of compartment door. Provide cardboard strip and self-adhesive numbers.

OR

Tenant Identification: Laminated, black plastic tabs, engraved with identification and adhesively applied to face of compartment door.

OR

Tenant Identification: Identification engraved into face of compartment door.
- c. Compartments and Doors: Manufacturer's standard compartments with ornamental doors fabricated from solid, die-cast brass **OR** zinc, **as directed**. Equip each with glass window, **as directed**, lock, nameplate, and two hinges.
- 1) Compartments: Number and size as follows: **OR** As indicated on Drawings, of the following sizes: **OR** As indicated on Drawings, **as directed**.
 - a) Size 1: Provide compartments **15 inches** (381 mm) deep with doors **5 inches high by 3-1/2 inches wide** (127 mm high by 89 mm wide).
 - b) Size 2: Provide compartments **15 inches** (381 mm) deep with doors **6 inches high by 5-1/2 inches wide** (152 mm high by 140 mm wide).
 - c) Size 3: Provide compartments **15 inches** (381 mm) deep with doors **6 inches high by 11 inches wide** (152 mm high by 279 mm wide).
 - 2) Compartment-Door Locks: Five-pin tumbler, cylinder cam **OR** spring-latch-type, **as directed**, locks capable of at least 1000 key changes; with two **OR** three, **as directed**, keys for each compartment door. Key each compartment differently.
 - 3) Compartment-Door Locks: Removable core locks, furnished by the Owner and installed as Work of this Section.
 - 4) Compartment-Door Locks: Spring-latch-type lock designed to accommodate cylinders keyed to building keying system; with two **OR** three, **as directed**, keys for each compartment door. Provide cylinders specified in Division 08 Section "Door Hardware".
 - 5) Compartment-Door Locks: Three-digit, single-dial, combination locks with spring latch and automatic throw off. Set each compartment with different combination.

- d. Frames: Fabricated from extruded aluminum or aluminum sheet **OR** brass sheet **OR** zinc sheet or plate, **as directed**; ganged and nested units, with cardholder and blank cards for tenant's identification behind each compartment.
 - e. Snap-on Trim: Fabricated from same material and finish as compartment doors.
 - f. Concealed Components and Mounting Frames: Aluminum or steel sheet with manufacturer's standard finish.
 - g. Exposed Aluminum Finish: Finish surfaces exposed to view as follows:
 - 1) Anodic Finish: Clear, **as directed**.
 - 2) Baked-Enamel or Powder-Coated Finish: Black **OR** Dark-bronze **OR** Gold **OR** Medium bronze **OR** Silver **OR** Color as indicated by manufacturer's designations **OR** Color as selected from manufacturer's full range, **as directed**.
 - h. Brass Finish: Buffed finish, lacquered **OR** Hand-rubbed finish, lacquered **OR** Brushed satin, lacquered, **as directed**.
 - i. Zinc Finish: Manufacturer's standard powder-coated finish, tan, **as directed**.
2. Rear-Loading, Private-Delivery Horizontal Mail Receptacles: Consisting of multiple compartments enclosed within recessed wall box. Provide access to compartments for distributing incoming mail from rear of unit with accessibility to entire group of compartments. Provide access to each compartment for removing mail by swinging compartment door.
- a. Rear-Loading Cover: Not required **OR** Lift-off rear cover fabricated from extruded aluminum or aluminum sheet, finished to match front of unit, **as directed**.
OR
 Rear-Loading Door: Side hinged, fabricated from extruded aluminum or aluminum sheet, finished to match front of unit; with full-length, stainless-steel piano hinge on one side and positive-latching **OR** locking, **as directed**, mechanism on the other. Fabricate rear-loading door to open not less than 90 degrees and to remain open while mail is deposited.
 - 1) Rear-Door Lock: Manufacturer's standard five-pin tumbler, cylinder lock; with two **OR** three, **as directed**, keys.
OR
 Rear-Door Lock: Cylinder lock keyed to building keying system; with two **OR** three, **as directed**, keys. Provide cylinders specified in Division 08 Section "Door Hardware".
 - b. Compartments and Doors: Manufacturer's standard compartments with doors fabricated from extruded aluminum. Equip each with lock, tenant identification, and concealed, full-length, flush hinge on one side. Provide one compartment prepared for master-door lock and with outgoing mail slot, **as directed**.
 - 1) Compartments: Number and size as follows: **OR** As indicated on Drawings, of the following sizes: **OR** As indicated on Drawings, **as directed**.
 - a) Size 1: Provide with inside dimensions not less than 3 inches high by 6 inches wide by 15 inches deep (76 mm high by 152 mm wide by 381 mm deep).
 - b) Size 2: Provide compartments with inside dimensions not less than 5 inches high by 3-1/2 inches wide by 15 inches deep (127 mm high by 89 mm wide by 381 mm deep).
 - c) Size 3: Provide compartments with inside dimensions not less than 5 inches high by 7-1/2 inches wide by 15 inches deep (127 mm high by 191 mm wide by 381 mm deep).
 - d) Size 4: Provide compartments with inside dimensions not less than 10-1/2 inches high by 3-1/2 inches wide by 15 inches deep (267 mm high by 89 mm wide by 381 mm deep).
 - e) Size 5: Provide compartments with inside dimensions not less than 10-1/2 inches high by 7-1/2 inches wide by 15 inches deep (267 mm high by 191 mm wide by 381 mm deep).
 - 2) Tenant Identification: 2-inch-wide by 5/8-inch- (51-mm-wide by 16-mm-) high, clear-plastic cardholder set in recessed slot in face of compartment door. Provide cardboard strip and self-adhesive numbers.
OR



Tenant Identification: Laminated, black plastic tabs, engraved with identification and adhesively applied to face of compartment door.

OR

Tenant Identification: Identification engraved into face of compartment door.

- c. Compartments and Doors: Manufacturer's standard compartments with ornamental doors fabricated from solid, die-cast brass **OR** zinc, **as directed**. Equip each with glass window, **as directed**, lock, nameplate, and two hinges.
 - 1) Compartments: Number and size as follows: **OR** As indicated on Drawings, of the following sizes: **OR** As indicated on Drawings, **as directed**.
 - a) Size 1: Provide compartments **15 inches (381 mm)** deep with doors **5 inches high by 3-1/2 inches wide (127 mm high by 89 mm wide)**.
 - b) Size 2: Provide compartments **15 inches (381 mm)** deep with doors **6 inches high by 5-1/2 inches wide (152 mm high by 140 mm wide)**.
 - c) Size 3: Provide compartments **15 inches (381 mm)** deep with doors **6 inches high by 11 inches wide (152 mm high by 279 mm wide)**.
 - d. Compartment-Door Locks: Five-pin tumbler, cylinder cam **OR** spring-latch-type, **as directed**, locks capable of at least 1000 key changes; with two **OR** three, **as directed**, keys for each compartment door. Key each compartment differently.
 - e. Compartment-Door Locks: Removable core locks, furnished by the Owner and installed as Work of this Section.
 - f. Compartment-Door Locks: Spring-latch-type lock designed to accommodate cylinders keyed to building keying system; with two **OR** three, **as directed**, keys for each compartment door. Provide cylinders specified in Division 08 Section "Door Hardware".
 - g. Compartment-Door Locks: Three-digit, single-dial, combination locks with spring latch and automatic throw off. Set each compartment with different combination.
 - h. Frames: Fabricated from extruded aluminum or aluminum sheet **OR** brass sheet **OR** zinc sheet or plate, **as directed**; ganged and nested units, with cardholder and blank cards for tenant's identification behind each compartment.
 - i. Snap-on Trim: Fabricated from same material and finish as compartment doors.
 - j. Concealed Components and Mounting Frames: Aluminum or steel sheet with manufacturer's standard finish.
 - k. Exposed Aluminum Finish: Finish surfaces exposed to view as follows:
 - 1) Anodic Finish: Clear, **as directed**.
 - 2) Baked-Enamel or Powder-Coated Finish: Black **OR** Dark bronze **OR** Gold **OR** Medium bronze **OR** Silver **OR** Color as indicated by manufacturer's designations **OR** Color as selected from manufacturer's full range, **as directed**.
 - l. Brass Finish: Buffed finish, lacquered **OR** Hand-rubbed finish, lacquered **OR** Brushed satin, lacquered, **as directed**.
 - m. Zinc Finish: Manufacturer's standard powder-coated finish, tan, **as directed**.
- D. Private Postal-Facility Horizontal Mail Receptacles
1. Standard, Rear-Loading Horizontal Mail Receptacles: Consisting of multiple compartments with open backs, enclosed within recessed, modular wall box, with approximate overall module dimensions of **30 inches high by 23-1/2 inches wide by 15-1/2 inches deep (762 mm high by 596 mm wide by 394 mm deep)**; for installation between studs spaced **24 inches (610 mm)** o.c. Provide access to compartments for distributing incoming mail from rear of unit with accessibility to entire group of compartments. Provide access to each compartment for removing mail by swinging compartment door.
 - a. Compartments: Provide 10 **OR** 20 **OR** 30, **as directed**, equal-sized compartments within each module.

OR

Compartments: Provide number and size, and number of modules as indicated on Drawings.
 - b. Compartment Doors: Fabricated from extruded or die-cast aluminum. Equip each with lock, tenant identification, and concealed, full-length, flush hinge on one side.

- 1) Tenant Identification: Identification engraved into face of compartment door **OR** self-adhesive placards, **as directed**.
 - 2) Compartment-Door Locks: Five-pin tumbler, cylinder cam **OR** spring-latch-type, **as directed**, locks capable of at least 1000 key changes; with two **OR** three, **as directed**, keys for each compartment door. Key each compartment differently.
 - c. Frames: Fabricated from aluminum or cold-rolled steel sheet; ganged and nested units, with cardholder and blank cards for tenant's identification behind each compartment.
 - d. Trim: Fabricated from same material as compartment doors.
 - e. Concealed Components and Mounting Frames: Aluminum or steel sheet with manufacturer's standard finish.
 - f. Exposed Aluminum Finish: Finish surfaces exposed to view with silver powder coat on doors, black on trim **OR** gold powder coat on doors and trim **OR** silver powder coat on doors and trim, **as directed**.
2. Rack-Ladder, Rear-Loading Horizontal Mail Receptacles: Consisting of multiple compartments with open backs, enclosed within recessed, modular wall box, with approximate overall module dimensions of **12 inches high by 23-1/2 inches wide by 15-1/2 inches deep (305 mm high by 596 mm wide by 394 mm deep)**; for installation between rack ladders. Provide access to compartments for distributing incoming mail from rear of unit with accessibility to entire group of compartments. Provide access to each compartment for removing mail by swinging compartment door.
- a. Compartments: Provide one within each module and number of modules as indicated on Drawings.
OR
Compartments: Provide two **OR** four **OR** eight **OR** 12, **as directed**, equal-sized compartments within each module and number of modules as indicated on Drawings.
OR
Compartments: Provide number and size, and number of modules as indicated on Drawings.
 - b. Compartment Doors: Fabricated from extruded aluminum. Equip each with lock, tenant identification, and concealed, full-length, flush hinge on one side.
 - 1) Tenant Identification: Identification engraved into face of compartment door **OR** self-adhesive placards, **as directed**.
 - 2) Compartment-Door Locks: Five-pin tumbler, cylinder cam **OR** spring-latch-type, **as directed**, locks capable of at least 1000 key changes; with two **OR** three, **as directed**, keys for each compartment door. Key each compartment differently.
 - c. Frames: Fabricated from aluminum or cold-rolled steel sheet; ganged and nested units, with cardholder and blank cards for tenant's identification behind each compartment.
 - d. Trim: Fabricated from same material as compartment doors.
 - e. Concealed Components and Mounting Frames: Aluminum or steel sheet with manufacturer's standard finish.
 - f. Rack Ladders: Aluminum or steel with manufacturer's standard finish.
 - 1) Height of Rack Ladders: Two **OR** Three **OR** Four **OR** Five **OR** Six, **as directed**, modules high.
 - 2) Provide two rack ladders for first column of modules and one ladder for each additional, adjacent column of modules.
 - g. Exposed Aluminum Finish: Finish surfaces exposed to view with silver powder coat on doors, black on trim.
- E. Vertical Mail Receptacles
1. USPS-Approved Vertical Mail Receptacles: Consisting of three to seven compartments enclosed within wall box; with inside dimensions of each compartment not less than **15 inches high by 5 inches wide by 6 inches deep (381 mm high by 127 mm wide by 152 mm deep)**. Provide access to compartments for distributing incoming mail from front of unit by unlocking master lock and tilting inner compartments forward as a group. Provide access to each compartment for removing mail by swinging compartment door. Comply with USPS-STD-4B+.



- a. Mounting: Recessed **OR** Semirecessed with mounting frame **OR** Surface mounted with mounting frame **OR** As indicated on Drawings, **as directed**.
 - b. Mail Delivery: USPS **OR** Private, **as directed**.
 - c. Compartments: Provide three - seven.
OR
Compartments: Provide number as indicated on Drawings.
 - d. Compartment Doors and Frames: Fabricated from striated, extruded aluminum. Equip each compartment door with lock, slot in face of door to receive tenant identification, and concealed, full-length, flush hinge on one side. Provide one double-wide compartment with outgoing mail slot, **as directed**.
 - 1) Tenant Identification: Cardboard name and number tab **OR** Laminated, black plastic tabs, engraved with identification, **as directed**.
 - 2) Compartment-Door Locks (for units served by USPS): Five-pin tumbler, cylinder cam **OR** spring-latch-type, **as directed**, locks capable of at least 1000 key changes; with two **OR** three, **as directed**, keys for each compartment door. Key each compartment differently.
OR
Compartment-Door Locks: Removable core locks, furnished by the Owner and installed as Work of this Section.
OR
Compartment-Door Locks: Spring-latch-type lock designed to accommodate cylinders keyed to building keying system; with two **OR** three, **as directed**, keys for each compartment door. Provide cylinders specified in Division 08 Section "Door Hardware".
 - e. Frames: Fabricated from aluminum or cold-rolled steel sheet; ganged and nested units, with cardholder and blank cards for tenant's identification within each compartment.
 - f. Concealed Components and Mounting Frames: Aluminum or steel sheet with manufacturer's standard finish.
 - g. Exposed Aluminum Finish: Finish surfaces exposed to view as follows:
 - 1) Anodic Finish: Clear **OR** Gold **OR** As indicated by manufacturer's designations **OR** As selected from manufacturer's full range, **as directed**.
 - 2) Baked-Enamel or Powder-Coated Finish: Aluminum **OR** Black **OR** Brass **OR** Dark bronze **OR** Gold **OR** Green **OR** Ivory **OR** Medium bronze **OR** Silver **OR** Color as indicated by manufacturer's designations **OR** Color as selected from manufacturer's full range, **as directed**.
- F. USPS-Approved Cluster Box Units (CBUs)
- 1. General: Consisting of multiple compartments enclosed within freestanding, pedestal-mounted enclosure. Provide access to compartments for distributing incoming mail from front of unit by unlocking master lock and swinging pair of side-hinged master doors to provide accessibility to entire group of compartments. Provide access to each compartment for removing mail by swinging compartment door. Comply with USPS-B-1118F.
 - 2. Compartment Enclosure: Fabricated from aluminum sheet with aluminum mounting pedestal and weather-protection hood, with the following number and size of compartments:
 - a. Type I: Provide eight compartments 12 inches wide by 3 inches high by 15 inches deep (305 mm wide by 76 mm high by 381 mm deep), one outgoing mail compartment 12 inches wide by 3 inches high by 15 inches deep (305 mm wide by 76 mm high by 381 mm deep), one parcel compartment 12 inches wide by 10 inches high by 15 inches deep (305 mm wide by 254 mm high by 381 mm deep), and another parcel compartment 12 inches wide by 13-1/2 inches high by 15 inches deep (305 mm wide by 343 mm high by 381 mm deep).
 - b. Type II: Provide 12 compartments 12 inches wide by 3 inches high by 15 inches deep (305 mm wide by 76 mm high by 381 mm deep), one outgoing mail compartment 12 inches wide by 3 inches high by 15 inches deep (305 mm wide by 76 mm high by 381 mm deep), and one parcel compartment 12 inches wide by 10 inches high by 15 inches deep (305 mm wide by 254 mm high by 381 mm deep).

- c. Type III: Provide 16 compartments 12 inches wide by 3 inches high by 15 inches deep (305 mm wide by 76 mm high by 381 mm deep), one outgoing mail compartment 12 inches wide by 3 inches high by 15 inches deep (305 mm wide by 76 mm high by 381 mm deep), one parcel compartment 12 inches wide by 10 inches high by 15 inches deep (305 mm wide by 254 mm high by 381 mm deep), and another parcel compartment 12 inches wide by 13-1/2 inches high by 15 inches deep (305 mm wide by 343 mm high by 381 mm deep).
- d. Type IV: Provide 13 compartments 12 inches wide by 4-3/4 inches high by 15 inches deep (305 mm wide by 121 mm high by 381 mm deep), one outgoing mail compartment 12 inches wide by 4-3/4 inches high by 15 inches deep (305 mm wide by 121 mm high by 381 mm deep), and one parcel compartment 12 inches wide by 10 inches high by 15 inches deep (305 mm wide by 254 mm high by 381 mm deep).
3. Compartment Doors and Frames: Fabricated from one-piece extruded aluminum or aluminum sheet. Equip each compartment door with lock, tenant identification, and concealed, full-length, flush hinge on one side. Provide outgoing mail slot with weather protection flap.
 - a. Tenant Identification: Number engraved into face **OR** applied into recess, **as directed**, of compartment door.
 - b. Compartment-Door Locks: Comply with USPS-L-1172C, PSIN O910, for locks and keys, or equivalent as approved by USPS; with three keys for each compartment door. Key each compartment differently.
 - c. Parcel-Locker-Door Locks: Two-key security system in which control key provides access to parcel-locker key, which opens compartment and is retained once opened.
4. Pedestal: Aluminum, with same finish as compartment enclosure and attached with theft-resistant fasteners.
5. Exposed Aluminum Finish: Finish surfaces exposed to view with powder-coated finish in postal gray (light gray) **OR** color as selected from manufacturer's full range of colors, **as directed**.
- G. Neighborhood Delivery And Collection Box Units (NDCBUs)
 1. General: Consisting of multiple compartments, with inside dimensions of each compartment not less than 5 inches high by 6 inches wide by 15 inches deep (127 mm high by 152 mm wide by 381 mm deep), enclosed within freestanding, pedestal-mounted enclosure. Provide access to compartments for distributing incoming mail from rear of unit by side-hinged rear door with accessibility to entire group of compartments. Provide access to each compartment for removing mail by swinging compartment door.
 2. Compartment Enclosure: Fabricated from aluminum sheet with integral weather protection hood, with eight equal-sized compartments (Type I) **OR** 12 equal-sized compartments (Type II) **OR** 16 equal-sized compartments (Type III) **OR** compartments of number and size as indicated on Drawings, **as directed**.
 3. Compartment Doors and Frames: Fabricated from one-piece extruded aluminum or aluminum sheet. Equip each compartment door with lock, tenant identification, and concealed, full-length, flush hinge on one side. Provide top left compartment with outgoing mail slot, **as directed**.
 - a. Tenant Identification: Number engraved into face of compartment door.
 - b. Compartment-Door Locks: Dustproof, five-pin tumbler, cylinder cam locks capable of at least 1000 key changes; with three, **as directed**, keys for each compartment door. Key each compartment differently.
 4. Rear-Loading Door: Fabricated from aluminum sheet, with full-length, stainless-steel piano hinge on one side and three-point latching mechanism on the other. Fabricate rear-loading door to open not less than 90 degrees and to remain open while mail is deposited.
 - a. Rear-Door Lock: Door prepared to receive lock furnished by local postmaster.
OR
Rear-Door Lock: Cylinder lock with two **OR** three, **as directed**, keys. Provide cylinders specified in Division 08 Section "Door Hardware".
 5. Pedestal: Same material and finish as compartment enclosure and attached with theft-resistant fasteners **OR** As indicated on Drawings, **as directed**.
 6. Exposed Aluminum Finish: Finish surfaces exposed to view as follows:
 - a. Anodic Finish: Clear, **as directed**.



- b. Baked-Enamel or Powder-Coated Finish: Black **OR** Dark bronze **OR** Gold **OR** Medium bronze **OR** Color as selected from manufacturer's full range, **as directed**.

H. USPS-Approved Parcel Lockers

1. Front-Loading, USPS-Approved Indoor Parcel Lockers: Consisting of single or multiple compartments enclosed within a larger enclosure of type indicated below. Provide access to compartments for distributing incoming parcels from front of unit. Provide access to each compartment for removing parcels by swinging compartment door. Comply with USPS-STD-4C **OR** USPS-STD-4B+ or USPS-B-1116A construction, adapted for larger-sized, interior, parcel compartments, **as directed**.
 - a. Enclosure Type: Recessed **OR** Freestanding, **as directed**.
 - b. Mail Delivery: USPS **OR** Private, **as directed**.
 - c. Compartments: Number and size as follows: **OR** As indicated on Drawings, of the following sizes: **OR** As indicated on Drawings, **as directed**.
 - 1) Type X, Parcel Only (No Master Door): Single parcel receptacle 15 inches high by 12 inches wide by 15 inches deep (381 mm high by 305 mm wide by 381 mm deep) **OR** 18 inches high by 12 inches wide by 15 inches deep (457 mm high by 305 mm wide by 381 mm deep), **as directed**.
 - 2) Type X, Parcel Only (No Master Door): A group of parcel receptacles in single-column configuration without a master door; one **OR** two, **as directed**, compartment(s) 18 inches high by 12 inches wide by 15 inches deep (457 mm high by 305 mm wide by 381 mm deep) and one compartment 15 inches high by 12 inches wide by 15 inches deep (381 mm high by 305 mm wide by 381 mm deep).
 - 3) Type XI, Parcel Only: A group of parcel receptacles in single-column configuration with single master door prepared for master-door lock; one **OR** two, **as directed**, compartment(s) 15 inches high by 12 inches wide by 15 inches deep (381 mm high by 305 mm wide by 381 mm deep) and one **OR** two, **as directed**, compartment(s) 18 inches high by 12 inches wide by 15 inches deep (457 mm high by 305 mm wide by 381 mm deep).
 - d. Compartments: Fabricated from aluminum sheet with number and size as follows: **OR** as indicated on Drawings, **as directed**.
 - 1) Type I: Provide one box with two compartments, one on top of the other, each compartment with inside dimensions of 12 inches wide by 14 inches high by 15 inches deep (305 mm wide by 356 mm high by 381 mm deep).
 - 2) Type II: Provide one box with four compartments, side by side, two on top and two on bottom, each compartment with inside dimensions of 12 inches wide by 14 inches high by 15 inches deep (305 mm wide by 356 mm high by 381 mm deep).
 - e. Front-Loading Master Door: Fabricated to hold compartment doors; prepared to receive master-door lock provided by local postmaster.
 - f. Compartment Doors and Frames: Fabricated from same material and finish as adjacent mail receptacles **OR** extruded aluminum **OR** aluminum sheet **OR** metallic-coated steel sheet **OR** aluminum or metallic-coated steel sheet, **as directed**. Equip each compartment door with lock, identification, and concealed, full-length, spring-loaded, flush hinge on right side.
 - 1) Compartment Identification: Black, sequential numbers engraved into **OR** stamped onto, **as directed**, recess in face of compartment door.
 - 2) Compartment-Door Locks (for USPS delivery): Dual lock security system in which master lock provides access to customer lock (USPS-L-1172C, PSIN O910) and parcel-locker key opens compartment and is retained once opened.
 - 3) Compartment-Door Locks (for private delivery): Two-key security system in which control key provides access to parcel-locker key, which opens compartment and is retained once opened.
 - g. Exposed Aluminum Finish: Finish surfaces exposed to view as follows:
 - 1) Anodic Finish: Clear **OR** Brass **OR** Dark bronze **OR** As indicated by manufacturer's designations **OR** As selected from manufacturer's full range, **as directed**.

- 2) Baked-Enamel or Powder-Coated Finish: Silver **OR** Black **OR** Medium bronze **OR** Dark bronze **OR** Gold **OR** Color as indicated by manufacturer's designations **OR** Color as selected from manufacturer's full range, **as directed**.
- h. Metallic-Coated Steel Finish: Finish surfaces exposed to view with baked-enamel or powder-coated finish; color as indicated by manufacturer's designations **OR** color as selected from manufacturer's full range, **as directed**.
2. Rear-Loading, USPS-Approved Indoor Parcel Lockers: Consisting of single or multiple compartments enclosed within recessed wall box. Provide access to compartments for distributing incoming parcels from rear of unit with accessibility to entire group of compartments. Provide access to each compartment for removing parcels by swinging compartment door. Comply with USPS-STD-4C **OR** USPS-STD-4B+ or USPS-B-1116A construction, adapted for larger-sized, interior, parcel compartments, **as directed**.
 - a. Mail Delivery: USPS **OR** Private, **as directed**.
 - b. Compartments: Number and size as follows: **OR** As indicated on Drawings, of the following sizes: **OR** As indicated on Drawings, **as directed**.
 - 1) Type XII, Parcel Only: A group of parcel receptacles in single-column configuration with a rear-access cover; one **OR** two, **as directed** compartment(s) 15 inches high by 12 inches wide by 15 inches deep (381 mm high by 305 mm wide by 381 mm deep) and one **OR** two, **as directed**, compartment(s) 18 inches high by 12 inches wide by 15 inches deep (457 mm high by 305 mm wide by 381 mm deep).
 - c. Compartments: Fabricated enclosure with number and size as follows: **OR** as indicated on Drawings, **as directed**.
 - 1) Type I: Provide one box with two compartments, one on top of the other, each compartment with inside dimensions of 12 inches wide by 14 inches high by 15 inches deep (305 mm wide by 356 mm high by 381 mm deep).
 - 2) Type II: Provide one box with four compartments, side by side, two on top and two on bottom, each compartment with inside dimensions of 12 inches wide by 14 inches high by 15 inches deep (305 mm wide by 356 mm high by 381 mm deep).
 - d. Rear-Loading Cover: Not required **OR** Lift-off rear cover fabricated from extruded aluminum or aluminum sheet, finished to match front of unit, **as directed**.
OR
Rear-Loading Door: Side hinged, fabricated from extruded aluminum or aluminum sheet, finished to match front of unit; with full-length, stainless-steel piano hinge on one side and positive-latching **OR** locking, **as directed**, mechanism on the other.
 - 1) Rear-Door Lock: Door prepared to receive lock provided by local postmaster.
OR
Rear-Door Lock: Cylinder lock keyed to building keying system; with two **OR** three, **as directed**, keys. Provide cylinders specified in Division 08 Section "Door Hardware".
 - e. Compartment Doors and Frames: Fabricated from same material and finish as adjacent mail receptacles **OR** extruded aluminum **OR** aluminum sheet **OR** metallic-coated steel sheet **OR** aluminum or metallic-coated steel sheet, **as directed**. Equip each compartment door with lock, identification, and concealed, full-length, spring-loaded, flush hinge on one side.
 - 1) Compartment Identification: Black, sequential numbers engraved into **OR** stamped onto, **as directed**, recess in face of compartment door.
 - 2) Compartment-Door Locks (for USPS delivery): Dual-lock security system in which master lock provides access to customer lock (USPS-L-1172C, PSIN O910) and parcel-locker key opens compartment and is retained once opened.
 - 3) Compartment-Door Locks (for private delivery): Two-key security system in which control key provides access to parcel-locker key, which opens compartment and is retained once opened.
 - f. Exposed Aluminum Finish: Finish surfaces exposed to view as follows:
 - 1) Anodic Finish: Clear **OR** Brass **OR** Dark bronze **OR** As indicated by manufacturer's designations **OR** As selected from manufacturer's full range, **as directed**.



- 2) Baked-Enamel or Powder-Coated Finish: Silver **OR** Black **OR** Medium bronze **OR** Dark bronze **OR** Gold **OR** Color as indicated by manufacturer's designations **OR** Color as selected from manufacturer's full range, **as directed**.
- g. Metallic-Coated Steel Finish: Finish surfaces exposed to view with baked-enamel or powder-coated finish; color as indicated by manufacturer's designations **OR** color as selected from manufacturer's full range, **as directed**.
3. USPS-Approved Outdoor Parcel Lockers (OPLs), Pedestal Mounted: Consisting of multiple compartments enclosed within freestanding, pedestal-mounted enclosure. Provide access to compartments for distributing incoming mail from front of unit by unlocking master lock and swinging pair of side-hinged master doors to provide accessibility to entire group of compartments. Provide access to each compartment for removing mail by swinging compartment door. Comply with USPS-B-1116A.
 - a. Compartment Enclosure: Fabricated from aluminum sheet with aluminum mounting pedestal and weather-protection hood, with the following number and size of compartments:
 - 1) Type I: Provide one box with two compartments, one on top of the other, each compartment with inside dimensions of **12 inches wide by 14 inches high by 15 inches deep (305 mm wide by 356 mm high by 381 mm deep)**.
 - 2) Type II: Provide one box with four compartments, side by side, two on top and two on bottom, each compartment with inside dimensions of **12 inches wide by 14 inches high by 15 inches deep (305 mm wide by 356 mm high by 381 mm deep)**.
 - b. Compartment Doors and Frames: Fabricated from one-piece extruded aluminum or aluminum sheet. Equip each compartment door with lock, tenant identification, and concealed, full-length, flush hinge on one side. Provide outgoing mail slot with weather protection flap.
 - 1) Locker Identification: Number engraved into face **OR** applied into recess, **as directed**, of compartment door.
 - 2) Door Locks: Two-key security system in which control key provides access to parcel-locker key, which opens compartment and is retained once opened.
 - c. Pedestal: Aluminum, with same finish as compartment enclosure and attached with theft-resistant fasteners.
 - d. Exposed Aluminum Finish: Finish surfaces exposed to view with powder-coated finish in postal gray (light gray) **OR** color as selected from manufacturer's full range of colors, **as directed**.
- I. USPS-Approved Collection Boxes
 1. USPS-Approved, Front-Loading Collection **OR** Receiving, **as directed**, Boxes: Consisting of single compartment with fire-resistant cushion bottom, enclosed within wall box, with mail slot **OR** hopper door, **as directed**, to receive mail. Provide access to compartment for collecting mail from front of unit. Comply with USPS Publication 16.
 - a. Mail Collection: USPS **OR** Private, **as directed**.
 - b. Mounting: Recessed **OR** Semirecessed **OR** Surface mounted, **as directed**.
 - c. Type: Collection box **OR** Receiving box for mail chutes, **as directed**.
 - d. Height: Sized to match height of four **OR** five **OR** six **OR** seven, **as directed**, horizontal mail receptacles.
OR
Height: As indicated on Drawings, **as directed**.
 - e. Compartment Door and Frame: Fabricated from **1/4-inch- (6-mm-)** **OR** minimum **1/8-inch- (3-mm-)**, **as directed**, thick aluminum, with opening not less than **12 by 20 inches (305 by 508 mm)** and not more than **18 by 30 inches (457 by 762 mm)**. Equip door with lock and concealed, full-length, flush hinge on one side.
 - 1) Door Lock (for units served by USPS): Door prepared to receive lock provided by local postmaster.
OR

- Door Lock: Cylinder lock keyed to building keying system; with two **OR** three, **as directed**, keys. Provide cylinders specified in Division 08 Section "Door Hardware".
- 2) Identification: Engrave face of compartment door with **1-inch- (25-mm-)** high letters as follows: "U.S. MAIL LETTER BOX" on two lines at top or bottom of unit.
 - 3) Door Style: Set door within face frame **OR** Extend door full width and height of unit, with no exposed frame, **as directed**.
- f. Mail Slot: Fabricated from **1/4-inch- (6-mm-)** thick aluminum, with **11-inch-wide by 1-1/4-inch- (279-mm-wide by 32-mm-)** high opening, protected by inside hood and hinge flap, and with inside baffle to prevent removal of mail from box.
- OR**
- Hopper Door: Fabricated from **1/4-inch- (6-mm-)** thick aluminum, with opening that allows a bundle measuring **6-1/2 inches wide by 11-1/2 inches long by 4 inches high (165 mm wide by 292 mm long by 102 mm high)** to be deposited, and with inside baffle to prevent removal of mail from box. Equip door with door pull and concealed, full-length bottom hinge.
- 1) Identification: Engrave face of hopper door with **1-inch- (25-mm-)** high letters as follows: "LETTERS AND LETTER MAIL TIED IN BUNDLES."
 - 2) Door Style: Set door within face frame **OR** Extend door full width and height of unit, with no exposed frame, **as directed**.
- g. Exposed Materials: Fabricated from stainless-steel-clad **OR** brass-clad, **as directed**, extruded or sheet aluminum.
- h. Concealed Components and Mounting Frames: Aluminum or steel sheet with manufacturer's standard finish.
- i. Schedule-Card Holder: Provide recessed or surface-mounted holder for pick-up schedule card in center of bottom front portion of unit. Fabricate of same material and finish as front of unit.
- j. Mailbag Hooks: Provide two aluminum or stainless-steel hooks at exterior front edge of bottom of surface-mounted units, spaced **15 to 17-1/2 inches (381 to 445 mm)** apart, for supporting mailbags.
- k. Mailbag Rack: Provide internal rack system for supporting mailbags within unit.
2. USPS-Approved, Rear-Loading Collection Boxes: Consisting of single compartment with fire-resistant cushion bottom, enclosed within recessed wall box, with mail slot **OR** hopper door, **as directed**, to receive mail. Provide access to compartment for collecting mail from rear of unit. Comply with USPS Publication 16.
- a. Mail Collection: USPS **OR** Private, **as directed**.
 - b. Height: Sized to match height of four **OR** five **OR** six **OR** seven, **as directed**, horizontal mail receptacles.
- OR**
- Height: As indicated on Drawings, **as directed**.
- c. Compartment Frame and Front Panel: Fabricated from **1/4-inch- (6-mm-)** **OR** minimum **1/8-inch- (3-mm-)**, **as directed**, thick aluminum.
- 1) Identification: Engrave face of front panel with **1-inch- (25-mm-)** high letters as follows: "U.S. MAIL LETTER BOX" on two lines at top or bottom of unit.
- d. Mail Slot: Fabricated from **1/4-inch- (6-mm-)** thick metal plate, with **11-inch-wide by 1-1/4-inch- (279-mm-wide by 32-mm-)** high opening, protected by inside hood and hinge flap, and with inside baffle to prevent removal of mail from box.
- OR**
- Hopper Door: Fabricated from **1/4-inch- (6-mm-)** thick metal plate, with opening that allows a bundle measuring **6-1/2 inches wide by 11-1/2 inches long by 4 inches high (165 mm wide by 292 mm long by 102 mm high)** to be deposited, and with inside baffle to prevent removal of mail from box. Equip door with door pull and concealed, full-length bottom hinge.
- 1) Identification: Engrave face of hopper door with **1-inch- (25-mm-)** high letters as follows: "LETTERS AND LETTER MAIL TIED IN BUNDLES."
 - 2) Door Style: Set door within face frame **OR** Extend door full width and height of unit, with no exposed frame, **as directed**.



- e. Rear-Loading Enclosure: Lift-off rear cover fabricated from same material and finish as front of unit.
OR
 Rear-Loading Door: Side hinged, with opening not less than **12 by 20 inches (305 by 508 mm)** and not more than **18 by 30 inches (457 by 762 mm)**, fabricated from same material and finish as front of unit; with full-length, stainless-steel piano hinge on one side and positive-latching mechanism on the other. Fabricate rear-loading door to remain open while mail is collected.
 - 1) Rear-Door Lock (for units served by USPS): Door prepared to receive lock provided by local postmaster.
OR
 Rear-Door Lock: Cylinder lock keyed to building keying system; with two **OR** three, **as directed**, keys. Provide cylinders specified in Division 08 Section "Door Hardware".
- f. Exposed Materials: Fabricated from extruded or sheet aluminum.
- g. Concealed Components and Mounting Frames: Aluminum or steel sheet with manufacturer's standard finish.
- h. Schedule-Card Holder: Provide recessed or surface-mounted holder for pick-up schedule card in center of bottom front portion of unit. Fabricate of same material and finish as front of unit.
- i. Mailbag Hooks: Provide two aluminum or stainless-steel hooks at exterior front edge of bottom of surface-mounted units, spaced **15 to 17-1/2 inches (381 to 445 mm)** apart, for supporting mailbags.
- j. Mailbag Rack: Provide internal rack system for supporting mailbags within unit.
- 3. Finish surfaces exposed to view as follows:
 - a. Aluminum Finish: Finish surfaces exposed to view as follows:
 - 1) Anodic Finish: Clear **OR** Black **OR** Gold **OR** Dark bronze **OR** Light bronze **OR** Medium bronze **OR** As indicated by manufacturer's designations **OR** As selected from manufacturer's full range, **as directed**.
 - 2) Baked-Enamel or Powder-Coated Finish: Black **OR** Gold **OR** Dark bronze **OR** Medium bronze **OR** Silver **OR** Color as indicated by manufacturer's designations **OR** Color as selected from manufacturer's full range, **as directed**.
 - b. Brass Finish: Buffed finish, lacquered **OR** Hand-rubbed finish, lacquered **OR** Brushed satin, lacquered, **as directed**.
 - c. Stainless-Steel Finish: No. 4.
- J. Private Collection Boxes
 - 1. Private, Horizontal, Front-Loading Collection Boxes: Consisting of single compartment of same depth as horizontal mail receptacles, enclosed within wall box, with slot in top of front to receive mail. Provide access to compartment for collecting mail from front of unit.
 - a. Height: Sized to match height of four **OR** five **OR** six **OR** seven, **as directed**, horizontal mail receptacles.
 - b. Mounting: Recessed **OR** Semirecessed **OR** Surface mounted, **as directed**.
 - c. Compartment Door and Frame: Fabricated from extruded aluminum or aluminum sheet that is full height of unit including **OR** in portion of unit below, **as directed**, mail slot, and equipped with lock and concealed, continuous side hinge.
 - 1) Door Lock (for units served by USPS): Door prepared to receive lock provided by local postmaster.
OR
 Door Lock: Cylinder lock keyed to building keying system; with two **OR** three, **as directed**, keys. Provide cylinders specified in Division 08 Section "Door Hardware".
 - 2) Identification: Engrave face of compartment door with **1-inch- (25-mm-)** high letters as follows: "LETTERS" **OR** "OUTGOING MAIL" **OR** "OFFICE," **as directed**.
 - d. Aluminum Finish: Finish surfaces exposed to view as follows:
 - 1) Anodic Finish: Clear, **as directed**.

- 2) Baked-Enamel or Powder-Coated Finish: Black **OR** Dark bronze **OR** Gold **OR** Medium bronze **OR** Color as indicated by manufacturer's designations **OR** Color as selected from manufacturer's full range, **as directed**.
2. Private, Horizontal, Rear-Loading Collection Boxes: Consisting of single compartment of same depth as horizontal mail receptacles, enclosed within recessed wall box, with slot in top of front to receive mail. Provide access to compartment for collecting mail from rear of unit.
 - a. Height: Sized to match height of four **OR** five **OR** six **OR** seven, **as directed**, horizontal mail receptacles.
 - b. Rear-Loading Cover: Not required **OR** Lift-off rear cover fabricated from extruded aluminum or aluminum sheet, finished to match front of unit, **as directed**.
OR
Rear-Loading Door: Side hinged, fabricated from extruded aluminum or aluminum sheet, finished to match front of unit; with continuous hinge on one side and positive-latching **OR** locking, **as directed**, mechanism on the other.
 - 1) Rear-Door Lock (for units served by USPS if lock is required): Door prepared to receive lock provided by local postmaster.
OR
Rear-Door Lock: Cylinder lock keyed to building keying system; with two **OR** three, **as directed**, keys. Provide cylinders specified in Division 08 Section "Door Hardware".
 - c. Exposed Materials: Fabricated from extruded or sheet aluminum.
 - d. Concealed Components and Mounting Frames: Aluminum or steel sheet with manufacturer's standard finish.
 - e. Identification: Engrave front of unit below mail slot with **1-inch- (25-mm-)** high letters as follows: "LETTERS" **OR** "OUTGOING MAIL" **OR** "OFFICE," **as directed**.
 - f. Aluminum Finish: Finish surfaces exposed to view as follows:
 - 1) Anodic Finish: Clear, **as directed**.
 - 2) Baked-Enamel or Powder-Coated Finish: Black **OR** Dark bronze **OR** Gold **OR** Medium bronze **OR** Color as indicated by manufacturer's designations **OR** Color as selected from manufacturer's full range, **as directed**.
3. Vertical Collection Boxes: Consisting of single compartment enclosed within wall box, with slot in top of front to receive mail. Provide access to compartment for collecting incoming mail from front of unit.
 - a. Mounting: Recessed **OR** Semirecessed **OR** Surface mounted, **as directed**.
 - b. Size: Same height as adjacent vertical mail receptacles **OR** **8-3/4 inches wide by 19 inches high by 6-1/2 inches deep (222 mm wide by 483 mm high by 165 mm deep)** **OR** **15 inches wide by 19 inches high by 6-1/2 inches deep (381 mm wide by 483 mm high by 165 mm deep)**, **as directed**.
 - c. Compartment Door and Frame: Fabricated from aluminum, with opening for mail. Equip door with lock and concealed, full-length, flush hinge on one side. Set door within face frame.
 - 1) Door Lock (for units served by USPS): Door prepared to receive lock provided by local postmaster.
OR
Door Lock: Cylinder lock keyed to building keying system; with two **OR** three, **as directed**, keys. Provide cylinders specified in Division 08 Section "Door Hardware".
 - 2) Identification: Engrave face of compartment door with **1-inch- (25-mm-)** high letters as follows: "LETTERS" **OR** "OUTGOING MAIL" **OR** "OFFICE," **as directed**.
 - d. Exposed Materials: Fabricated from extruded or sheet aluminum.
 - e. Concealed Components and Mounting Frames: Aluminum or steel sheet with manufacturer's standard finish.
 - f. Aluminum Finish: Finish surfaces exposed to view as follows:
 - 1) Anodic Finish: Clear, **as directed**.
 - 2) Baked-Enamel or Powder-Coated Finish: Aluminum **OR** Black **OR** Brass **OR** Dark bronze **OR** Gold **OR** Green **OR** Ivory **OR** Medium bronze **OR** Silver **OR** Color as

indicated by manufacturer's designations **OR** Color as selected from manufacturer's full range, **as directed**.

4. Private, Pedestal-Mounted Collection Boxes: Consisting of single compartment enclosed within freestanding, pedestal-mounted enclosure, with slot in top of front of unit to receive mail. Provide access to compartment for collecting mail from front or rear of unit through door equipped with concealed, continuous side hinge and lock.
 - a. Compartment Enclosure: Fabricated from extruded aluminum or aluminum sheet with integral weather-protection hood.
 - b. Pedestal: Same material and finish as parcel locker and attached with theft-resistant fasteners **OR** As indicated on Drawings, **as directed**.
 - c. Aluminum Finish: Finish surfaces exposed to view as follows:
 - 1) Anodic Finish: Clear, **as directed**.
 - 2) Baked-Enamel or Powder-Coated Finish: Blue **OR** Gray **OR** White **OR** Color as indicated by manufacturer's designations **OR** Color as selected from manufacturer's full range, **as directed**.
5. Private, Curbside Collection Boxes: Consisting of single compartment enclosed within curved-top, freestanding enclosure with four legs and casters, **as directed**. Fabricate enclosure from welded and riveted steel. Provide hopper door with door pull in top of unit to receive packages, with opening size not less than **4-1/2 inches high by 15-1/2 inches wide (114 mm high by 394 mm wide)**. Provide access to compartment for collecting packages from bottom of front of unit through door equipped with concealed, continuous bottom hinge and lock.
 - a. Door Lock: Five-pin tumbler cylinder **OR** Hasp for padlock, **as directed**.
 - b. Snorkel: Provide rear-mounted, drive-by attachment with opening not less than **12 inches wide by 3 inches high (305 mm wide by 76 mm high)**.
 - c. Steel Finish: Baked-enamel or powder-coated finish; gray **OR** white **OR** color as indicated by manufacturer's designations **OR** color as selected from manufacturer's full range, **as directed**.

K. Data Distribution Boxes

1. Data Distribution Boxes: Consisting of multiple compartments enclosed within enclosure.
 - a. Enclosure Configuration: Freestanding **OR** Recessed in wall **OR** Recessed in wall and installed between rack ladders, **as directed**.
 - b. Compartment Access: Provide access to compartments as follows:
 - 1) For Distributing Incoming Mail from Front of Unit: Mail slot in each compartment door.
 - 2) For Distributing Incoming Mail from Rear of Unit: Open backs with aluminum cover finished to match front of unit, **as directed**.
 - 3) For Removing Mail: Unlocking and swinging compartment door.
 - c. Compartments: Number and size as follows: **OR** As indicated on Drawings, of the following sizes: **OR** As indicated on Drawings, **as directed**.
 - 1) Size 1: Provide compartments with inside dimensions not less than **5 inches high by 12-1/2 inches wide by 15 inches deep (127 mm high by 318 mm wide by 381 mm deep)**.
 - d. Compartment Doors: Equip each with lock and concealed, continuous hinge.
 - 1) Door Locks: Five-pin tumbler, cylinder cam **OR** spring-latch-type, **as directed**, locks capable of at least 1000 key changes; with two **OR** three, **as directed**, keys for each compartment door. Key each compartment differently.
OR
Door Locks: Three-digit, single-dial, combination locks with spring latch and automatic throw off. Set each compartment with different combination.
 - e. Concealed Components and Mounting Frames: Aluminum or steel sheet with manufacturer's standard finish.
 - f. Exposed Materials: Fabricated from steel sheet or aluminum with powder-coat finish.
 - g. Rack Ladders: Aluminum or steel with manufacturer's standard finish.

- h. Powder-Coated Finish: Silver **OR** Silver with black trim **OR** Silver with slate trim **OR** Sandalwood with sand trim **OR** Color as indicated by manufacturer's designations **OR** Color as selected from manufacturer's full range, **as directed**.

L. Mail Chutes

1. General: Factory assembled and fabricated with tight joints, overlaps in direction of mail flow, and free of ledges. Provide transition sections so all sections of chutes are connected and overlap at least **2 inches (51 mm)**. Fabricate mail chutes so joint sections comply with same dimensions with no reduction in chute size. Provide removable panels for access to concealed portions of chutes that exceed **5 feet (1.5 m)** in length. Comply with USPS Publication 16, **as directed**.
 - a. Mail Collection: USPS **OR** Private, **as directed**.
 - b. Inside Dimensions: **8 inches wide by 2 inches deep (203 mm wide by 51 mm deep)** (for chutes served by USPS) **OR 14 inches wide by 3 inches deep (356 mm wide by 76 mm deep)** **OR 14 inches wide by 7 inches deep (356 mm wide by 178 mm deep)**, **as directed**.
 - c. Mounting: Recessed **OR** Semirecessed **OR** Surface mounted **OR** As detailed, **as directed**.
2. Exposed Front Panels: Continuous, one-piece frames and covers fabricated from **0.125-inch- (3.2-mm-)** thick, stainless-steel-clad **OR** brass-clad, **as directed**, extruded aluminum, and retaining removable transparent material as follows, for not less than 3/4 of length of front of chute on each floor:
 - a. Transparent Material: Manufacturer's standard glazing, complying with USPS Publication 16.
3. Concealed Front Panels: Consisting of continuous, one-piece frames retaining **0.0269-inch- (0.7-mm-)** thick, metallic-coated steel sheet panels. Extend concealed front panels from top of ceiling fascia to bottom of floor collar above.
4. Sides and Backs: Continuous, one-piece, **0.125-inch- (3.2-mm-)** thick aluminum sheet extending from floor to ceiling on each floor and extending **54 inches (1372 mm)** above finish flooring at top story.
5. Floor and Ceiling Fasciae and Lock Band: Manufacturer's standard, matching material and finish of front frames and covers. Provide lock band with locking device and keyed lock that prevents key removal if locking device is not secured.
6. Mail Slots: Same material and finish as chute; not less than **4-3/4 inches wide by 1/2 inch high (121 mm wide by 13 mm high)** with device designed to guide mail into inside opening of same size located **2-1/2 inches (64 mm)** below mail slot. Provide mail slots on each floor.
 - a. For chutes served by USPS, inscribe the words "U.S. MAIL" on face of mail slots.
7. Finish surfaces exposed to view as follows:
 - a. Aluminum Finish: Finish surfaces exposed to view as follows:
 - 1) Anodic Finish: Clear **OR** Black **OR** Dark bronze **OR** Medium bronze **OR** As indicated by manufacturer's designations **OR** As selected from manufacturer's full range, **as directed**.
 - 2) Baked-Enamel or Powder-Coated Finish: Color as indicated by manufacturer's designations **OR** Color as selected from manufacturer's full range, **as directed**.
 - b. Brass Finish: Buffed finish, lacquered **OR** Hand-rubbed finish, lacquered **OR** Brushed satin, lacquered, **as directed**.
 - c. Stainless-Steel Finish: No. 4.

M. Accessories

1. Directory for Mail Receptacles: Surface-mounted, front-opening unit, with clear glass or plastic window.
 - a. Framed, Top-Mount Unit for Horizontal Mail Receptacles: Fabricate directory as framed, horizontal unit with modular sections having a 24-name capacity (3 modules) **OR** 32-name capacity (4 modules) **OR** 40-name capacity (5 modules), **as directed**; of same material, size, **as directed**, and finish as adjacent mail receptacles; mounted above mail receptacles as indicated on Drawings, **as directed**.



- b. Framed, Side-Mount Unit for Horizontal Mail Receptacles: Fabricate directory as framed, horizontal unit with 50-name capacity, **28 inches (711 mm)** OR 60-name capacity, **33-3/8 inches (848 mm)** OR 70-name capacity, **38-3/4 inches (984 mm)**, **as directed** high; of same material and finish as adjacent mail receptacles; mounted along side of mail receptacles as indicated on Drawings, **as directed**.
 - c. Framed, Side-Mount Unit for Vertical Mail Receptacles: Fabricate directory as framed, vertical unit with modular sections having a 40-name capacity (1 module) OR 80-name capacity (2 modules) OR 120-name capacity (3 modules) OR 160-name capacity (4 modules) OR 200-name capacity (5 modules), **as directed**; of same size, material, and finish as adjacent vertical mail compartment doors unless otherwise indicated.
 - d. Insert Units for Vertical Mail Receptacles: Fabricate directory as modular inserts having a 40-name capacity (1 module) OR 80-name capacity (2 modules) OR 120-name capacity (3 modules) OR 160-name capacity (4 modules) OR 200-name capacity (5 modules), **as directed**; of same size, material, and finish as adjacent vertical mail compartment doors unless otherwise indicated.
 - e. Provide name strips made of **1/4-inch- (6-mm-)** high label tape.
 2. Key Keeper: Consisting of single compartment with door; interior compartment size not less than **4-3/4 inches wide by 2-1/4 inches high by 1-1/2 inches deep (121 mm wide by 57 mm high by 38 mm deep)**, **as directed**. USPS approved, **as directed**.
 - a. Mounting: Recessed OR Surface mounted, **as directed**.
 - b. Style: Compartment door set within face frame OR extending full width and height of unit, with no exposed frame, **as directed**.
 - c. Type of Operation: Loose key in box OR Retractor reel with minimum **20-inch- (508-mm-)** long chain OR Push button, 24-V switch in box, **as directed**.
 - d. Mail Delivery: USPS OR Private, **as directed**.
 - e. Door Lock (for units served by USPS): Door prepared to receive lock furnished by local postmaster.
OR
 Door Lock: Five-pin tumbler, cylinder cam lock capable of at least 1000 key changes; with two OR three, **as directed**, keys.
OR
 Door Lock: Cylinder lock keyed to building keying system; with two OR three, **as directed**, keys. Provide cylinders specified in Division 08 Section "Door Hardware".
 - f. Exposed Material and Finish: Exposed surfaces fabricated from same material and finish as adjacent mail receptacles.
 - g. Exposed Material and Finish: Steel, aluminum OR brass, **as directed**, powder-coated finish.
 - h. Exposed Material and Finish: Stainless steel, brushed finish.
 - i. Exposed Material and Finish: Aluminum, as follows:
 - 1) Anodic Finish: Clear OR Brass OR Dark bronze OR As indicated by manufacturer's designations OR As selected from manufacturer's full range, **as directed**.
 - 2) Baked-Enamel or Powder-Coated Finish: Black OR Dark bronze OR Medium bronze OR Gold OR Color as indicated by manufacturer's designations OR Color as selected from manufacturer's full range, **as directed**.
 3. Key Cabinet: Wall-mounted, metallic-coated, **as directed**, steel cabinet with pivoting, key-holding panels and side-hinged door equipped with five-pin tumbler, cylinder door lock and concealed, full-length flush hinge. Finish cabinet, panels, and door with baked-enamel or powder-coated finish. Provide key control system consisting of key-holding hooks, labels, two sets of key tags with self-locking key holders, key-gathering envelopes, and temporary and permanent markers.
 - a. Capacity: Keys for 150 percent of the number of, **as directed**, mail-receptacle locks.
 - b. Cross-Index System: Consisting of index cards for recording key information. Include three receipt forms for each key-holding hook.
 - c. Baked-Enamel or Powder-Coated Finish: Color as indicated by manufacturer's designations OR Color as selected from manufacturer's full range, **as directed**.

4. Mail-Sorting Collection Unit: Consisting of **1/4-inch- (6-mm-)** thick, metal face plate and through-the-wall hopper door(s) allowing receipt and separation of mail.
 - a. Hopper Doors: One **OR** Two **OR** Three, **as directed**, door(s), with door pull for each and with opening size not less than dimensions approved by the Owner.
 - 1) Engrave doors with **1-inch- (25-mm-)** high letters as follows: "STAMPED MAIL" **OR** "METERED MAIL," **as directed**.
 - 2) Identification: Engrave unit at top with **2-inch- (51-mm-)** high letters as follows: "U.S. MAIL" **OR** "UNITED STATES MAIL," **as directed**.
 - b. Exposed Material and Finish: Exposed surfaces fabricated from same material and finish as adjacent mail receptacles.
 - c. Aluminum Finish: Finish surfaces exposed to view as follows:
 - 1) Anodic Finish: Clear **OR** Black **OR** Dark bronze **OR** Light bronze **OR** Medium bronze **OR** As indicated by manufacturer's designations **OR** As selected from manufacturer's full range, **as directed**.
 - 2) Baked-Enamel or Powder-Coated Finish: Black **OR** Dark bronze **OR** Gold **OR** Medium bronze **OR** Color as indicated by manufacturer's designations **OR** Color as selected from manufacturer's full range, **as directed**.
 - d. Brass Finish: Buffed finish, lacquered **OR** Hand-rubbed finish, lacquered **OR** Brushed satin, lacquered, **as directed**.
 - e. Stainless-Steel Finish: No. 4.
5. Letter Drops (Through Wall): Consisting of **11-inch-wide by 3-1/2-inch- (279-mm-wide by 89-mm-)** high, top-hinged, spring-loaded flap that pivots inward, held in place by **1-inch- (25-mm-)** wide face frame. Fabricated from **1/4-inch- (6-mm-)** thick aluminum or steel, with exposed surfaces finished to match adjacent mail receptacles.
 - a. Sleeve: Provide metallic-coated, **as directed**, steel wall sleeve for full depth of wall.
 - b. Finished Frame: Provide finished face frame on back side of wall opening.
 - c. Identification: Engrave face of swinging flap with **1-inch- (25-mm-)** high letters as follows: "U.S. MAIL" **OR** "LETTERS" **OR** "OUTGOING MAIL," **as directed**.
 - d. Exposed Material and Finish: Exposed surfaces fabricated from same material and finish as adjacent mail receptacles, **as directed**.
6. Package Depository (Through Wall): Consisting of **1/4-inch- (6-mm-)** thick, aluminum or steel face plate and through-the-wall hopper door with hinged baffle, **as directed**, allowing receipt of packages; fabricated from **1/4-inch- (6-mm-)** thick aluminum or steel.
 - a. Hopper Door: Equipped with door pull and concealed, full-length bottom hinge; with opening size not less than **15 inches wide by 6-1/2 inches high (381 mm wide by 165 mm high)** **OR** as indicated on Drawings, **as directed**.
 - b. Sleeve: Provide metallic-coated, **as directed**, steel wall sleeve for full depth of wall.
 - c. Slowdown: Provide steel slowdown ramp on back side of wall opening.
 - d. Identification: Engrave face of hopper door with **1-inch- (25-mm-)** high letters as follows: "BOOK DEPOSITORY," **as directed**.
 - e. Finish: Exposed surfaces finished same as mail receptacles.
 - f. Aluminum Finish: Finish surfaces exposed to view as follows:
 - 1) Anodic Finish: Clear **OR** As indicated by manufacturer's designations **OR** As selected from manufacturer's full range, **as directed**.
 - 2) Baked-Enamel or Powder-Coated Finish: Dark bronze **OR** Gold **OR** Color as indicated by manufacturer's designations **OR** Color as selected from manufacturer's full range, **as directed**.
 - g. Steel Finish: Finish surfaces exposed to view with baked-enamel or powder-coated finish; color as indicated by manufacturer's designations **OR** color as selected from manufacturer's full range, **as directed**.

N. Fabrication

1. Form postal specialties to required shapes and sizes, with true lines and angles, square, rigid, and without warp, and with metal faces flat and free of dents or distortion. Make exposed metal edges and corners free of sharp edges and burrs and safe to touch. Fabricate doors of postal specialties to preclude binding, warping, or misalignment.

2. Preassemble postal specialties in shop to greatest extent possible to minimize field assembly.
3. Mill joints to a tight, hairline fit. Cope or miter corner joints. Form joints exposed to weather to exclude water penetration.
4. Drill or punch holes required for fasteners and remove burrs. Use security fasteners where fasteners are exposed. If used, seal external rivets before finishing.
5. Weld in concealed locations to greatest extent possible without distorting or discoloring exposed surfaces. Remove weld spatter and welding oxides from exposed surfaces.
6. Fabricate tubular and channel frame assemblies with manufacturer's standard welded or mechanical joints. Provide subframes and reinforcement as required for a complete system to support loads.
7. Fabricate rack ladders to support indicated number of units to form a column of units.
8. Where dissimilar metals will contact each other, protect against galvanic action by painting contact surfaces with bituminous coating or by applying other permanent separation as recommended by manufacturers of dissimilar metals.

O. General Finish Requirements

1. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
2. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
3. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

P. Copper-Alloy Finishes

1. Buffed Finish, Lacquered: M21-O6x (Mechanical Finish: buffed, smooth specular; Coating: clear organic coating as specified below).
2. Hand-Rubbed Finish, Lacquered: M31-M34-O6x (Mechanical Finish: directionally textured, fine satin; Mechanical Finish: directionally textured, hand rubbed; Coating: clear organic coating as specified below).
3. Brushed Satin Finish, Lacquered: M32-O6x (Mechanical Finish: directionally textured, medium satin; Coating: clear organic coating as specified below).
4. Clear Organic Coating: Clear, waterborne, air-drying, acrylic lacquer specially developed for coating copper-alloy products, applied by air spray in two coats per manufacturer's written instructions, with interim drying, to a total thickness of 1 mil (0.025 mm). It consists of a solution of methyl methacrylate copolymer with benzotriazole to prevent breakdown of the film in UV light, and is called "Incralac."

1.3 EXECUTION

A. Installation

1. General: Install postal specialties level and plumb, according to manufacturer's written instructions and roughing-in drawings.
 - a. Where dissimilar metals will be in permanent contact with each other, protect against galvanic action by painting contact surfaces with bituminous coating or by applying other permanent separation as recommended by manufacturer for this purpose.
 - b. Where aluminum will contact grout, concrete, masonry, or wood, protect against corrosion by painting contact surfaces with bituminous coating.
 - c. Final acceptance of postal specialties served by USPS depends on compliance with USPS requirements.
2. Horizontal Mail Receptacles: Install horizontal mail receptacles with center of tenant-door lock cylinders and bottom of compartments at the maximum and minimum heights above finished floor established by USPS and manufacturer's written instructions.

- a. Install removable-core and keyed-in door lock cylinders as required for each type of cylinder lock.
 - b. Install and align two rack ladders for the first column of mail receptacles and one rack ladder for each additional adjacent column of mail receptacles.
 3. Vertical Mail Receptacles: Install vertical mail receptacles with center of master lock cylinder not more than **48 inches (1219 mm)** and not less than **30 inches (762 mm)** above finished floor.
 4. Pedestal-Mounted Postal Specialties: Anchor units with **1/2-inch- (13-mm-)** diameter, galvanized **OR** stainless, **as directed**, -steel anchor bolts with hooked ends, for CBUs, NDCBUs, and some models of parcel lockers and collection boxes.
 5. Collection Boxes: Install collection boxes with centerline of mail slots **OR** handle of hopper doors, **as directed**, not more than **48 inches (1219 mm)** above finished floor.
 6. Receiving Boxes: Install receiving boxes with bottom of unloading door not less than **30 inches (762 mm)** above finished floor.
 - a. Install receiving boxes with exterior of box bottom not more than **20 inches (508 mm)** above finished floor.
 7. Freestanding Data Distribution Boxes: Locate freestanding data distribution boxes at locations indicated or, if not indicated, as directed.
 8. Rack-Ladder Data Distribution Boxes: Install and align two rack ladders for the first column of data distribution boxes and one rack ladder for each additional adjacent column of data distribution boxes.
 9. Mail Chutes: Mount chutes with bottom ends extending **1 inch (25 mm)** into receiving boxes. Attach chutes with straps, collars, and sleeves. Do not penetrate chute with fasteners.
 - a. Comply with USPS Publication 16 for installation.
 - b. Install chutes with centerline of mail slots not more than **48 inches (1219 mm)** above finished floor.
 10. Key Keeper: Install horizontally **OR** vertically **OR** as indicated on Drawings, **as directed**.
- B. Field Quality Control
 1. Arrange for USPS personnel to examine and test postal specialties served by USPS after they have been installed according to USPS regulations.
 2. Obtain written final approval of postal specialties to be served by USPS. Obtain this approval from USPS postmaster that authorizes mail collection for the served installation.
- C. Adjusting, Cleaning, And Protection
 1. Remove temporary protective coverings and strippable films, if any, as postal specialties are installed unless otherwise indicated in manufacturer's written installation instructions.
 2. Adjust doors, hardware, and moving parts to function smoothly, and lubricate as recommended by manufacturer. Verify that integral locking devices operate properly.
 3. Touch up marred finishes or replace postal specialties that cannot be restored to factory-finished appearance. Use only materials and procedures recommended or furnished by postal specialty manufacturer.
 4. Replace postal specialties that have been damaged or have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.
 5. On completion of postal specialty installation, clean interior and exterior surfaces as recommended by manufacturer.

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Task	Specification	Specification Description
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SECTION 10 56 13 16 - METAL STORAGE SHELVING

1.1 GENERAL

A. Description Of Work

1. This specification covers the furnishing and installation of materials for metal storage shelving. Product shall be as follows or as directed by the Owner. Installation procedures shall be in accordance with the product manufacturer's recommendations. Demolition and removal of materials shall be as required to support the work.

B. Summary

1. Section Includes:
 - a. Case-type metal storage shelving.
 - b. Four-post metal storage shelving.
 - c. Post-and-beam metal storage shelving.

C. Performance Requirements

1. Delegated Design: Design metal storage shelving, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.
2. Structural Performance for Case-Type and Four-Post Metal Storage Shelving: Capable of withstanding the loads indicated according to MH 28.1.
3. Structural Performance for Post-and-Beam Metal Storage Shelving: Capable of withstanding the loads indicated according to MH 28.2.
4. Seismic Performance: Metal storage shelving shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.
 - a. Seismic Component Importance Factor: 1.5 **OR** 1.0, **as directed**.

D. Submittals

1. Product Data: For each type of product indicated.
2. LEED Submittal:
 - a. Product Data for Credit EQ 4.4: For particleboard, documentation indicating that product contains no urea formaldehyde.
3. Shop Drawings: For customized metal storage shelving. Include plans, elevations, sections, details, and attachments to other work. Include installation details of connectors, lateral bracing, and special bracing.
4. Samples: For each exposed product and for each color and texture specified.
5. Delegated-Design Submittal: For metal storage shelving indicated to comply with performance requirements, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
 - a. Design Calculations: Calculate requirements for seismic restraints.
6. Seismic Qualification Certificates: For metal storage shelving, accessories, and components, from manufacturer.
7. Product certificates.
8. Maintenance data.

E. Quality Assurance

1. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for installation of units required for this Project.
2. Preinstallation Conference: Conduct conference at Project site.

1.2 PRODUCTS

A. Materials

1. Hot-Rolled Steel Sheet: ASTM A 1011/A 1011M, Commercial Steel (CS), Type B; free of scale, pitting, or surface defects; pickled and oiled.
2. Cold-Rolled Steel Sheet: ASTM A 1008/A 1008M, Commercial Steel (CS), Type B.
3. Metallic-Coated Steel Sheet: ASTM A 653/A 653M, Commercial Steel (CS), Type B; with **G60 (Z180)** zinc (galvanized) or **A60 (ZF180)** zinc-iron-alloy (galvannealed) coating.
4. Steel Tubing: ASTM A 513, Type 2.
5. Stainless-Steel Tubing: ASTM A 554, Grade MT-304.
6. Steel Wire: ASTM A 899.
7. Stainless-Steel Wire: ASTM A 580/A 580M, Type 304.
8. Particleboard: ANSI A208.1, made with binder containing no urea formaldehyde.
9. Hardboard: ANSI A135.4.
10. Floor Anchors: Galvanized-steel, post-installed expansion anchors **OR** power-actuated fasteners **OR** threaded concrete screws, **as directed**. Provide number per unit recommended by manufacturer unless additional anchors are indicated in calculations.
11. Wall Anchors: Manufacturer's standard, galvanized-steel anchors designed to secure metal storage shelving to adjacent wall. Provide one per shelving unit for each shelving unit adjacent to a wall unless additional anchors are indicated in calculations.

B. Case-Type Metal Storage Shelving

1. General: Factory-formed, field-assembled, freestanding, case-type metal storage shelving system, designed for shelves to span between and be supported by sheet metal end panels (without posts), with shelves adjustable over the height of shelving unit. Fabricate shelf units with end panel at each end so each unit is independent. Provide fixed top and bottom shelves, adjustable intermediate shelves, and accessories indicated.
2. Load-Carrying Capacity per Shelf: **200 lb (91 kg)** **OR** As indicated on Drawings, **as directed**.
3. End Panels: Fabricated from cold-rolled steel sheet, with concealed perforations at front and back edges at manufacturer's standard spacing **OR 1 inch (25 mm)** o.c., **as directed**, for receiving adjustable shelf clips.
 - a. Steel-Sheet Thickness, Nominal: **0.036 inch (0.91 mm)** **OR** As required for load-carrying capacity per shelf and number of shelves, **as directed**.
 - b. Adjustable Shelf Clips: Fabricated from **0.036-inch- (0.91-mm-)** nominal thickness, cold-rolled steel; with projections designed to engage at least two perforations in end panels.

OR

End Panels: Fabricated from cold-rolled steel sheet; with horizontal slots spaced at manufacturer's standard spacing **OR 1 inch (25 mm)** o.c. **OR 1-1/2 inches (38 mm)** o.c., **as directed**, for supporting shelves.
4. Back Panel: One piece, fabricated from cold-rolled steel sheet.
 - a. Steel-Sheet Thickness, Nominal: **0.036 inch (0.91 mm)** **OR** As required for load-carrying capacity per shelf, **as directed**.
5. Shelves: Fabricated from cold-rolled steel sheet, with slots or holes at **2 inches (51 mm)** o.c. for shelf dividers, **as directed**. Fabricate shelves with vertical front that is flanged and returned.
 - a. Steel-Sheet Thickness, Nominal: **0.048 inch (1.21 mm)** **OR** As required for load-carrying capacity per shelf and number of shelves, **as directed**.
6. Shelf Quantity: Three **OR** Four **OR** Five **OR** Six, **as directed**, shelves per shelving unit in addition to top and bottom shelf.
7. Base: Closed front, with base strips fabricated from same material and with same finish as end panels.
8. Overall Unit Width: **30 inches (762 mm)** **OR 36 inches (914 mm)** **OR 42 inches (1067 mm)** **OR 48 inches (1219 mm)**, **as directed**.

9. Overall Unit Depth: **12 inches (305 mm) OR 18 inches (457 mm) OR 24 inches (610 mm), as directed.**
 10. Overall Unit Height: **72 inches (1829 mm) OR 84 inches (2134 mm) OR 96 inches (2438 mm), as directed.**
 11. Accessories:
 - a. Finished End Panels: Fabricated as solid **OR** perforated, **as directed**, full-height panels from same material and with same finish as end panels, with trim for a finished appearance along edges abutting end panels and top shelf.
 - b. Shelf Dividers: Fabricated from same material and with same finish as shelves; full-height **OR** angle **OR** tapered **OR** sliding, **as directed**, type.
 - c. Bins: Fabricated from same material and with same finish as shelves; size as indicated on Drawings **OR as directed**.
 - d. Shelf-Label Holders: Clear **OR** Colored, **as directed**, plastic, designed to clip onto front edge of shelf.
 12. Finish: Baked enamel **OR** Powder coat, **as directed**.
 - a. Color and Gloss: As selected from manufacturer's full range.
- C. Four-Post Metal Storage Shelving
1. Open **OR** Closed, **as directed**, Four-Post Metal Storage Shelving: Factory-formed, field-assembled, freestanding system, designed for shelves to span between and be supported by corner posts, with shelves adjustable over the height of shelving unit. Fabricate initial shelving unit with a post at each corner. Fabricate additional shelving units similarly, so each unit is independent **OR** as add-on units, designed to share two corner posts with initial shelving unit, **as directed**. Provide fixed top and bottom shelves, adjustable intermediate shelves, and accessories indicated.
 - a. Load-Carrying Capacity per Shelf: **350 lb (159 kg) OR 700 lb (318 kg) OR 1500 lb (680 kg) OR As indicated on Drawings, as directed.**
 - b. Posts: Fabricated from hot-rolled steel; in angle **OR** offset angle **OR** beaded **OR** T- **OR** tubular T- **OR** V- **OR** box **OR** manufacturer's standard, **as directed**, shape; with perforations at **1-1/2 inches (38 mm)** o.c. to receive shelf-to-post connectors.
 - 1) Steel Thickness, Nominal: **0.075 inch (1.90 mm) OR As required for load-carrying capacity per shelf and number of shelves, as directed.**
 - 2) Add-On Shelf Posts: Fabricated from hot-rolled steel, T- **OR** manufacturer's standard, **as directed**, shape; perforated to match main posts and of same thickness.
 - 3) Post Base: Bolt leveler **OR** Adjustable steel floor plate, drilled for floor anchors, **as directed**.
 - c. Bracing: Manufacturer's standard, single **OR** double, **as directed**, diagonal cross bracing at back **OR** ends **OR** back and ends, **as directed**; as required for stability, load-carrying capacity of shelves, and number of shelves.
 - d. Back Panel: One piece **OR** Two half panels, **as directed**, fabricated from cold-rolled steel sheet.
 - 1) Steel-Sheet Thickness, Nominal: **0.024 inch (0.61 mm) OR As required for load-carrying capacity per shelf, as directed.**
 - e. End Panels: Fabricated from cold-rolled steel sheet.
 - 1) Steel-Sheet Thickness, Nominal: **0.024 inch (0.61 mm) OR As required for load-carrying capacity per shelf, as directed.**
 - f. Solid-Type Shelves: Fabricated from steel sheet as follows:
 - 1) Steel-Sheet Thickness, Nominal: **0.030 inch (0.76 mm) OR 0.036 inch (0.91 mm) OR 0.048 inch (1.21 mm) OR As required for load-carrying capacity per shelf, as directed.**
 - 2) Metallic-Coated Steel-Sheet Thickness, Nominal: **0.034 inch (0.86 mm) OR 0.040 inch (1.02 mm) OR 0.052 inch (1.32 mm) OR As required for load-carrying capacity per shelf, as directed.**
 - 3) Slots or Holes for Shelf Dividers: **2 inches (51 mm) OR 3 inches (76 mm), as directed, o.c.**



- 4) Fabricate fronts and backs of shelves with box-formed edges, with corners lapped and welded.
OR
Fabricate fronts and backs of shelves with vertical edges that are flanged and returned, with edges reinforced with steel bars, angles, or channels.
- g. Framed-Type Wire Shelves: Steel **OR** Metallic-coated-steel, **as directed**, wire; with shelf frame fabricated from same material and with same finish as posts.
- h. Truss-Type Wire Shelves: Steel **OR** Metallic-coated-steel **OR** Stainless-steel **OR** Manufacturer's standard, chrome-plated, **as directed**, wire-over-wire construction, with downturned wire truss edges.
- i. Shelf Quantity: Three **OR** Four **OR** Five **OR** Six, **as directed**, shelves per shelving unit in addition to top and bottom shelf.
- j. Shelf-to-Post Connectors: Mechanical fasteners (nuts and bolts) **OR** Compression clips **OR** Support clips **OR** Containment clips **OR** Horizontal supports with rivet connectors to post **OR** Manufacturer's standard connectors, **as directed**.
- k. Base: Open, with exposed post legs **OR** Closed, with base strips fabricated from same material and with same finish as shelving, **as directed**.
- l. Overall Unit Width: 30 inches (762 mm) **OR** 36 inches (914 mm) **OR** 42 inches (1067 mm) **OR** 48 inches (1219 mm), **as directed**.
- m. Overall Unit Depth: 12 inches (305 mm) **OR** 18 inches (457 mm) **OR** 24 inches (610 mm), **as directed**.
- n. Overall Unit Height: 72 inches (1829 mm) **OR** 84 inches (2134 mm) **OR** 96 inches (2438 mm), **as directed**.
- o. Accessories:
 - 1) Finished End Panels: Fabricated as solid **OR** perforated, **as directed**, full-height panels from manufacturer's standard thickness cold-rolled steel sheet and with same finish as posts, with trim for a finished appearance along edges abutting posts and top shelf.
 - 2) Shelf Dividers: Fabricated from same material and with same finish as shelves; full-height **OR** angle **OR** tapered **OR** sliding, **as directed**, type.
 - 3) Bins: Fabricated from same material and with same finish as shelves; size as indicated on Drawings **OR as directed**.
 - 4) Shelf-Label Holders: Clear **OR** Colored, **as directed**, plastic, designed to clip onto front edge of shelf.
- p. Finish: Baked enamel **OR** Powder coat, **as directed**.
 - 1) Color and Gloss: As selected from manufacturer's full range.
2. Wire-Type, Four-Post Metal Storage Shelving: Factory-formed, field-assembled, freestanding system without back or end panels, designed for shelves to span between and be supported by corner posts, with shelves adjustable over the entire height of shelving unit. Fabricate initial shelving unit with a post at each corner. Fabricate additional shelving units similarly, so each unit is independent **OR** as add-on units, designed to share two corner posts with initial shelving unit, **as directed**. Provide fixed top and bottom shelves, adjustable intermediate shelves, and accessories indicated.
 - a. Load-Carrying Capacity per Shelf: 200 lb (91 kg) **OR** 600 lb (272 kg) **OR** 1200 lb (544 kg) **OR** As indicated on Drawings, **as directed**.
 - b. Posts: Fabricated from 1-inch- (25-mm-) OD, square **OR** round, **as directed**, tubing of indicated material; with grooves or notches at 1 inch (25 mm) o.c. to receive shelf-to-post connectors. Label posts with numbers at not less than 2 inches (51 mm) o.c. for determining shelf height.
 - 1) Post Material: Steel **OR** Stainless steel, **as directed**.
 - 2) Post Base: Bolt leveler **OR** Adjustable steel floor plate, drilled for floor anchors, **as directed**.
 - 3) Post Cap: Nylon or plastic.
 - c. Framed-Type Wire Shelves: Steel **OR** Metallic-coated-steel **OR** Stainless-steel, **as directed**, wire-over-wire construction, with shelf frame fabricated from same material and

- with same finish as posts; with manufacturer's standard post collar, designed to engage collet (wedge), welded at each corner.
- d. Truss-Type Wire Shelves: Steel **OR** Metallic-coated-steel **OR** Stainless-steel **OR** Manufacturer's standard, chrome-plated, **as directed**, wire-over-wire construction, with downturned wire truss edges; with manufacturer's standard post collar, designed to engage collet (wedge), welded at each corner.
 - e. Waterfall-Type Wire Shelves: Steel **OR** Metallic-coated-steel **OR** Stainless-steel, **as directed**, wire-over-wire waterfall construction; with manufacturer's standard post collar, designed to engage collet (wedge), welded at each corner.
 - f. Solid-Type Shelves: Fabricated from 0.050-inch- (1.27-mm-) thick, stainless-steel sheet metal of indicated material and thickness.
 - g. Shelf Quantity: Three **OR** Four **OR** Five **OR** Six, **as directed**, shelves per shelving unit in addition to top and bottom shelf.
 - h. Shelf-to-Post Connectors: Manufacturer's standard one-piece collet (wedge), designed to engage post collar attached to shelves.
 - i. Bracing: Manufacturer's standard diagonal cross bracing, as required for stability, load-carrying capacity of shelves, and number of shelves.
 - j. Overall Unit Width: 24 inches (610 mm) **OR** 36 inches (914 mm) **OR** 48 inches (1219 mm) **OR** 60 inches (1524 mm), **as directed**.
 - k. Overall Unit Depth: 12 inches (305 mm) **OR** 18 inches (457 mm) **OR** 24 inches (610 mm), **as directed**.
 - l. Overall Unit Height: 60 inches (1524 mm) **OR** 72 inches (1829 mm) **OR** 84 inches (2134 mm), **as directed**.
 - m. Accessories:
 - 1) Shelf Dividers: Fabricated from same material and with same finish as shelves; full-height **OR** angle **OR** tapered **OR** sliding, **as directed**, type.
 - 2) Shelf Inlay: Manufacturer's standard clear plastic **OR** static-dissipative plastic **OR** hardboard, **as directed**, mat.
 - 3) Storage Basket: Edge-of-shelf-mounted wire basket; fabricated from same material and with same finish as shelves.
 - 4) Back Ledges: 1 inch (25 mm) **OR** 4 inches (102 mm), **as directed**, high, fabricated from same material and with same finish as shelves.
 - 5) Side Ledges: 1 inch (25 mm) **OR** 4 inches (102 mm), **as directed**, high, fabricated from same material and with same finish as shelves.
 - 6) Garment Hanger Tube: Width of 21 inches (533 mm) **OR** shelves, **as directed**; with mounting brackets.
 - 7) Shelf-Label Holders: Clear plastic **OR** Colored plastic **OR** Cold-rolled steel sheet, **as directed**, designed to clip onto front edge of shelf.
 - n. Steel Finish: Baked enamel **OR** Powder coat **OR** Manufacturer's standard chrome plated, **as directed**.
 - 1) Color and Gloss: As selected from manufacturer's full range.
 - o. Stainless-Steel Finish: No. 4 directional-satin finish **OR** Manufacturer's standard nondirectional-polish finish, **as directed**.
- D. Post-And-Beam Metal Storage Shelving
1. General: Factory-formed, field-assembled, freestanding, post-and-beam metal storage shelving system, designed for shelves to be supported by beams that span between and are supported by corner posts, with beams adjustable over the entire height of shelving unit. Fabricate initial shelving unit with a post at each corner. Fabricate additional shelving units similarly, so each unit is independent **OR** as add-on units, designed to share two corner posts with initial shelving unit, **as directed**. Provide fixed top and bottom beams, adjustable intermediate beams, and accessories indicated.
 2. Load-Carrying Capacity per Shelf: 400 lb (181 kg) **OR** 1000 lb (454 kg) **OR** 2000 lb (907 kg) **OR** As indicated on Drawings, **as directed**.

3. Posts: Fabricated from cold-rolled steel; in manufacturer's standard **OR** manufacturer's standard angle or open-box **OR** 1-1/2-by-1-1/2-inch (38-by-38-mm) angle **OR** open-box, **as directed**, shape; with perforations at 1-1/2 inches (38 mm) o.c. to receive beam-to-post connectors.
 - a. Steel Thickness, Nominal: 0.075 inch (1.90 mm) **OR** As required for load-carrying capacity per shelf and number of shelves, **as directed**.
 - b. Add-On Shelf Posts: Fabricated from hot-rolled steel, T-shape; perforated to match main posts and of same thickness.
 - c. Post Base: Cold-rolled steel floor plate, drilled for floor anchors.
4. Beams: Fabricated from cold-rolled steel; in channel **OR** flanged **OR** manufacturer's standard, **as directed**, shape; with projecting rivet **OR** tab **OR** manufacturer's standard, **as directed**, beam-to-post connectors at each end designed to engage posts. Provide beam at each side of each shelf, with center supports as required for load-carrying capacity of shelf.
 - a. Steel Thickness, Nominal: 0.075 inch (1.90 mm) **OR** As required for load-carrying capacity per shelf, **as directed**.
 - b. Provide top, bottom, and intermediate shelf beams with single **OR** double, **as directed**, beam-to-post connectors.
OR
Provide top and bottom shelf beams with double beam-to-post connectors and intermediate shelf beams with single beam-to-post connectors.
 - c. Provide beams for the number of shelves required.
OR
Provide beams for shelves per shelving unit in addition to top and bottom shelf beams.
5. Particleboard Shelves: 5/8 inch (16 mm) thick; factory **OR** field, **as directed**, cut.
6. Flat Metal Shelves: Fabricated from steel sheet as follows:
 - a. Steel-Sheet Thickness, Nominal: 0.030 inch (0.76 mm) **OR** 0.036 inch (0.91 mm) **OR** 0.048 inch (1.21 mm) **OR** As required for load-carrying capacity per shelf, **as directed**.
 - b. Metallic-Coated Steel-Sheet Thickness, Nominal: 0.034 inch (0.86 mm) **OR** 0.040 inch (1.02 mm) **OR** 0.052 inch (1.32 mm) **OR** As required for load-carrying capacity per shelf, **as directed**.
 - c. Fabricate fronts and backs **OR** fronts, backs, and sides, **as directed**, of shelves with box-formed edges, with corners lapped and welded.
7. Ribbed-Metal-Decking Shelves: Fabricated from 0.036-inch- (0.91-mm-) nominal thickness steel sheet.
8. Wire Shelves: Welded steel wire; with 2-by-4-inch (51-by-102-mm) **OR** Manufacturer's standard, **as directed**, openings.
9. Shelf Quantity: Three **OR** Four **OR** Five **OR** Six, **as directed**, shelves per shelving unit in addition to top and bottom shelf.
10. Overall Unit Width: 36 inches (914 mm) **OR** 48 inches (1219 mm) **OR** 60 inches (1524 mm) **OR** 69 inches (1753 mm) **OR** 72 inches (1829 mm) **OR** 96 inches (2438 mm), **as directed**.
11. Overall Unit Depth: 18 inches (457 mm) **OR** 24 inches (610 mm) **OR** 30 inches (762 mm) **OR** 36 inches (914 mm) **OR** 48 inches (1219 mm), **as directed**.
12. Overall Unit Height: 60 inches (1524 mm) **OR** 72 inches (1829 mm) **OR** 84 inches (2134 mm) **OR** 96 inches (2438 mm), **as directed**.
13. Accessories:
 - a. Tie Plates: Cold-rolled steel, finished to match posts; designed for joining posts of adjacent shelving units.
 - b. Supports: Back-to-wall **OR** Back-to-back **OR** Back-to-wall and back-to-back, **as directed**, type that bolt to posts; as required for shelving unit stability.
 - c. Record Boxes: Knocked-down, corrugated fiberboard with white finish and contrasting contents legend; with prepunched handles and matching separate lid.
 - 1) Letter/Legal-Size Boxes: 12-1/2 inches wide by 16 inches deep by 10-1/2 inches high (318 mm wide by 406 mm deep by 267 mm high) for letter-size material stored left to right and legal-size material stored front to back.

- 2) Letter-Size Boxes: 12-1/2 inches wide by 24 inches deep by 10-1/2 inches high (318 mm wide by 610 mm deep by 267 mm high) for letter-size material stored left to right.
- d. Record Box Support Rails: 1-1/2-by-1-1/2-inch (38-by-38-mm) metal angle, with length to match depth of shelving unit; fabricated from same material and with same finish as beams.
14. Finish: Baked enamel **OR** Powder coat, **as directed**.
 - a. Color and Gloss: As selected from manufacturer's full range.
- E. Fabrication
 1. Shop Fabrication: Prefabricate shelving components in shop to greatest extent possible to minimize field fabrication; temporarily preassemble shelving components where necessary to ensure that field-assembled components fit together properly. Use connections that maintain structural value of joined pieces. Clearly mark units for reassembly and coordinated installation.
 2. Fabricate metal storage shelving square and rigid, with posts plumb and true and shelves flat and free of dents or distortion. Fabricate connections to form a rigid structure, free of buckling and warping.
 - a. Form exposed work true to line and level with accurate angles and surfaces and straight sharp edges.
 - b. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners where possible. Locate joints where least conspicuous.
 - c. Build in straps, plates, brackets, and other reinforcements as needed to support shelf loading.
 - d. Cut, reinforce, drill, and tap metal fabrications to receive hardware, fasteners, and similar items.
 3. Form metal in maximum lengths to minimize joints. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing the Work. Form backs of shelving units up to 48 inches (1219 mm) wide from one piece, **as directed**.
 4. Form edges and corners free of sharp edges or rough areas. Fold back and crimp exposed edges of unsupported sheet metal to form a 1/2-inch- (13-mm-) wide hem on the concealed side; ease edges of metal plate to radius of approximately 1/32 inch (0.8 mm). Shear and punch metals cleanly and accurately. Remove burrs.
 5. Weld corners and seams continuously to develop strength, minimize distortion, and maintain the corrosion resistance of base metals. At exposed locations, finish welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface. Weld before finishing components to greatest extent possible. Remove weld spatter and welding oxides from exposed surfaces before finishing.
- F. General Finish Requirements
 1. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
 2. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.
- G. Metallic-Coated Steel-Sheet Finishes
 1. Surface Preparation: Clean surfaces with nonpetroleum solvent so surfaces are free of oil and other contaminants. After cleaning, apply a conversion coating suited to the organic coating to be applied over it. Clean welds, mechanical connections, and abraded areas, and apply galvanizing repair paint, complying with SSPC-Paint 20, to comply with ASTM A 780.
 2. Baked-Enamel or Powder-Coat Finish: Manufacturer's standard baked-on finish consisting of prime coat and thermosetting topcoat. Comply with coating manufacturer's written instructions for cleaning, pretreatment, application, and minimum dry thickness.
- H. Steel Finishes



1. Surface Preparation: Remove mill scale and rust, if present, from uncoated steel, complying with SSPC-SP 5/NACE No. 1, "White Metal Blast Cleaning" or SSPC-SP 8, "Pickling."
2. Baked-Enamel or Powder-Coat Finish: Manufacturer's standard baked-on finish consisting of prime coat and thermosetting topcoat. Comply with coating manufacturer's written instructions for cleaning, pretreatment, application, and minimum dry thickness.

I. Stainless-Steel Finishes

1. Surface Preparation: Remove tool and die marks and stretch lines, or blend into finish.
2. Polished Finishes: Grind and polish surfaces to produce uniform finish, free of cross scratches.
 - a. Run grain of directional finishes with long dimension of each piece.
 - b. When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.
 - c. Directional Satin Finish: No. 4.

1.3 EXECUTION

A. Preparation

1. Vacuum finished floor and wet mop resilient flooring over which metal storage shelving is to be installed.

B. Installation

1. Install metal storage shelving level, plumb, square, rigid, true, and with shelves flat and free of dents or distortion. Make connections to form a rigid structure, free of buckling and warping.
 - a. Install exposed connections with hairline joints, flush and smooth, using concealed fasteners where possible.
 - b. Install braces, straps, plates, brackets, and other reinforcements as needed to support shelf loading and as required for stability.
 - c. Adjust post-base bolt leveler to achieve level and plumb installation.
 - d. Anchor shelving units to floor with floor anchors through floor plate. Shim floor plate to achieve level and plumb installation.
 - e. Install seismic restraints.
 - f. Connect side-to-side and back-to-back shelving units together.
 - g. Install shelves in each shelving unit at spacing indicated on Drawings or, if not indicated, at equal spacing.
 - 1) Case-Type Metal Storage Shelving: Install adjustable shelf clips at front and back of each shelf.
 - 2) Four-Post Metal Storage Shelving: Install four clips, one at each post, for support of each shelf; with clips fully engaged in post perforations.
 - 3) Post-and-Beam Metal Storage Shelving: Install beams with beam-to-post connectors fully engaged in post perforations.
2. Accessories:
 - a. Install finished end panels and trim at exposed ends of shelving units.
 - b. Shelf Dividers: Install full-height dividers per shelf **OR** angle dividers per shelf **OR** tapered dividers per shelf **OR** sliding dividers per shelf **OR** dividers of types and locations indicated on Drawings, **as directed**.
 - c. Bins: Install per shelf **OR** at locations indicated on Drawings, **as directed**.
 - d. Shelf-Label Holders: Install one on each shelf, centered **OR** vertically aligned **OR** at locations indicated on Drawings, **as directed**, within each shelving unit.
 - e. Record Box Support Rails: Provide two for each record storage box.
 - f. Shelf Inlays: Install one per shelf **OR** at locations indicated on Drawings, **as directed**.
 - g. Storage Baskets: Install per shelf **OR** at locations indicated on Drawings, **as directed**.
 - h. Back Ledges: Install one per shelf **OR** at locations indicated on Drawings, **as directed**.
 - i. Side Ledges: Install on each side of each shelf **OR** at locations indicated on Drawings, **as directed**.

- j. Garment Hanger Tubes: Install one per shelving unit **OR** more where directed **OR** at locations indicated on Drawings, **as directed**.

C. Erection Tolerances

1. Erect case-type and four-post metal storage shelving to a maximum tolerance from vertical of **1/2 inch (13 mm)** in up to **10 feet (3 m)** of height, not exceeding **1 inch (25 mm)** for heights taller than **10 feet (3 m)**.
2. Erect post-and-beam metal storage shelving to a maximum tolerance from vertical of **1/4 inch (6 mm)** in **84 inches (2134 mm)** of height.

D. Adjusting

1. Adjust metal storage shelving so that connectors and other components engage accurately and securely.
2. Adjust and lubricate operable components to operate smoothly and easily, without binding or warping. Check and readjust operating hardware.
3. Touch up marred finishes or replace metal storage shelving that cannot be restored to factory-finished appearance. Use only materials and procedures recommended or furnished by metal storage shelving manufacturer.
4. Replace metal storage shelving that has been damaged or has deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

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Task	Specification	Specification Description
10 56 16 00	06 05 23 00a	Miscellaneous Carpentry

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SECTION 10 71 13 13 - EXTERIOR SHUTTERS

1.1 GENERAL

A. Description Of Work

1. This specification covers the furnishing and installation of materials for exterior shutters. Products shall be as follows or as directed by the Owner. Installation procedures shall be in accordance with the product manufacturer's recommendations. Demolition and removal of materials shall be as required to support the work.

B. Submittals

1. Product Data:
 - a. Manufacturer's data.
 - b. For wood-preservative-treated materials and finishes indicated.
2. Shop Drawings: Show location of each item, dimensioned plans and elevations, large-scale details, attachment devices, and other components.
3. Samples: For lumber for exterior wood stain finish and lumber and panel products for shop-applied opaque finish, for each finish system and color, with one-half of exposed surface finished.
4. LEED Submittals:
 - a. Credit MR 7: Certificates of chain-of-custody signed by manufacturers certifying that products specified to be made from certified wood were made from wood obtained from forests certified by an FSC-accredited certification body to comply with FSC 1.2, "Principles and Criteria."
5. Woodwork Quality Standard Compliance Certificates: AWI Quality Certification Program certificates **OR** WIC-certified compliance certificates, **as directed**.

C. Quality Assurance

1. Quality Standard: Unless otherwise indicated, comply with AWI's "Architectural Woodwork Quality Standards" **OR** WIC's "Manual of Millwork," **as directed**.
2. Forest Certification: Provide exterior architectural woodwork produced from wood obtained from forests certified by an FSC-accredited certification body to comply with FSC 1.2, "Principles and Criteria."

D. Delivery, Storage, and Handling

1. Do not deliver shutters until painting and similar operations that could damage shutters have been completed in installation areas.

1.2 PRODUCTS

A. Wood Shutters

1. Materials
 - a. Preservative Treatment by Nonpressure Process: Comply with AWPA N1 using the following preservative for woodwork items indicated to receive water-repellent preservative treatment:
 - 1) Water-Repellent Preservative: Formulation containing 3-iodo-2-propynyl butyl carbamate (IPBC) complying with AWPA P8 as its active ingredient.
 - 2) Water-Repellent Preservative/Insecticide: Formulation containing 3-iodo-2-propynyl butyl carbamate (IPBC) as its active ingredient, combined with an insecticide containing chlorpyrifos as its active ingredient, both complying with AWPA P8.
2. Fabrication
 - a. Wood Moisture Content: 9 to 15 **OR** 10 to 15 **OR** 7 to 12, **as directed**, percent.
 - b. Complete fabrication, including assembly, finishing, and hardware application, to maximum extent possible, before shipment to Project site. Disassemble components only as

necessary for shipment and installation. Where necessary for fitting at site, provide ample allowance for scribing, trimming, and fitting.

- c. Woodwork for Transparent Finish:
 - 1) Grade: Premium **OR** Custom **OR** Economy, **as directed**.
 - 2) Wood Species: Teak **OR** African mahogany **OR** White oak **OR** All-heart redwood **OR** Western red cedar **OR** Eastern white pine, **as directed**.
- d. Woodwork for Opaque Finish:
 - 1) Grade: Premium **OR** Custom **OR** Economy, **as directed**.
 - 2) Wood Species: All-heart redwood **OR** Western red cedar **OR** Ponderosa pine **OR** Eastern white pine, sugar pine, or western white pine **OR** Spanish Cedar, **OR** Cyprus, **OR** Cedar, **OR** Any closed-grain hardwood, **as directed**.
- e. Backout or groove backs of flat trim members and kerf backs of other wide, flat members, except for members with ends exposed in finished work.
- f. Shop Priming: Shop prime woodwork for paint finish with one coat of wood primer specified in Division 07.
 - 1) Backpriming: Apply one coat of sealer or primer, compatible with finish coats, to concealed surfaces of woodwork. Apply two coats to surfaces installed in contact with concrete or masonry and to end-grain surfaces.

B. Thermo-Plastic Shutters

- 1. Provide high impact resistant, minimum 1-inch thick, pressure molded plastic shutters, shop assembled.
 - a. Color shall be throughout material, with acrylic top layer to provide fade and UV protection. Color as directed. Provide lifetime warranty against fading.

C. Installation Materials

- 1. Anchors: Select material, type, size, and finish required for each substrate for secure anchorage. Provide nonferrous-metal or hot-dip galvanized anchors and inserts as required for corrosion resistance. Provide toothed-steel or lead expansion sleeves for drilled-in-place anchors.

D. Fabrication, General

- 1. Fabricate shutters to dimensions, profiles, and details indicated.
- 2. Complete fabrication, including assembly, and hardware application, to maximum extent possible, before shipment to Project site.

E. Size

- 1. Sizes shall be as directed.

F. Configuration: As directed.

- 1. Louvered decorative shutters.
- 2. Raised panel decorative shutters.
- 3. Board-and-Batten shutters.

1.3 EXECUTION

A. Preparation

- 1. Before installing shutters, examine for completion, including removal of packing and backpriming.

B. Installation

- 1. Before installation, condition wood shutters to average prevailing humidity conditions in installation areas. Before installing shutters, examine shop-fabricated work for completion and complete work as required.
- 2. Preservative-Treated Wood: Where cut or drilled in field, treat cut ends and drilled holes according to AWPAC M4.

3. Install shutters in accordance with manufacturer's instructions.
4. Install shutters level, plumb, true, and straight.
5. Anchor shutters to anchors or blocking built in or directly attached to substrates.
6. Fill nail and screw holes with matching filler where exposed.
7. Refer to Division 07 for final finishing of installed shutters.

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10 71 13 13	01 22 16 00	No Specification Required

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SECTION 10 73 13 13 - AWNINGS

1.1 GENERAL

A. Description Of Work:

1. This specification covers the furnishing and installation of materials for awnings. Product shall be as follows or as directed by the Owner. Installation procedures shall be in accordance with the product manufacturer's recommendations. Demolition and removal of materials shall be as required to support the work.

B. Summary

1. This Section includes the following:
 - a. Fixed awnings.
 - b. Retractable awnings, manually operated and motorized.

C. Definitions

1. Awning: An architectural projection that provides weather protection, identity, or decoration and is wholly supported by the building to which it is attached. An awning is comprised of a lightweight, rigid skeleton structure over which a rigid covering is attached.
2. Retractable Awning: A cover with a frame that retracts against a building or other structure to which it is entirely supported.

D. Performance Requirements

1. General: Design, fabricate, and install awnings to withstand loads from gravity, wind, snow, ponding, drift, seismic, and structural movement, including thermally induced movement; and to resist, without failure, other conditions of in-service use, including exposure to weather.
2. Structural Performance: Provide awnings capable of withstanding the effects of gravity loads and loads and stresses within limits and under conditions required for the location of the Work.
3. Seismic Performance: Provide awnings capable of withstanding the effects of earthquake motions determined according to ASCE 7, "Minimum Design Loads for Buildings and Other Structures."
4. Thermal Movements: Provide awnings that allow for thermal movements resulting from the following maximum change (range) in ambient and surface temperatures by preventing buckling, opening of joints, overstressing of components, failure of connections, tearing of fabric, and other detrimental effects. Base engineering calculation on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.
 - a. Temperature Change (Range): 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.

E. Submittals

1. Product Data: Include styles, material descriptions, construction details, fabrication details, dimensions of individual components and profiles, hardware, fittings, mounting accessories, features, finishes, and operating instructions for awnings.
 - a. Motorized Awning Operators: Include operating instructions.
 - b. Motors: Show nameplate data, ratings, characteristics, and mounting arrangements.
2. Shop Drawings: Show location and extent of awnings. Include elevations, sections, and details not shown in Product Data. Show materials, fabrication, dimensions, mounting heights, connections, anchorages, installation details, attachments to other work, operational clearances, and relationship to adjoining work. Show colors and graphic layout and content.
3. Samples: For each of the following products and for the full range of color, texture, and pattern variations required, prepared on Samples of size indicated below. If finishes involve normal color and texture variations, include sample sets showing the full range of variations expected.
 - a. Awning Fabric: 12-inch- (300-mm-) square section of fabric from dye lot to be used for the Work, with specified treatments applied. Mark face of fabric.

- b. Graphics: Not less than **12-inch- (300-mm-)** square section showing graphics application method.
- c. Seam, Edge, and Corner Condition: Not less than **12-inch- (300-mm-)** long section showing seam, edge, and corner treatment.
- d. Valance: Full-size unit, not less than **12 inches (300 mm)** long.
- e. Frame Finish: Not less than **6-inch (150-mm)** lengths.
- f. Frame Corner and Three **OR** Four, **as directed**, -Way Truss Intersection: Not less than **12-inch (300-mm)** sections showing finished joint construction and fabric and valance attachment to awning frame.
- g. Exposed Hardware Finishes: Manufacturer's standard-size unit, not less than **3 inches (76 mm)** square.
- h. Accessories: Manufacturer's full-size unit.
- 4. Welding certificates.
- 5. Maintenance Data: For awnings to include in maintenance manuals.

F. Quality Assurance

- 1. Welding: Qualify procedures and personnel according to the following.
 - a. AWS D1.1/D1.1M, "Structural Welding Code--Steel."
 - b. AWS D1.2, "Structural Welding Code--Aluminum."
- 2. Regulatory Requirements: Provide awnings complying with or exceeding requirements of authorities having jurisdiction>.
- 3. Fire-Test-Response Characteristics: Provide awning fabrics with the fire-test-response characteristics indicated, as determined by testing identical products per test method indicated below by UL or another testing and inspecting agency acceptable to authorities having jurisdiction:
 - a. Flame-Resistance Ratings: Passes NFPA 701 **OR** California Code of Regulations, Title 19, **as directed**.
 - b. Permanently attach label to each awning fabric indicating whether fabric is inherently and permanently flame resistant, or treated with flame-retardant chemicals, and whether it will require retreatment after designated time period or cleaning.
- 4. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

G. Warranty: Manufacturer's standard form in which manufacturer and fabricator agree to repair or replace components of awnings that fail in materials or workmanship within specified warranty period.

- 1. Awning Warranty Period: Five years from date of Final Completion.
- 2. Fabric Warranty Period: Three **OR** Five **OR** Eight **OR** 12, **as directed**, years from date of Final Completion.
- 3. Thread Warranty Period: Five **OR** Eight, **as directed**, years from date of Final Completion.
- 4. Graphics Warranty Period: Outdoor durability not less than five **OR** three, **as directed**, years from date of Final Completion.

1.2 PRODUCTS

A. Source Limitations: Obtain awnings from single source from single manufacturer.

B. Awning Fabrics

- 1. Fabric Fiber Content: Vinyl-laminated or -coated polyester mesh **OR** Vinyl-laminated or -coated polyester **OR** Acrylic-coated polyester **OR** Resin-coated polyester **OR** Vinyl-coated polyester/cotton blend **OR** Acrylic-coated polyester/cotton blend **OR** Resin-coated polyester/cotton blend **OR** Solution-dyed acrylic **OR** Solution-dyed modacrylic, **as directed**.
- 2. Style:

- a. Bottom Hem: Straight **OR** Scalloped, evenly spaced pattern **OR** As indicated by manufacturer's designation **OR** As indicated in an awning schedule, **as directed**.
- b. Trim: As indicated by manufacturer's designation for style and color **OR** As indicated in a window treatment schedule, **as directed**.
- c. Fringe: As indicated by manufacturer's designation for style and color **OR** As indicated in an awning schedule, **as directed**.
- d. Color: Match samples **OR** As selected from manufacturer's full range **OR** As indicated in an awning schedule, **as directed**.
- e. Applied Treatment: Stain resistant **OR** Mildew resistant **OR** Polymer, flame resistant **OR** Water repellent **OR** Lamination, **as directed**.
- f. Performance Characteristics: As follows:
 - 1) Mildew Resistance: Showing no growth when tested per ASTM G 21.
 - 2) Shrinkage: Not greater than 0.1 **OR** 0.5 **OR** 1, **as directed**, percent per ASTM D 1204.
 - 3) Stretch Factor: Not less than 0.4 **OR** 1 **OR** 4, **as directed**, percent per ASTM D 4851.
3. Graphic Application: Hand painting **OR** Silk-screen printing **OR** Heat color transfer **OR** Vinyl film with pressure-sensitive adhesive backing **OR** PVDF film with pressure-sensitive adhesive backing **OR** PVF film with pressure-sensitive adhesive backing **OR** Radio-frequency, heat-sealed vinyl film **OR** Eradication **OR** Cut-out lettering, **as directed**.
 - a. Text Message: As indicated on Drawings **OR** As indicated in an awning schedule, **as directed**.
 - 1) Text Font: Arial, **unless directed otherwise**.
 - 2) Character Size: Minimum ~~1-inch~~ (25.4-mm-) **OR** 1-foot- (0.3048-m-), **as directed**, high characters.
 - b. Vinyl Film: Calendered-vinyl film, not less than 3 mils (0.076 mm) thick, with pressure-sensitive adhesive backing **OR** Cast-vinyl film, not less than 2 mils (0.051 mm) thick, with pressure-sensitive adhesive backing **OR** Cast-vinyl reflective film, not less than 2 mils (0.051 mm) thick, with pressure-sensitive adhesive backing, **as directed**.
4. Inset Fabric: Heat-sealed **OR** Sewn-in, **as directed**, process, and as follows:
 - a. Colors: Match samples **OR** As selected from manufacturer's full range **OR** As indicated in an awning schedule, **as directed**.
 - b. Applied Treatment: Stain resistant **OR** Mildew resistant **OR** Polymer, flame resistant **OR** Water repellent, **as directed**.
- C. Thread: 100 percent expanded PTFE **OR** 100 percent bonded polyester, **as directed**, UV-light, mildew, and rot resistant.
- D. Awning Frames
 1. Steel Frames:
 - a. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.
 - b. Cold-Formed Steel Tubing: ASTM A 500, grade as required by structural loads.
 - c. Steel Pipe: ASTM A 53/A 53M, standard weight (Schedule 40) unless another weight is indicated or required by structural loads.
 - d. Steel Mechanical Tubing: Cold-rolled, electric-resistance-welded carbon or alloy steel tubing complying with ASTM A 513 or steel tubing fabricated from steel complying with ASTM A 1011/A 1011M and complying with dimensional tolerances in ASTM A 500.
 - e. Steel Finish: Manufacturer's standard galvanized and corrosion-resistant mill **OR** Manufacturer's standard decorative **OR** Baked-enamel **OR** Powder-coat, **as directed**, finish complying with finish manufacturer's written instructions for surface preparation including pretreatment, application, baking, and minimum dry film thickness.
 2. Aluminum Frames: Alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated and with not less than the strength and durability properties of alloy and temper required by structural loads.
 - a. Aluminum Plate and Sheet: **ASTM B 209 (ASTM B 209M)**.
 - b. Aluminum Extrusions: **ASTM B 221 (ASTM B 221M)**.

- c. Extruded Structural Pipe and Round Tubing: ASTM B 429, standard weight (Schedule 40) unless another weight is indicated or required by structural loads.
 - d. Drawn Seamless Tubing: **ASTM B 210** (**ASTM B 210M**).
 - e. Aluminum Finish: Mill **OR** Manufacturer's standard decorative **OR** Baked-enamel **OR** Powder-coat, **as directed**, finish complying with finish manufacturer's written instructions for surface preparation including pretreatment, application, baking, and minimum dry film thickness.
3. Anchors, Fasteners, Fittings, Hardware, and Installation Accessories: Complying with performance requirements indicated and suitable for exposure conditions, supporting structure, anchoring substrates, and installation methods indicated. Corrosion-resistant or noncorrodible units; weather-resistant, tamperproof, vandal- and theft-resistant, compatible, nonstaining materials. Provide as required for awning assembly, mounting, and secure attachment. Number as needed to comply with performance requirements and to maximize appearance; evenly spaced. Where exposed to view, with finish and color as selected by Architect from manufacturer's full range.
- a. Wood Screws: ASME B18.6.1.
 - b. Lag Bolts: **ASME B18.2.1**. (**ASME B18.2.3.8M**).
 - c. Bolts: Steel bolts complying with **ASTM A 307, Grade A** (**ASTM F 568M, Property Class 4.6**); with **ASTM A 563** (**ASTM A 563M**) hex nuts and, where indicated, flat washers.
 - d. Expansion Anchors: Anchor bolt and sleeve assembly of material indicated below with capability to sustain, without failure, a load equal to 6 times the load imposed when installed in unit masonry assemblies and equal to 4 times the load imposed when installed in concrete as determined by testing per ASTM E 488 conducted by a qualified independent testing and inspecting agency.
 - 1) Material: Stainless steel with bolts and nuts complying with **ASTM F 593 and ASTM F 594, Alloy Group 1 or 2** (**ASTM F 738M and ASTM F 836M, Grade A1 or A4**).
 - e. Adhesive-Bonded Anchors: Anchor bolt and sleeve assembly of material indicated below with capability to sustain, without failure, a load equal to 6 times the load imposed when installed in unit masonry assemblies and equal to 4 times the load imposed when installed in concrete as determined by testing per ASTM E 1512 conducted by a qualified independent testing and inspecting agency.
 - 1) Material: Stainless steel with bolts and nuts complying with **ASTM F 593 and ASTM F 594, Alloy Group 1 or 2** (**ASTM F 738M and ASTM F 836M, Grade A1 or A4**).
 - f. Grommets: Zinc-coated brass, No. 2 **OR** Stainless steel, No. 2, **as directed**.
 - 1) Grommet Spacing: **6-inch** (**150-mm**) o.c.
 - g. Lacing: 100 percent polyester, braided No. 4.
4. Galvanizing Repair Paint: High-zinc-dust-content paint for regalvanizing welds in steel, complying with SSPC-Paint 20.
5. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187.
- E. Awning Fabrication
1. Fabrics: Reinforce wear points and hardware attachment points with nonwoven **OR** mesh **OR** polypropylene mesh, **as directed**, webbing.
 - a. Fabric Edges and Seams:
 - 1) Fold and stitch selvedge, and cut fabric edges.
 - 2) Hot cut and sealed.
 - 3) Radio-frequency welded.
 - 4) Adhesively bonded.
 - 5) Manufacturer's standard hemming and seaming methods.
 2. Decorative Trims: Borders **OR** Braid and bindings **OR** Cords **OR** Fringe **OR** Patterned edge; scalloped **OR** Patterned edge; V-shaped **OR** Streamers **OR** Tassels **OR** Welting, **as directed**.

- a. Colors: As indicated by manufacturer's designations **OR** Match samples **OR** Matching or coordinating with awning fabric color **OR** As selected from manufacturer's full range **OR** As indicated in an awning schedule, **as directed**.
 3. Frames: Preassemble awning frames in the shop to greatest extent possible. Disassemble units only as necessary for shipping and handling limitations. Use connections that maintain structural value of joined pieces. Clearly mark units for reassembly and coordinated installation.
 - a. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing work.
 - b. Form exposed work true to line and level with accurate angles and surfaces and straight edges.
 - c. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners where possible. Fabricate slip-fit connections that will be exposed to weather in a manner to exclude water. Provide weep holes where water may accumulate.
 - d. Weld corners and connections continuously. Obtain fusion without undercut or overlap. Remove welding flux immediately. At exposed corners and connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.
 - e. Provide for anchorage of type indicated; coordinate with supporting structure. Space anchoring devices to secure metal fabrications in place and to properly transfer loads.
 4. Colors of Metal and Plastic Components Exposed to View: As indicated by manufacturer's designations **OR** Match samples **OR** Matching or coordinating with awning fabric color **OR** As selected from manufacturer's full range **OR** As indicated in an awning schedule, **as directed**.
- F. Retractable Awning Operators
 1. Manual Operation: With gear and crank operator.
 - a. Manual Operation Assist Mechanism: Manufacturer's standard spring assist for operating heavy awnings.
 - b. Crank Handle: One **OR** Two, **as directed**, detachable.
 - c. Awning Coupler System: Designed for simultaneously operating two **OR** three, **as directed**, awnings with a single crank. Provide system for each group of awnings **OR** where indicated on Drawings **OR** where indicated in an awning schedule, **as directed**.
 - d. Operating Function: Stop and hold awning at any position in ascending or descending travel **OR** Stop and hold awning at either fully open or fully closed positions only, **as directed**.
 2. Motorized Operation: Provide factory-assembled motorized retractable awning operation systems designed for retracing awnings of type, size, weight, construction, use, and operation frequency indicated. Provide operation systems of size and capacity and with features, characteristics, and accessories suitable for Project conditions and recommended by awning manufacturer, complete with electric motors and factory-prewired motor controls, remote-control stations, remote-control devices, power disconnect switches, enclosures protecting controls and all operating parts, and accessories required for reliable operation without malfunction. Include wiring from motor controls to motors. Coordinate operator wiring requirements and electrical characteristics with building electrical system.
 3. Comply with NFPA 70.
 4. Control Equipment: Comply with NEMA ICS 1, NEMA ICS 2, and NEMA ICS 6 with NFPA 70, Class 2 control circuit, maximum 24-V ac or dc.
 5. Electric Motors: UL-approved or -recognized, totally enclosed, insulated motor, complying with NEMA MG 1, with thermal-overload protection and internal limit switches; sized by awning manufacturer to start and operate size and weight of awning considering service factor or considering Project's service conditions without exceeding nameplate ratings.
 - a. Service Factor: According to NEMA MG 1, unless otherwise indicated.
 - b. Motor Characteristics: Single phase, 24 **OR** 110 **OR** 220, **as directed**, V, 60 Hz.
 - c. Coordinate wiring requirements and electrical characteristics of motors with building electrical system.
 - d. Motor Mounting: Within manufacturer's standard roller enclosure.



6. Remote Controls: Electric controls with NEMA ICS 6, Type 1 **OR** 4, **as directed**, enclosure for surface **OR** recessed or flush, **as directed**, mounting. Provide the following devices for remote-control activation of awnings:
 - a. Control Stations:
 - 1) Keyed, maintained **OR** momentary, **as directed**, -contact, three-position, switch-operated control station with open, close, and off functions. Provide two keys per station.
OR
Maintained **OR** Momentary, **as directed**, -contact, three-position, toggle **OR** rocker, **as directed**, -style, wall switch-operated control station with open, close, and center off functions.
 - 2) Color: Ivory **OR** White **OR** As indicated in an awning schedule, **as directed**.
 - b. Group Control Stations: Maintained **OR** Momentary, **as directed**, -contact, three-position, rocker-style, wall switch-operated control station with open, close, and center-off functions for single-switch group control.
 - 1) Color: Ivory **OR** White **OR** As indicated in an awning schedule, **as directed**.
 - c. Individual/Group Control Stations: Maintained **OR** Momentary, **as directed**, -contact, three-position, rocker-style, wall switch-operated control station with open, close, and center-off functions for individual and group control.
 - 1) Color: Ivory **OR** White **OR** As indicated in an awning schedule, **as directed**.
 - d. Sun Sensor Controls: Programmable system activated by LEDs detecting daylight intensity and responding by automatically adjusting awnings.
 - e. Radio Controls: Digital system consisting of code-compatible universal coaxial receiver, one per awning **OR** where indicated on Drawings, **as directed**, and two portable single-channel transmitters for operating a single motor with a single button to open and close awning.
 - f. Radio Controls: Digital system consisting of code-compatible universal coaxial receiver, one per awning **OR** where indicated on Drawings **OR** where indicated in an awning schedule, **as directed**, and two portable multiple-channel transmitters for operating two **OR** four **OR** up to 12, **as directed**, awnings individually, each with a single button to open and close awnings.
 - g. Timer Controls: Clock timer, 24-hour **OR** seven-day, **as directed**, programmable for regular events.
 - h. Microprocessor Controls: Electronic programmable means for setting, changing, and adjusting control features. Provide unit isolated from voltage spikes and surges.
7. Limit Switches: Adjustable switches, interlocked with motor controls and set to automatically stop awning at fully raised and fully lowered positions.
8. Operating Function: Stop and hold awning at any position **OR** Stop and hold awning at three predetermined positions including open, closed, and one user-programmed position, **as directed**.
9. Operating Features: Include the following:
 - a. Group switching with integrated switch control; single face plate for multiple switch cut-outs.
 - b. Capable of accepting input from building automation control system.
 - c. Override switch.
 - d. Backup gear and crank operator for manual operation during power failures with detachable handle, 6 feet (1.8 m) long **OR** manufacturer's standard length **OR** length required to make operation convenient from ground level **OR** length as indicated on Drawings, **as directed**.
10. Awning Hood: Sheet metal enclosure sized to fit awning roller and operating hardware inside and designed for UV-light, dust, weather, and vandal protection. Finish and color to match awning framing **OR** as indicated on Drawings **OR** as indicated in an awning schedule, **as directed**.

1.3 EXECUTION

A. Installation, General

1. General: Install awnings and motor controls at locations and in position indicated, securely connected to supports, free of rack, and in proper relation to adjacent construction. Use mounting methods of types described and in compliance with Shop Drawings and fabricator's written instructions.
2. Install awnings after other finishing operations, including joint sealing and painting, have been completed.
3. Attach fabric to frames as recommended by fabricator, by stapling into slotted track in frame **OR** using lacing method as required to conceal ends of lacing **OR** using fabric hem pockets, **as directed**, to ensure tight, wrinkle-free fit of fabric to frame.
4. Slip fit frame connections accurately together to form hairline joints and tighten to secure.
5. Weld frame connections that are not to be left as exposed joints but cannot be shop welded because of shipping size limitations.
 - a. Field Welding: Comply with the following requirements:
 - 1) Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
 - 2) Obtain fusion without undercut or overlap.
 - 3) Remove welding flux immediately.
 - 4) At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.
6. Anchoring to In-Place Construction: Use anchors, fasteners, fittings, hardware, and installation accessories where necessary for securing awnings to structural support and for properly transferring load to in-place construction.
7. Corrosion Protection: Coat concealed surfaces of aluminum that will come into contact with grout, concrete, masonry, wood, or dissimilar metals with a heavy coat of bituminous paint.
8. Coordinate awning installation with flashing and joint-sealant installation so these materials are installed in sequence and manner that prevent exterior moisture from passing through completed exterior wall and roof assemblies.
9. Connections: Connect motorized operators to building electrical system.

B. Adjusting

1. Adjust awnings to operate smoothly, easily, safely, and free from binding or malfunction throughout entire operational range.

C. Cleaning And Protection

1. Clean awning surfaces after installation, according to manufacturer's written instructions.
2. Touchup Painting: Immediately after erection, clean field welds, connections, and abraded areas. Paint uncoated and abraded areas with same or compatible material as used for shop-applied finish painting.
 - a. Apply by brush or spray to provide a minimum **2.0-mil (0.05-mm)** dry film thickness.
3. Galvanized Surfaces: Clean field welds, connections, and abraded areas and repair galvanizing to comply with ASTM A 780.
4. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and Installer, that ensure that awnings are without damage or deterioration at time of Final Completion.
5. Replace damaged awnings that cannot be repaired, in a manner approved, before time of Final Completion.

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SECTION 10 73 26 13 - EXTRUDED ALUMINUM WALKWAY COVER

1.1 GENERAL

A. Description Of Work

1. This specification covers the furnishing and installation of mesh or netting for extruded aluminum walkway cover. Products shall be as directed by the Owner. Installation procedures shall be in accordance with the product manufacturer's recommendations. Demolition and removal of materials shall be as required to support the work.

B. Submittals

1. Product Data: Submit manufacturer's product information, specifications and installation instructions for building components and accessories.
2. Shop Drawings: Submit complete shop drawings including all necessary plan dimensions, elevations and details. Contractor shall verify all dimensions and provide elevations at each column, finish floor, and related soffit prior to manufacturer for fabrication.
3. Certification: Submit design calculations signed by a Registered Professional Engineer, licensed in the project state. Design calculations shall state that the walkway cover system design complies with the wind requirements of ASCE 7-95, the stability criteria of applicable building code, and all other governing criteria.

C. Quality Assurance

1. Walkway cover shall be wholly produced by a recognized manufacturer with at least 5 years experience in the design and fabrication of extruded aluminum walkway cover systems. Components shall be assembled in shop to the greatest extent possible to minimize field assembly. Walkway system shall be installed by manufacturer. Walkway system, including material and workmanship, shall be warranted from defects for a period of one year from Final Completion of installation.

1.2 PRODUCTS

A. Design

1. Walkway cover shall be all welded extruded aluminum system complete with internal drainage. Non-welded systems are not acceptable. Roll formed deck is not acceptable. Expansion joints shall be included to accommodate temperature changes of 120 degrees F. Expansion joints shall have no metal to metal contact.

B. Materials

1. Aluminum Members: Extruded aluminum 6063 alloy, heat treated to T-6 temper.
2. Fasteners: Aluminum, 18-8 stainless steel or 300 series stainless steel.
3. Protective coating: Aluminum columns embedded in concrete shall be protected with clear acrylic coating.
4. Grout: 2000 psi compressive strength, 1 part Portland cement to 3 parts masonry sand. Add water to grout mixture to produce pouring consistency.
5. Gaskets: Dry seal santoprene or neoprene, pressure type.

C. Components

1. Columns: Radius-cornered tubular extrusion of size indicated with cutout and internal diverter for drainage where indicated. Circular downspout openings in columns are not acceptable.
2. Beams: Open-top tubular extrusion of size and shape indicated, top edges thickened for strength and designed to receive deck members in self-flashing manner. Structural ties shall be installed in tops of beams.



3. Deck: Extruded self-flashing sections interlocking into a composite unit. Closures at deck ends shall be welded plates.
4. Fascia: Manufacturer's standard shape. Size as directed.
5. Flashing: Minimum 0.040-inch thick aluminum.

D. Fabrication

1. Internal Drainage: Water flow shall be directed from deck to beams to columns, as indicated by the shop drawings, for discharge out "weepholes" at ground level. Should underground drainage be required, proper coordination of trades shall be by Contractor.
2. Bent Construction: Beams and columns shall be factory welded with neatly mitered corners into rigid, one-piece units. All welds shall be smooth and uniform using an inert gas shielded arc. Suitable edge preparation shall be provided to assure 100 percent penetration. Grind welds only where interfering with adjoining structure to allow for flush connection. Field welding is not permitted. When size of bent does not permit shipment as a welded unit, rigid mechanical joints may be utilized.
3. Deck Construction: Extruded self-flashing deck sections shall interlock into a composite unit, spanning double-bays. Interlocking joints shall be positively fastened at 8-inches on centers, creating a monolithic structural unit capable of developing the full strength of the sections. The fastenings shall have minimum shear strength of 350 pounds each. Deck shall be assembled with sufficient camber to offset dead load deflection.

E. Finish

1. Clear anodized 204-R1, per AA-M10C22A21 (AAMA 607.1) **OR** bronze, amber or black anodizing per AA-M10C22A42 (AAMA 606.1), **as directed**, color to be selected,
OR
Painted finish shall be baked acrylic enamel (AAMA 603.8) over chromate conversion pretreatment or wash-etch primer **OR** polyester powder coating **OR** high-performance fluoropolymer coating (AAMA 605.2), **as directed**, on deck and fascia.

F. Light Fixture

1. Surface mounted to roof deck as shown on the drawings. Construction shall be of a welded weatherproof, extruded housing, high impact FR grade white acrylic diffuser tethered to housing by wire cables, including 1/2-inch conduit coupling and "Weldnuts" for attachment to roof deck. Finish shall match the extruded roof deck. Ballast shall be class P of voltage required, 0 degree F start. Sockets shall receive dual lamps. Fixtures shall occur at each bay of deck. All penetrations will be covered with a bed of silicone caulking. Caulking shall be applied to a clean and dry surface.

G. Accessories

1. Provide all accessories, fasteners, flashings and other items as necessary for a complete installation.

1.3 EXECUTION

A. Erection

1. Concrete Footings: Provide manufacturer's standard column sleeves (styrofoam block-outs).
2. Surface Mount: Bents shall be anchored to top of existing walks. In canopy runs where lengths exceed 100 ft., the next proceeding bent shall be set into a concrete footing.

B. Installation

1. Walkway cover shall be erected true to line, level, and plumb. Aluminum columns embedded in concrete shall be protected with clear acrylic. Downspout columns shall be filled with grout to the discharge level to prevent standing water. Non-draining columns shall have weep holes installed at top of concrete to remove condensation.

- C. Cleaning
 - 1. All walkway cover components shall be cleaned promptly after installation.
- D. Protection
 - 1. Extreme care shall be taken to protect materials during and after installation.

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SECTION 10 75 16 00 - FLAGPOLES

1.1 GENERAL

A. Description Of Work:

1. This specification covers the furnishing and installation of materials for flagpoles. Product shall be as follows or as directed by the Owner. Installation procedures shall be in accordance with the product manufacturer's recommendations. Demolition and removal of materials shall be as required to support the work.

B. Summary

1. Section includes ground-mounted, wall-mounted, and roof-mounted flagpoles made from aluminum, copper alloy (bronze), fiberglass, stainless steel, and steel.

C. Performance Requirements

1. Structural Performance: Flagpole assemblies, including anchorages and supports, shall withstand the effects of gravity loads, and the following loads and stresses within limits and under conditions indicated according to the following design criteria:
 - a. Seismic Loads: **<Insert seismic criteria>** according to SEI/ASCE 7.
 - b. Wind Loads: **<Insert wind speed and exposure factor>** according to NAAMM FP 1001, "Guide Specifications for Design of Metal Flagpoles" **OR** SEI/ASCE 7, **as directed**.
 - c. Base flagpole design on polyester **OR** nylon or cotton, **as directed**, flags of maximum standard size suitable for use with flagpole or flag size indicated, whichever is more stringent.

D. Submittals

1. Product Data: For each type of product indicated.
2. Delegated-Design Submittal: For flagpole assemblies indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
 - a. Include loads, point reactions, and locations for attachment of flagpoles to building's structure.
3. Operation and Maintenance Data: For flagpoles to include in operation and maintenance manuals.

E. Delivery, Storage, And Handling

1. General: Spiral wrap flagpoles with heavy paper and enclose in a hard fiber tube or other protective container.

1.2 PRODUCTS

A. Flagpoles

1. Flagpole Construction, General: Construct flagpoles in one piece if possible. If more than one piece is necessary, comply with the following:
 - a. Fabricate shop and field joints without using fasteners, screw collars, or lead calking.
 - b. Provide flush hairline joints using self-aligning, snug-fitting, internal sleeves.**OR**
Provide self-aligning, snug-fitting joints.
2. Exposed Height: **20 feet (6 m) OR 25 feet (7.5 m) OR 30 feet (9 m) OR 35 feet (11 m) OR 40 feet (12 m) OR 45 feet (13.5 m) OR 50 feet (15 m) OR 60 feet (18 m) OR 70 feet (21 m) OR 80 feet (24 m), as directed.**



3. Aluminum Flagpoles: Provide cone **OR** entasis, **as directed**, tapered flagpoles fabricated from seamless extruded tubing complying with ASTM B 241/B 241M, Alloy 6063, with a minimum wall thickness of **3/16 inch (4.8 mm)**.
4. Copper-Alloy (Bronze) Flagpoles: Provide cone **OR** entasis, **as directed**, tapered flagpoles fabricated from seamless pipe or tube complying with ASTM B 43 or **ASTM B 135 (ASTM B 135M)**, Alloy UNS C23000 (red brass, 85 percent copper).
5. Fiberglass Flagpoles: Provide cone **OR** entasis, **as directed**, tapered flagpoles fabricated from polyester resin reinforced with woven glass-fiber roving with 75 percent of glass fibers parallel to length of flagpole.
6. Stainless-Steel Flagpoles: Provide cone **OR** entasis, **as directed**, tapered flagpoles fabricated from pipe, tube, or plate complying with ASTM A 312/A 312M, ASTM A 269, or ASTM A 666, Alloy UNS S30400 **OR** Alloy UNS S31603, **as directed**.
7. Steel Flagpoles: Provide cone-tapered **OR** stepped-sectional, **as directed**, flagpoles fabricated from standard-weight, seamless steel pipe complying with ASTM A 53/A 53M, Type S, Grade B or steel tube complying with ASTM A 513.
8. Metal Foundation Tube: Manufacturer's standard corrugated-steel foundation tube, not less than **0.064-inch- (1.6-mm-)** nominal wall thickness. Provide with **3/16-inch (4.8-mm)** steel bottom plate and support plate; **3/4-inch- (19-mm-)** diameter, steel ground spike; and steel centering wedges welded together. Galvanize steel after assembly. Provide loose hardwood wedges at top of foundation tube for plumbing pole.
 - a. Provide flashing collar of same material and finish as flagpole.
 - b. Provide steel ground protectors extending **12 inches (300 mm)** aboveground and **6 inches (150 mm)** belowground for steel flagpoles where flashing collars are not provided.
9. Sleeve for Fiberglass **OR** Aluminum, **as directed**, Flagpole: Fiberglass or PVC pipe foundation sleeve, made to fit flagpole, for casting into concrete foundation.
 - a. Provide flashing collar of same material and finish as flagpole.
10. Cast-Metal Shoe Base: For anchor-bolt mounting; provide with anchor bolts.
 - a. Provide units made from aluminum **OR** steel, **as directed**, with same finish and color as flagpoles.
 - b. Provide ground spike at grade-mounted flagpoles for metal flagpoles or fiberglass flagpoles with metal halyards.
 - c. Provide connector to building's lightning protection system conductor at roof-mounted flagpoles for metal flagpoles or fiberglass flagpoles with metal halyards.
11. Hinged Baseplate: Cast-metal tilting hinged base and anchored plate joined by permanently secured pivot rod for aluminum and fiberglass flagpoles 30 to 40 feet (9 to 12 m) or less in height. Provide with stainless-steel screws for securing tilting base to anchored plate when not tilted; provide with anchor bolts.
 - a. Finish base to match flagpole.
 - b. Provide aluminum base or aluminum flashing collar finished to match flagpole.
 - c. Provide ground spike at grade-mounted flagpoles for metal flagpoles or fiberglass flagpoles with metal halyards.
 - d. Provide connector to building's lightning protection system conductor at roof-mounted metal flagpoles for metal flagpoles or fiberglass flagpoles with metal halyards.
12. Pivoting Tilt Base: Steel baseplate with channel or rectangular tube uprights, pivot bolt, and locking device for tilting flagpole. Provide tilting flagpole with steel counterweight box and weights, or provide with internal counterweight. Provide base with anchor bolts.
 - a. Finish base to match flagpole.
 - b. Provide ground spike at grade-mounted flagpoles.

OR

Provide connector to building's lightning protection system conductor at roof-mounted metal flagpoles.
13. Vertical Wall Mount: Cast-aluminum **OR** Cast-copper-alloy (bronze), **as directed**, mounting bracket complete with escutcheon, **as directed**, mounting plate and through-wall anchorage.
 - a. Provide units with same finish as flagpole for copper-alloy (bronze) or aluminum units.

- b. Provide units with gold anodic **OR** bronze powder-coated **OR** black powder-coated, **as directed**, finish for aluminum units.
 14. Outrigger Wall Mount: Aluminum **OR** Copper-alloy (bronze), **as directed**, mounting bracket complete with escutcheon, **as directed**, mounting plate and through-wall anchorage.
 - a. Provide units with same finish as flagpole for copper-alloy (bronze) or aluminum units.
 - b. Provide units with gold anodic **OR** bronze powder-coated **OR** black powder-coated, **as directed**, finish for aluminum units.
 15. Braced Roof Mount: Roof-mounted flagpole socket and either rod or tubular braces with turnbuckles and mounting bases. Provide as a complete assembly with anchor bolts and connector for lightning protection system.
 - a. Provide braces, turnbuckles, and connectors made from same metal and with same finish as flagpoles.
- B. Fittings
 1. Finial Ball: Manufacturer's standard flush-seam ball, sized as indicated or, if not indicated, to match flagpole-butt diameter.
 - a. **0.063-inch (1.6-mm)** spun aluminum, finished to match flagpole **OR** with gold anodic finish, **as directed**.
 - b. **20-oz. (0.70-mm)** copper with 23-karat gold leaf finish.
 - c. Spun stainless steel, finished to match flagpole.
 - d. Spun copper alloy, finished to match flagpole.
 2. Finial Eagle: Manufacturer's standard, sized as indicated **OR** as standard with manufacturer for flagpole size indicated, **as directed**.
 - a. Cast aluminum, finished to match flagpole **OR** with gold anodic finish, **as directed**.
OR
20-oz. (0.70-mm) copper with 23-karat gold leaf finish.
 3. Internal Halyard, Winch System: Manually operated winch with control stop device and removable handle, stainless-steel cable halyard, and concealed revolving truck assembly with plastic-coated counterweight and sling. Provide flush access door secured with cylinder lock. Finish truck assembly to match flagpole.
 - a. Halyard Flag Snaps: Provide two chromium-plated bronze **OR** stainless-steel **OR** bronze **OR** nylon, **as directed**, swivel snap hooks per halyard.
 - 1) Provide with neoprene or vinyl covers.
 - b. Plastic Halyard Flag Clips: Made from injection-molded, UV-stabilized, acetal resin (Delrin). Clips attach to flag and have two eyes for inserting both runs of halyards. Provide two flag clips per halyard.
 4. Internal Halyard, Cam Cleat System (for flagpoles 40 feet (12 m) or less in height): **5/16-inch- (8-mm-)** diameter, braided polypropylene halyard; cam cleat; and concealed revolving truck assembly with plastic-coated counterweight and sling. Provide flush access door secured with cylinder lock. Finish truck assembly to match flagpole.
 - a. Halyard Flag Snaps: Provide two chromium-plated bronze **OR** stainless-steel **OR** bronze **OR** nylon, **as directed**, swivel snap hooks per halyard.
 - 1) Provide with neoprene or vinyl covers.
 - b. Plastic Halyard Flag Clips: Made from injection-molded, UV-stabilized, acetal resin (Delrin). Clips attach to flag and have two eyes for inserting both runs of halyards. Provide two flag clips per halyard.
 5. External Halyard: Ball-bearing, nonfouling, revolving truck assembly of cast metal with continuous **5/16-inch- (8-mm-)** diameter, braided polypropylene halyard and **9-inch (228-mm)** cast-metal cleats with fasteners. Finish exposed metal surfaces to match flagpole.
 - a. Provide one halyard and one cleat **OR** two halyards and two cleats, **as directed**, at each flagpole.
 - b. Provide cast-metal cleat covers, finished to match flagpole, secured with cylinder locks.
 - c. Provide halyard covers consisting of a **2-inch (50-mm)** channel, **60 inches (1500 mm)** long, finished to match flagpole.
 - d. Halyard Flag Snaps: Provide two chromium-plated bronze **OR** stainless-steel **OR** bronze **OR** nylon, **as directed**, swivel snap hooks per halyard.



- 1) Provide with neoprene or vinyl covers.
 - e. Plastic Halyard Flag Clips: Made from injection-molded, UV-stabilized, acetal resin (Delrin). Clips attach to flag and have two eyes for inserting both runs of halyards. Provide two flag clips per halyard.
- C. Miscellaneous Materials
1. Nonshrink, Nonmetallic Grout (for baseplate-mounted flagpoles): Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C 1107.
 2. Drainage Material (for ground-set flagpoles with foundations): Crushed stone, or crushed or uncrushed gravel; coarse aggregate.
 3. Sand (for ground-set, foundation-tube-mounted flagpoles): ASTM C 33, fine aggregate.
 4. Elastomeric Joint Sealant (for ground-set, foundation-tube-mounted flagpoles): Multicomponent nonsag urethane **OR** Single-component nonsag urethane **OR** Single-component neutral- and basic-curing silicone **OR** Single-component neutral-curing silicone, **as directed**, joint sealant complying with requirements in Division 07 Section "Joint Sealants" for Use NT (nontraffic) and for Use M, G, A, and, as applicable to joint substrates indicated, for Use O.
 5. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187.
- D. General Finish Requirements
1. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
 2. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.
- E. Aluminum Finishes
1. Natural Satin Finish: AA-M32, fine, directional, medium satin polish; buff complying with AA-M20; seal aluminum surfaces with clear, hard-coat wax.
 2. Clear Anodic Finish: AAMA 611, AA-M12C22A41, Class I, 0.018 mm **OR** AA-M12C22A31, Class II, 0.010 mm, **as directed**, or thicker.
 3. Color Anodic Finish: AAMA 611, AA-M12C22A42/A44, Class I, 0.018 mm **OR** AA-M12C22A32/A34, Class II, 0.010 mm, **as directed**, or thicker.
 - a. Color: Light bronze **OR** Medium bronze **OR** Dark bronze **OR** Black, **as directed**.
 - b. Color: Match sample **OR** As selected from full range of industry colors and color densities, **as directed**.
 4. Gold Anodic Finish: AAMA 611, AA-M32C22A43 Class I, 0.018 mm or thicker; gold color.
 5. Baked-Enamel or Powder-Coat Finish: AAMA 2603 except with a minimum dry film thickness of **1.5 mils (0.04 mm)**. Comply with coating manufacturer's written instructions for cleaning, conversion coating, and applying and baking finish.
 - a. Color and Gloss: As indicated by manufacturer's designations **OR** Match sample **OR** As selected from manufacturer's full range, **as directed**.
 6. High-Performance Organic Finish: Two-coat fluoropolymer finish complying with AAMA 2604 **OR** AAMA 2605, **as directed**, and containing not less than 50 **OR** 70, **as directed**, percent PVDF resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
 - a. Color and Gloss: As indicated by manufacturer's designations **OR** Match sample **OR** As selected from manufacturer's full range, **as directed**.
- F. Steel Finishes
1. Flagpole Interior Finish: Apply one coat of bituminous paint on interior of flagpole or otherwise treat to prevent corrosion.
 2. Galvanized Finish: Hot-dip galvanize after fabrication to comply with ASTM A 123/A 123M.
 3. Surface Preparation: Remove mill scale and rust, if present, from uncoated steel, complying with SSPC-SP 5/NACE No. 1, "White Metal Blast Cleaning" **OR** SSPC-SP 8, "Pickling," **as**

directed. After cleaning, apply a conversion coating suited to the organic coating to be applied over it, **as directed.**

4. Polyurethane Enamel Finish: Immediately after cleaning, apply manufacturer's standard primer and two-coat, high-gloss, high-build polyurethane-enamel finish.
 - a. Color: As indicated by manufacturer's designations **OR** Match sample **OR** As selected from manufacturer's full range, **as directed.**
5. Baked-Enamel or Powder-Coat Finish: Immediately after cleaning and pretreating, apply manufacturer's standard two-coat, baked-on finish consisting of prime coat and thermosetting topcoat. Comply with coating manufacturer's written instructions for applying and baking to achieve a minimum dry film thickness of **2 mils (0.05 mm)**.
 - a. Color and Gloss: As indicated by manufacturer's designations **OR** Match sample **OR** As selected from manufacturer's full range, **as directed.**

G. Stainless-Steel Finishes

1. Surface Preparation: Remove tool and die marks and stretch lines, or blend into finish.
2. Polished Finishes: Grind and polish surfaces to produce uniform finish, free of cross scratches.
 - a. Run grain of directional finishes with long dimension of each piece.
 - b. When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.
 - c. Directional Satin Finish: No. 4.

H. Copper-Alloy Finishes

1. Buffed Finish, Lacquered: M21-O6x (Mechanical Finish: buffed, smooth specular; Coating: clear organic, air drying, as specified below).
 - a. Clear, Organic Coating: Lacquer specified for copper alloys, applied by air spray in two coats per manufacturer's written instructions, with interim drying, to a total thickness of **1 mil (0.025 mm)**.
2. Medium Satin Finish, Lacquered: M32-O6x (Mechanical Finish: medium satin; Coating: clear organic, air drying, as specified below).
 - a. Clear, Organic Coating: Lacquer specified for copper alloys, applied by air spray in two coats per manufacturer's written instructions, with interim drying, to a total thickness of **1 mil (0.025 mm)**.
3. Statuary Conversion Coating over Satin Finish: M31-C55 (Mechanical Finish: directionally textured, fine satin; Chemical Finish: conversion coating, sulfide).
 - a. Color: Match sample.

I. Fiberglass Finishes

1. Fiberglass: UV-light stable, hard, high-gloss gel coat or high-gloss, high-build polyurethane or polyester coating.
 - a. Color: As indicated by manufacturer's designations **OR** Match sample **OR** As selected from manufacturer's full range, **as directed.**

1.3 EXECUTION

A. Preparation

1. Prepare uncoated metal flagpoles that are set in foundation tubes by painting below-grade portions with a heavy coat of bituminous paint.
2. Foundation Excavation: Excavate to neat clean lines in undisturbed soil. Remove loose soil and foreign matter from excavation and moisten earth before placing concrete. Place and compact drainage material at excavation bottom.
3. Provide forms where required due to unstable soil conditions and for perimeter of flagpole base at grade. Secure and brace forms to prevent displacement during concreting.
4. Place concrete, as specified in Division 03 Section "Cast-in-place Concrete". Compact concrete in place by using vibrators. Moist-cure exposed concrete for not less than seven days or use nonstaining curing compound.



5. Trowel exposed concrete surfaces to a smooth, dense finish, free of trowel marks, and uniform in texture and appearance. Provide positive slope for water runoff to perimeter of concrete base.

B. Flagpole Installation

1. General: Install flagpoles where shown and according to Shop Drawings and manufacturer's written instructions.
2. Ground Set: Place foundation tube, sleeve, center, and brace to prevent displacement during concreting. Place concrete. Plumb and level foundation tube **OR** sleeve, **as directed**, and allow concrete to cure. Install flagpole, plumb, in foundation tube **OR** sleeve, **as directed**.
 - a. Foundation Tube: Place tube seated on bottom plate between steel centering wedges and install hardwood wedges to secure flagpole in place. Place and compact sand in foundation tube and remove hardwood wedges. Seal top of foundation tube with a **2-inch (50-mm)** layer of elastomeric joint sealant and cover with flashing collar.
3. Baseplate: Cast anchor bolts in concrete foundation. Install baseplate on washers placed over leveling nuts on anchor bolts and adjust until flagpole is plumb. After flagpole is plumb, tighten retaining nuts and fill space under baseplate solidly with nonshrink, nonmetallic grout. Finish exposed grout surfaces smooth and slope 45 degrees away from edges of baseplate.
4. Mounting Brackets and Bases: Anchor brackets and bases securely through to structural support with fasteners as indicated on Shop Drawings.

END OF SECTION 10 75 16 00



Task	Specification	Specification Description
10 75 23 00	10 75 16 00	Flagpoles

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SECTION 10 81 13 00 - ORIENTED FLEXIBLE NETTING BIRD BARRIER

1.1 GENERAL

A. Description Of Work

1. This specification covers the furnishing and installation of oriented flexible netting bird barrier. Products shall match existing materials and/or shall be as follows or as directed by the Owner. Installation procedures shall be in accordance with the product manufacturer's recommendations. Demolition and removal of materials shall be as required to support the work.

1.2 PRODUCTS

A. Material

1. Polyethylene twine netting attached to pre-installed cable system and steel installation hardware.
2. Netting shall be high density polyethylene knitted into sheets with mesh sizes of 3/4" **OR** 1-1/8" **OR 2", as directed.** Polyethylene shall be UV treated, color stable, and flame-retardant.
3. Color shall be selected from manufacturer's standard colors.
4. Installation hardware shall include corner and intermediate attachments, perimeter cable, turnbuckles, ferrules or clamps and net rings.

1.3 EXECUTION

A. Installation

1. Comply with manufacturer's printed instructions.

END OF SECTION 10 81 13 00

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SECTION 10 86 00 00 - DETENTION FURNITURE

1.1 GENERAL

A. Description Of Work

1. This specification covers the furnishing and installation of materials for detention furniture. Product shall be as follows or as directed by the Owner. Installation procedures shall be in accordance with the product manufacturer's recommendations. Demolition and removal of materials shall be as required to support the work.

B. Summary

1. Section Includes:
 - a. Gun lockers.
 - b. Security key cabinets.
 - c. Detention bunks.
 - d. Detention mattresses.
 - e. Detention desks.
 - f. Detention tables.
 - g. Detention seating.

C. Submittals

1. Product Data: For each type of product indicated.
2. LEED Submittal:
 - a. Product Data for Credit EQ 4.1: For security sealants, including printed statement of VOC content.
3. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
4. Samples: For factory-applied color finishes.
5. Samples for Verification:
 - a. Furniture: Full-size units. Approved Samples may become part of the completed Work.
 - b. Detention Mattresses: Not less than 6 inches (152 mm) square by full depth, including core and cover fabric.
6. Welding certificates.
7. Product certificates.
8. Maintenance data.
9. Other Informational Submittals:
 - a. Field quality-control reports documenting inspections of installed products.
 - b. Field quality-control certification signed by Contractor and Detention Specialist, **as directed.**

D. Quality Assurance

1. Welding Qualifications: Qualify procedures and personnel according to the following:
 - a. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
 - b. AWS D1.3, "Structural Welding Code - Sheet Steel."
 - c. AWS D1.6, "Structural Welding Code - Stainless Steel."
2. Preinstallation Conference: Conduct conference at Project site.

E. Delivery, Storage And Handling

1. Detention Mattresses: Deliver wrapped to provide protection during transit and Project-site storage. Protect from contact with moisture.

1.2 PRODUCTS

A. Materials



1. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.
 2. Cold-Rolled Steel Sheet: ASTM A 1008/A 1008M, CS (Commercial Steel), Type B; suitable for exposed applications.
 3. Hot-Rolled Steel Sheet: ASTM A 1011/A 1011M, CS (Commercial Steel), Type B; free of scale, pitting, or surface defects; pickled and oiled.
 4. Stainless-Steel Sheet, Strip, Plate, and Flat Bars: ASTM A 666 or ASTM A 240/A 240M, austenitic stainless steel, Type 304.
 5. Steel Tubing: ASTM A 513, Type B unless otherwise indicated; thickness indicated or required by structural loads.
 6. Steel Pipe: ASTM A 53/A 53M, Standard Weight (Schedule 40) unless another weight is indicated or required by structural loads.
 7. Concealed Bolts: ASTM A 307, Grade A unless otherwise indicated.
 8. Cast-in-Place Anchors in Concrete: Fabricated from corrosion-resistant materials capable of sustaining, without failure, a load equal to four times the load imposed, as determined by testing per ASTM E 488, conducted by a qualified independent testing agency; of type indicated below.
 - a. Threaded or wedge type; galvanized ferrous castings, either ASTM A 47/A 47M malleable iron or ASTM A 27/A 27M cast steel. Provide bolts, washers, and shims as needed; hot-dip galvanized per ASTM A 153/A 153M or ASTM F 2329.
 9. Embedded Plate Anchors: Fabricated from steel shapes and plates, minimum **3/16 inch (4.8 mm)** thick; with minimum **1/2-inch- (12.7-mm-)** diameter headed studs welded to back of plate.
 10. Proprietary Built-in Masonry Anchors: Fabricated from **0.134-inch (3.42-mm)** nominal-thickness steel sheet **OR 1/4-inch (6-mm)** nominal-thickness steel plate **OR 1/2-inch (12.7-mm)** nominal-thickness steel plate, **as directed**, into **6-inch- (152-mm-)** **OR 8-inch- (203-mm-)**, **as directed**, deep blocks matching size of concrete masonry units; with weld nuts attached on inside to receive field-bolted attachments, **as directed**.
 - a. Finish: Factory primed for field painting for anchors with field-welded attachments **OR** Polyester powder coat for anchors with bolted attachments **OR** Epoxy paint for anchors with bolted attachments, **as directed**.
 11. Welding Rods and Bare Electrodes: Select according to AWS specifications.
- B. Security Sealants
1. Manufacturer's standard, high-modulus, nonsag, two-part, pick-proof, epoxy sealant, with a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24), recommended for sealing nonmoving interior joints in security applications.
- C. Security Fasteners
1. Fasteners operable only by tools produced by fastener manufacturer or other licensed fabricator for use on specific type of fastener.
 2. Provide drive-system type, head style, material, and protective coating as required for assembly, installation, and strength, and as follows:
 - a. Drive-System Type: Pinned Torx-Plus **OR** Pinned Torx, **as directed**.
 - b. Fastener Strength: **120,000 psi (827 MPa)**.
 - c. Socket Button Head Fasteners:
 - 1) Heat-treated alloy steel, **ASTM F 835 (ASTM F 835M)**.
 - 2) Stainless steel, **ASTM F 879 (ASTM F 879M)**, Group 1 CW.
 - d. Socket Flat Countersunk Head Fasteners:
 - 1) Heat-treated alloy steel, **ASTM F 835 (ASTM F 835M)**.
 - 2) Stainless steel, **ASTM F 879 (ASTM F 879M)**, Group 1 CW.
 - e. Socket Head Cap Fasteners:
 - 1) Heat-treated alloy steel, **ASTM A 574 (ASTM A 574M)**.
 - 2) Stainless steel, **ASTM F 837 (ASTM F 837M)**, Group 1 CW.
 - f. Protective Coatings for Heat-Treated Alloy Steel:
 - 1) Zinc and clear trivalent chromium where indicated.
 - 2) Zinc phosphate with oil, ASTM F 1137, Grade I, or black oxide unless otherwise indicated.

D. Gun Lockers

1. Pistol Lockers:

- a. Cabinet: Minimum 20 inches (508 mm) wide by 15 inches (381 mm) high by 10 inches (254 mm) deep; formed from 0.134-inch (3.42-mm) OR 0.075-inch (1.90-mm), as directed, nominal-thickness steel sheet. Line each compartment with mothproofed felt or nonabsorbing, closed-cell padding.
 - 1) Compartments: Six.
- b. Doors: Formed from same material as cabinet, supported by heavy-duty continuous bottom hinge.
- c. Locks: Snap OR Cylinder, as directed, type, keyed differently and master keyed, as directed; provide one lock for each compartment.
- d. Mounting: Surface OR Recessed, with mounting flange formed from same material as body, as directed.
- e. Finish: Factory primed for field painting OR Baked enamel or powder coat, as directed.

2. Tilt-Out, Pistol Locker:

- a. Cabinet: Minimum 39 inches (991 mm) wide by 15 inches (381 mm) high by 6 inches (152 mm) deep; formed from 0.134-inch (3.42-mm) OR 0.075-inch (1.90-mm), as directed, nominal-thickness steel sheet. Line each compartment with mothproofed felt or nonabsorbing, closed-cell padding.
 - 1) Compartments: Six.
- b. Doors: Formed from same material as cabinet, supported by heavy-duty continuous bottom hinge, with attached tilt-out compartment with formed metal sides.
- c. Locks: Snap OR Cylinder, as directed, type, keyed differently and master keyed, as directed; provide one lock for each compartment.
- d. Mounting: Surface OR Recessed, with mounting flange formed from same material as body, as directed.
- e. Finish: Factory primed for field painting OR Baked enamel or powder coat, as directed.

E. Security Key Cabinets

1. Cabinet: Minimum 16 inches (406 mm) wide by 24 inches (610 mm) high by 6-1/2 inches (165 mm) deep; formed from 0.134-inch (3.42-mm) nominal-thickness steel sheet. Provide 0.060-inch (1.52-mm) nominal-thickness, steel sheet interior panels, supported on pivots, for mounting 150 OR 300, as directed, paracentric or mogul keys.
2. Doors: Formed from same material as cabinet, supported by heavy-duty continuous side hinge welded to cabinet and door; with tumbler deadlock.
3. Cross-Index System: Set up by key control manufacturer; include labels, two sets of key tags with self-locking key holders, key-gathering envelopes, temporary and permanent markers, and the following:
 - a. Card Index: Furnish four sets of index cards for recording key information. Include three receipt forms for each key-holding hook.
 - b. Computer Software: Furnish cross-index software for recording and reporting key-holder listings, tracking keys and lock and key history, and printing receipts for transactions. Include instruction manual.
4. Finish: Factory primed for field painting OR Baked enamel or powder coat, as directed.

F. Detention Bunks

1. Freestanding Single Bunks:

- a. Bunk Pan: Formed from 0.134-inch (3.42-mm) OR 0.105-inch (2.66-mm), as directed nominal-thickness steel sheet, perforated with at least six holes, as directed.
 - 1) Size: Minimum 27 inches (689 mm) wide by 76 inches (1930 mm) long with bunk pan 14 inches (356 mm) above floor.
 - 2) Turn up edges of back and sides and turn down edge of front OR back, sides, and front, as directed, with minimum 2-inch (51-mm) flanges.
- b. Drawer: Minimum 21 inches (533 mm) wide by 24 inches (610 mm) deep by 5 inches (127 mm) high, with full-width integral pull formed from steel sheet OR solid-steel bar pull, as directed; formed from 0.134-inch (3.42-mm) nominal-thickness steel sheet.



- c. Legs and Frames: Formed from 2-by-2-by-3/16-inch (51-by-51-by-4.8-mm) steel angle welded at connections to each other and to bunk pan; provide four legs for each bunk.
- d. Mounting Plates: Formed from 1/4-inch- (6-mm-) thick steel plate punched with one hole for floor anchorage; provide one mounting plate for each leg.
- e. Finish: Factory primed for field painting **OR** Baked enamel or powder coat, **as directed**.
- 2. Freestanding Double Bunks:
 - a. Bunk Pan: Formed from 0.134-inch (3.42-mm) **OR** 0.105-inch (2.66-mm), **as directed**, nominal-thickness steel sheet, each pan perforated with at least six holes, **as directed**.
 - 1) Size: Minimum 27 inches (689 mm) wide by 76 inches (1930 mm) long with lower bunk pan 14 inches (356 mm) above floor and upper bunk pan at least 49 inches (1245 mm) above floor.
 - 2) Upper and Lower Bunks: Turn up edges of back and sides and turn down edge of front **OR** back, sides, and front, **as directed**, with minimum 2-inch (51-mm) flanges.
 - 3) Upper Bunk: Turn up edges of back and sides and turn down edge of front **OR** back, sides, and front, **as directed**, with minimum 2-inch (51-mm) flanges.
 - 4) Lower Bunk: Turn up edges of back and sides and turn down edge of front, with minimum 2-inch (51-mm) flanges.
 - b. Drawers: Two; minimum 21 inches (533 mm) wide by 24 inches (610 mm) deep by 5 inches (127 mm) high, with full-width integral pull formed from steel sheet **OR** solid-steel bar pull, **as directed**; formed from 0.134-inch (3.42-mm) nominal-thickness steel sheet.
 - c. Legs and Frames: Formed from 2-by-2-by-3/16-inch (51-by-51-by-4.8-mm) steel angle welded at connections to each other and to bunk pan; provide four legs for each bunk.
 - d. Mounting Plates: Formed from 1/4-inch- (6-mm-) thick steel plate punched with one hole for floor anchorage; provide one mounting plate for each leg.
 - e. Assembly: Factory assembled **OR** Knocked down for field assembly, **as directed**.
 - f. Finish: Factory primed for field painting **OR** Baked enamel or powder coat, **as directed**.
- 3. Wall-Mounted Bunks:
 - a. Bunk Pan: Formed from 0.134-inch (3.42-mm) **OR** 0.105-inch (2.66-mm), **as directed**, nominal-thickness steel sheet, perforated with at least six holes, **as directed**.
 - 1) Size: Minimum 27 inches (689 mm) wide by 76 inches (1930 mm) long with bunk pan 2 inches (51 mm) from wall.
 - 2) Turn up edges of back and sides and turn down edge of front **OR** back, sides, and front, **as directed**, with minimum 2-inch (51-mm) flanges.
 - b. Drawer: Minimum 21 inches (533 mm) wide by 24 inches (610 mm) deep by 5 inches (127 mm) high, with full-width integral pull formed from steel sheet **OR** solid-steel bar pull, **as directed**; formed from 0.134-inch (3.42-mm) nominal-thickness steel sheet.
 - c. Combination End Panel/Mounting Plate: Formed from 3/16-inch- (0.048-mm-) thick steel sheet welded at connections to bunk pan, with 2-inch (51-mm) flange for wall mounting; provide two end panel/mounting plates for each bunk.
 - d. Finish: Factory primed for field painting **OR** Baked enamel or powder coat, **as directed**.

G. Detention Mattresses

- 1. General: Comply with 16 CFR 1632 and California Technical Bulletin 121 as determined by testing identical products by a testing and inspecting agency acceptable to authorities having jurisdiction. Identify materials with appropriate markings of applicable testing and inspecting agency.
- 2. Core: Fire-resistive solid foam **OR** Fire-resistive densified polyester **OR** Cotton, with 10 percent boric acid treatment, tufted to nylon netting to retain shape, **as directed**.
- 3. Cover Fabric: Vinyl bonded to nylon scrim; with a minimum total weight of 10 oz./sq. yd. (339 g/sq. m). Fabricate cover of four-corner box construction with seams facing inside of detention mattress except end closing seam located at foot of mattress; sew with nylon thread in a double-lock stitch.
- 4. Thickness: 4 inches (102 mm) **OR** 6 inches (152 mm), **as directed**.

H. Detention Desks

1. Single-Seat, Floor-Mounted Desks:
 - a. Desk Top: Formed from 0.134-inch (3.42-mm) nominal-thickness steel OR 0.105-inch (2.66-mm) nominal-thickness steel OR 0.141-inch- (3.57-mm-) thick, stainless-steel OR 0.062-inch- (1.59-mm-) thick, stainless-steel, **as directed**, sheet, with minimum 1-1/2-inch (38-mm) flanged edges.
 - b. Pedestal: Provide two storage shelves with sides and shelves formed from 0.134-inch (3.42-mm) nominal-thickness steel.
 - c. Legs: Formed from 1-1/2-inch-square by 3/16-inch- (38-mm-square by 4.8-mm-) thick steel tubing welded to desk top and mounting plate for an overall desk height of not less than 30 inches (762 mm).
 - d. Seat: 12-inch (305-mm) diameter, formed from 0.134-inch (3.42-mm) nominal-thickness steel OR 0.075-inch (1.90-mm) nominal-thickness steel OR 0.141-inch- (3.57-mm-) thick, stainless-steel OR 0.062-inch- (1.59-mm-) thick, stainless-steel, **as directed**, sheet; reinforced with 0.134-inch (3.42-mm) nominal-thickness steel sheet, with minimum 1-1/2-inch (38-mm) flanged edges.
 - e. Swivel Seat Support: Formed from 1-by-2-by-0.075-inch (25-by-51-by-1.90-mm) nominal-thickness steel tubing, 2-inch-OD-by-0.075-inch (51-mm-OD-by-1.90-mm) nominal-thickness steel tubing, or 3/8-inch- (9.5-mm-) thick, steel plate bar; with 1/2-inch (12.7-mm) pivot pin welded to legs.
 - f. Towel Bar: Formed from 1/4-by-1-1/2-inch (6-by-38-mm) steel OR stainless-steel, **as directed**, plate, mounted on one side of desk.
 - g. Mounting Plates: Formed from 1/4-inch- (6-mm-) thick steel plate punched with one hole for floor anchorage; provide one mounting plate for each leg.
 - h. Steel Finish: Factory primed for field painting OR Baked enamel or powder coat, **as directed**.
 - i. Stainless-Steel Finish: No. 3.
 - 1) Size: Minimum 36 inches (914 mm) wide by 15-1/2 inches (381 mm) deep.
 2. Wall-Mounted Desk and Seat:
 - a. Desk: Formed from 0.134-inch (3.42-mm) nominal-thickness steel OR 0.141-inch- (3.57-mm-) thick, stainless-steel, **as directed**, sheet, with minimum 1-1/2-inch (38-mm) flanged edges.
 - 1) Size: Minimum 12 inches (305 mm) wide by 18 inches (457 mm) deep OR 18 inches (457 mm) wide by 18 inches (457 mm) deep OR 24 inches (610 mm) wide by 18 inches (457 mm) deep OR 30 inches (762 mm) wide by 20 inches (508 mm) deep, **as directed**.
 - b. Seat: Minimum 12 inches (305 mm) wide by 16 inches (406 mm) OR 18 inches (457 mm), **as directed**, deep; formed from 0.134-inch (3.42-mm) nominal-thickness steel OR 0.141-inch- (3.57-mm-) thick, stainless-steel, **as directed**, sheet, with minimum 1-1/2-inch (38-mm) flanged edges.
 - c. Steel Finish: Factory primed for field painting OR Baked enamel or powder coat, **as directed**.
 - d. Stainless-Steel Finish: No. 3.
- I. Detention Tables
1. Pedestal-Style Table:
 - a. Tabletop: Formed from 0.134-inch (3.42-mm) nominal-thickness steel OR 0.105-inch (2.66-mm) nominal-thickness steel OR 0.109-inch- (2.78-mm-) thick, stainless-steel OR 0.078-inch- (1.98-mm-) thick, stainless-steel OR 0.062-inch- (1.59-mm-) thick, stainless-steel, **as directed**, sheet; reinforced with steel shapes or steel plate, with minimum 1-1/2-inch (38-mm) flanged edges.
 - 1) Size: Minimum 30 inches (762 mm) OR 40 inches (1016 mm), **as directed**, wide by length required for capacity by 30 inches (762 mm) OR 35 inches (889 mm), **as directed**, high.
 - 2) Game Top: Engrave, or otherwise integrally incorporate, checkerboard into tabletop.

- b. Seats: 12-inch (305-mm) diameter, formed from 0.105-inch (2.66-mm) nominal-thickness steel OR 0.075-inch (1.90-mm) nominal-thickness steel OR 0.078-inch- (1.98-mm-) thick, stainless-steel OR 0.062-inch- (1.59-mm-) thick, stainless-steel, **as directed**, sheet; reinforced with 0.134-inch (3.42-mm) nominal-thickness steel plate, with minimum 1-1/2-inch (38-mm) flanged edges.
 - c. Pedestal Supports: Formed from 3-inch-square by 3/16-inch- (76-mm-square by 4.8-mm-) OR 4-inch-square by 0.134-inch- (102-mm-square by 3.42-mm-), **as directed**, thick steel tubing welded to top and base plate. Provide two pedestals for tables with capacity of more than four persons.
 - d. Seat Framing: Formed from 3-inch-square by 0.134-inch- (76-mm-square by 3.42-mm-) OR 3-by-2-by-3/16-inch- (76-by-51-by-4.8-mm-), **as directed**, thick steel tubing welded to pedestal supports.
 - e. Base Plate: Minimum 16-inch- (406-mm-) square, 1/4-inch- (6-mm-) thick steel plate punched with four holes for floor anchorage.
 - f. Capacity: Four persons OR Six persons OR Eight persons OR As indicated on Drawings, **as directed**.
 - g. Steel Finish: Factory primed for field painting OR Baked enamel or powder coat, **as directed**.
 - h. Stainless-Steel Finish: No. 3.
 - 2. Bench-Style Table:
 - a. Tabletop: Formed from 0.134-inch (3.42-mm) nominal-thickness steel OR 0.105-inch (2.66-mm) nominal-thickness steel OR 0.109-inch- (2.78-mm-) thick, stainless-steel, **as directed**, sheet; reinforced with steel channel frame or steel plate, with minimum 1-1/2-inch (38-mm) flanged edges.
 - 1) Size: Minimum 24 inches (610 mm) wide by length required for capacity by 30 inches (762 mm) OR 35 inches (889 mm), **as directed**, high.
 - b. Benches: 12 inches (305 mm) deep by length of tabletop, formed from 0.134-inch (3.42-mm) nominal-thickness steel OR 0.105-inch (2.66-mm) nominal-thickness steel OR 0.109-inch- (2.78-mm-) thick, stainless-steel OR 0.062-inch- (1.59-mm-) thick, stainless-steel, **as directed**, sheet, with minimum 1-1/2-inch (38-mm) flanged edges.
 - c. Vertical Supports: Formed from 8-inch (203-mm) hot-rolled steel channels or 0.164-inch- (4.18-mm-) thick, formed-steel channels; braced and welded, with steel base plates punched for floor anchorage. Provide three supports for tables with capacity of more than four persons.
 - d. Bench Supports: Formed from 2-by-2-1/2-by-1/4-inch- (51-by-64-by-6-mm-) thick steel angle or 2-inch-square by 1/4-inch- (51-mm-square by 6-mm-) thick steel tubing; welded to vertical supports.
 - e. Floor Anchor: Formed from steel angle punched for floor anchorage.
 - f. Capacity: Four persons OR Six persons OR Eight persons OR As indicated on Drawings, **as directed**.
 - g. Steel Finish: Factory primed for field painting OR Baked enamel or powder coat, **as directed**.
 - h. Stainless-Steel Finish: No. 3.
- J. Detention Seating
- 1. Floor-Mounted Stool:
 - a. Seats: Minimum 12-inch (305-mm) diameter, formed from 0.134-inch (3.42-mm) nominal-thickness steel OR 0.075-inch (1.90-mm) nominal-thickness steel OR 0.125-inch- (3.18-mm-) thick, stainless-steel OR 0.062-inch- (1.59-mm-) thick, stainless-steel, **as directed**, sheet; reinforced with 0.134-inch- (3.42-mm-) thick steel sheet cut to interior dimension of seat, with minimum 1-1/2-inch (38-mm) flanged edges.
 - b. Seat Support: Formed from steel pipe or 2-inch-OD-by-0.075-inch- (51-mm-OD-by-1.90-mm-) thick steel tubing welded to seat reinforcement and base plate for an overall stool height of not less than 18 inches (457 mm).

- c. Base Plate: Minimum **6-by-1/4-inch- (152-by-6-mm-)** thick, square **OR** round, **as directed**, steel punched with four holes for floor anchorage.
- d. Steel Finish: Factory primed for field painting **OR** Baked enamel or powder coat, **as directed**.
- e. Stainless-Steel Finish: No. 3.
2. Wall-Mounted Stool:
 - a. Seat: Minimum **12-inch (305-mm)** diameter, formed from **0.134-inch (3.42-mm)** nominal-thickness steel **OR** **0.075-inch (1.90-mm)** nominal-thickness steel **OR** **0.125-inch- (3.18-mm-)** thick, stainless-steel **OR** **0.078-inch- (1.98-mm-)** thick, stainless-steel, **as directed**, sheet; reinforced with **0.134-inch- (3.42-mm-)** thick steel sheet cut to interior dimension of seat, with minimum **1-1/2-inch (38-mm)** flanged edges.
 - b. Seat Support: Formed from **1-by-2-by-0.075-inch- (25-by-51-by-1.90-mm-)** thick steel tubing, **2-inch-OD-by-0.075-inch- (51-mm-OD-by-1.90-mm-)** thick steel tubing or **3/8-inch- (9.5-mm-)** thick, steel plate bar; welded to seat reinforcement and wall bracket.
 - c. Swivel Wall Bracket: Minimum **1/2-inch (12.7-mm)** pivot pin, with **3/8-inch- (9.5-mm-)** thick steel plate for welding to embedded steel plate **OR** for welding to steel wall **OR** punched with four holes for wall anchorage, **as directed**.
 - d. Steel Finish: Factory primed for field painting **OR** Baked enamel or powder coat, **as directed**.
 - e. Stainless-Steel Finish: No. 3.
3. Floor-Mounted Bench:
 - a. Bench Top: Formed from **0.134-inch (3.42-mm)** nominal-thickness steel **OR** **0.105-inch (2.66-mm)** nominal-thickness steel **OR** **0.141-inch- (3.57-mm-)** thick, stainless-steel **OR** **0.109-inch- (2.78-mm-)** thick, stainless-steel, **as directed**, sheet, with minimum **1-1/2-inch (38-mm)** flanged edges.
 - 1) Size: Minimum **12 inches (305 mm)** deep by **48 inches (1219 mm)** **OR** **60 inches (1524 mm)** **OR** **72 inches (1829 mm)** **OR** **96 inches (2438 mm)**, **as directed**, long.
 - b. Supports: Formed from **0.164-inch- (4.18-mm-)** thick, formed-steel channels **2-1/2-inch-OD-by-0.0677-inch- (64-mm-OD-by-1.7-mm-)** thick steel tubing; welded to bench and base plate for an overall bench height of not less than **18 inches (457 mm)**. Provide three supports for benches with length of more than **72 inches (1829 mm)**.
 - c. Base Plates: Minimum **8-inch-square by 1/4-inch- (203-mm-square by 6-mm-)** thick steel plate punched with four holes for floor anchorage.
 - d. Capacity: Four persons **OR** Six persons **OR** Eight persons **OR** As indicated on Drawings, **as directed**.
 - e. Steel Finish: Factory primed for field painting **OR** Baked enamel or powder coat, **as directed**.
 - f. Stainless-Steel Finish: No. 3.
- K. Fabrication
 1. Shop Assembly: Preassemble items in shop to greatest extent possible to minimize field splicing and assembly. Disassemble units only as necessary for shipping and handling limitations. Use connections that maintain structural value of joined pieces. Clearly mark units for reassembly and coordinated installation.
 2. Coordinate dimensions and attachment methods of detention furniture with those of adjoining construction to produce integrated assemblies with closely fitting joints and with edges and surfaces aligned unless otherwise indicated.
 3. Shear and punch metals cleanly and accurately. Remove burrs.
 4. Form and grind edges and corners to be free of sharp edges or rough areas.
 - a. Fabricate detention furniture with no more than **1/32-inch (0.8-mm)** gap between component materials. Weld edges that cannot be crimped to meet tolerance so as to provide a seamless joint with no place for concealment of contraband.
 5. Form metal in maximum lengths to minimize joints. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing the Work.
 6. Weld corners and seams continuously to comply with referenced AWS standard and the following:

- a. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
- b. Obtain fusion without undercut or overlap.
- c. Remove welding flux immediately.
- d. Finish exposed welds and surfaces smooth and blended at exposed connections so that no roughness shows after finishing and contour of welded surface matches that of adjacent surface.
- e. Weld before finishing components to greatest extent possible. Remove weld spatter and welding oxides from exposed surfaces by descaling or grinding.
7. Provide for anchorage of type indicated; coordinate with supporting structure. Fabricate and space anchoring devices to secure detention furniture rigidly in place and to support expected loads. Build in straps, plates, and brackets as needed to support and anchor fabricated items to adjoining construction. Reinforce formed-metal units as needed to attach and support other construction.
8. Cut, reinforce, drill, and tap detention furniture as indicated to receive hardware, security fasteners, and similar items.
9. Form exposed work true to line and level with accurate angles, surfaces, and straight sharp edges.
10. Form exposed connections with hairline joints, flush and smooth using concealed fasteners where possible. Use exposed security fasteners of type indicated or, if not indicated, flat-head (countersunk) security fasteners. Locate joints where least conspicuous.
11. Attach drawer slides **OR** shelves, **as directed**, to furniture by welding **OR** with security fasteners, **as directed**.

L. Steel Finishes

1. Surface Preparation: Remove mill scale and rust, if present, from uncoated steel, complying with SSPC-SP 5/NACE No. 1, "White Metal Blast Cleaning" or SSPC-SP 8, "Pickling". After cleaning, apply a conversion coating suited to the organic coating to be applied over it.
2. Factory Prime Finish: Apply manufacturer's standard, fast-curing, lead- and chromate-free, universal primer immediately after surface preparation and pretreatment.
3. Baked-Enamel or Powder-Coat Finish: Immediately after cleaning and pretreating, apply manufacturer's standard two-coat, baked-on finish consisting of prime coat and thermosetting topcoat. Comply with coating manufacturer's written instructions for applying and baking to achieve a minimum dry film thickness of **2 mils (0.05 mm)**.
 - a. Color and Gloss: As indicated by manufacturer's designations **OR** Match sample **OR** As selected from manufacturer's full range, **as directed**.

M. Stainless-Steel Finishes

1. General: Remove tool and die marks and stretch lines or blend into finish. Grind and polish surfaces to produce uniform, directionally textured, polished finish indicated, free of cross scratches. Run grain with long dimension of each piece.
2. Intermediate Polish Finish: No. 3 unless otherwise indicated.
3. When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.

1.3 EXECUTION

A. Installation

1. Fastening to In-Place Construction: Provide anchorage devices and fasteners where necessary for securing detention furniture to in-place construction. Include threaded fasteners for concrete and masonry inserts, security fasteners, and other connectors.
2. Cutting, Fitting, and Placement: Obtain manufacturer's written approval for cutting, drilling, and fitting required for installing detention furniture. Set detention furniture accurately in location,

- alignment, and elevation; with edges and surfaces level, plumb, true, and free of rack; and measured from established lines and levels.
3. Provide temporary bracing or anchors in formwork for items that are to be built into concrete or masonry or similar construction.
 4. Fit exposed connections accurately together to form hairline joints. Weld connections that are not to be left as exposed joints but cannot be shop welded because of shipping size limitations.
 5. Field Welding: Comply with the following requirements:
 - a. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
 - b. Obtain fusion without undercut or overlap.
 - c. Remove welding flux immediately.
 - d. Finish exposed welds and surfaces smooth and blended at exposed connections so that no roughness shows after finishing and contour of welded surface matches that of adjacent surface.
 - e. Fillet Welds: Minimum size of **1/8 inch by 1-1/2 inches (3 mm by 38 mm)** long, spaced not greater than **12 inches (305 mm)** o.c. Fill spaces between welds with security sealant **OR** auto body filler, **as directed**, where weld is exposed.
OR
Fillet Welds: Continuous.
 6. Adjust doors and latches of detention gun lockers and key cabinets to operate easily without binding. Verify that integral locking devices operate properly.
 7. Assemble detention furniture requiring field assembly with security fasteners with no exposed fasteners on exposed faces and frames.
 8. Anchor furniture with security fasteners **OR** by welding **OR** as indicated on Drawings, **as directed**, to floors and walls at intervals required by expected loads, but not more than **12 inches (305 mm)** o.c.
 - a. Install anchors through backup reinforcing plates where necessary to avoid metal distortion.
 - b. Use security fasteners with head styles appropriate for installation requirements, strength, and finish of adjacent materials, except that a maximum of two different sets of tools shall be required to operate security fasteners for Project. Provide stainless-steel security fasteners in painted materials.
 - c. Weld nuts onto cast-in-place anchors after installation so as to be nonremovable.
 9. Apply security sealant **OR** auto body filler, **as directed**, at all exposed gaps between detention furniture and adjacent construction greater than **1/16 inch (1.6 mm)**.
 10. Install one detention mattress for each detention bunk.
- B. Field Quality Control
1. Detention Specialist shall inspect **OR** Inspect, **as directed**, installed products to verify compliance with requirements. Prepare inspection reports and indicate compliance with and deviations from the Contract Documents.
 2. Prepare field quality-control certification endorsed by Detention Specialist, **as directed**, that states installed products and their installation comply with requirements in the Contract Documents.
- C. Cleaning And Protection
1. Touchup Painting: Immediately after erection, clean bolted connections and abraded areas of shop paint, and paint exposed areas with same material used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.

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Task	Specification	Specification Description
10 86 00 00	10 28 13 13a	Detention Toilet Accessories

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Task	Specification	Specification Description
11 12 13 00	01 22 16 00	No Specification Required

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SECTION 11 12 16 00 - PARKING CONTROL EQUIPMENT

1.1 GENERAL

A. Description Of Work

1. This specification covers the furnishing and installation of materials for parking control equipment. Products shall be as follows or as directed by the Owner. Installation procedures shall be in accordance with the product manufacturer's recommendations. Demolition and removal of materials shall be as required to support the work.

B. Summary

1. Section Includes:
 - a. Automatic barrier gates.
 - b. Vehicle detectors.
 - c. Traffic controllers.
 - d. Entry terminal ticket dispensers.
 - e. Exit terminals.
 - f. Pay stations.
 - g. Fee computers.
 - h. Parking facility management software.
 - i. Access control units.

C. System Description

1. Parking Control System: Intended to be used for the following types of parking management:
 - a. Transient Parking: Hourly rated parking, with fee paid while entering **OR** exiting, **as directed**.
 - b. Monthly Parking: Monthly rated parking, with fee paid by the month and access gained by access control card.
 - c. Flat-Rate Parking: Unlimited-duration parking, with free gate entry and fixed-fee amount paid while exiting.
 - d. Special-Event Parking: Duration-of-event parking, with fee paid while entering with gates up or down.
 - e. Limited Date(s) and Time(s) Parking: Limited-duration parking, with predetermined fee access control card.
 - f. Merchant Validated Parking: Fee set, reduced, or waived by merchant validation, with free gate entry and fee paid while exiting.
 - g. Valet Parking: Assisted parking, with fee paid while entering or exiting.
 - h. Hotel Guest Parking: Unlimited access for duration of stay, with access gained by access control card.

D. Submittals

1. Product Data: For each type of product indicated.
2. Shop Drawings: For parking control equipment. Include plans, elevations, sections, details, and attachments to other work.
 - a. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
 - b. Wiring Diagrams: For power, signal, and control wiring.
3. Field quality-control reports.
4. Operation and Maintenance Data: For parking control equipment to include in emergency, operation, and maintenance manuals.
5. Software and Firmware Operational Documentation:
 - a. Software operating and upgrade manuals.
 - b. Program Software Backup: On magnetic media or compact disk, complete with data files.
 - c. Device address list.

d. Printout of software application and graphic screens.

E. Quality Assurance

1. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for installation of units required for this Project.
2. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
3. Preinstallation Conference: Conduct conference at Project site.

F. Software Service Agreement

1. Technical Support: Beginning with Final Completion, provide software support for two, **as directed**, years.
2. Upgrade Service: Update software to latest version at Project completion. Install and program software upgrades that become available within two, **as directed**, years from date of Final Completion. Upgrading software shall include operating system. Upgrade shall include new or revised licenses for use of software.
 - a. Provide 30, **as directed**, days' notice to the Owner to allow scheduling and access to system and to allow the Owner to upgrade computer equipment if necessary.

1.2 PRODUCTS

A. Materials

1. Aluminum: Alloy and temper recommended by aluminum producer and manufacturer for type of use and finish indicated, and as follows:
 - a. Sheet: **ASTM B 209 (ASTM B 209M)**.
 - b. Extruded Shapes: **ASTM B 221 (ASTM B 221M)**.
2. Cold-Rolled Steel Sheet: ASTM A 1008/A 1008M, Commercial Steel (CS), Type B.
3. Zinc-Coated (Galvanized) Steel Sheet: ASTM A 653/A 653M, commercial quality, with **G60 (Z180)** coating designation; mill phosphatized.
4. Stainless-Steel Sheet: ASTM A 666, Type 304.
5. Anchorages: Anchor bolts, hot-dip galvanized according to ASTM A 153/A 153M and ASTM F 2329.

B. Automatic Barrier Gates

1. General: Provide UL-approved parking control device consisting of operator and controller housed in a weathertight, tamper-resistant cabinet enclosure with gate arm. Device shall be activated by a signal from access or revenue control device. Fabricate unit with gate-arm height in down position of not more than **35 inches (889 mm)** above pavement to prevent even small vehicles from passing under gate arm.
2. Standard: Provide barrier gates and gate operators that are listed and labeled according to UL 325 by a qualified testing agency. Provide barrier gates that comply with ASTM F 2200, **as directed**.
3. Controller: Factory-sealed, solid-state, plug-in type, with galvanized-steel box for wiring connections.
 - a. Type: Noncommunicating.
 - 1) Capable of logic for one- and two-way lanes.
 - 2) Separate momentary contacts for transient patrons, monthly patrons, vehicle entries, and vehicle exits.
 - b. Type: Communicating.
 - 1) Real-time communication of lane counts, status messages, and execute commands.
 - 2) Monitor illegal entries and exits, tailgates, tickets, monthlies, and backouts.
 - 3) Status messages for gate up too long, backouts, ticket in chute, and gate-arm rebound.

- 4) Communication commands for resetting loops, turning "Full" signs on/off, raising and lowering gate arm, and disabling ticket dispensers **OR** card readers, **as directed**.
- c. Features: Equip unit with the following:
 - 1) Able to store successive inputs and sequentially processing each one.
 - 2) Automatic instant-reversing obstacle detector mechanism that stops downward motion of gate arm if arm contacts or nears an object and that immediately returns arm to upward position. Include a 0- to 60-second, variable-time reset device.
 - 3) On-off power supply switch.
 - 4) Automatic-manual switch.
 - 5) Differential counter.
 - 6) Directional arming logic.
 - 7) RS-422 communication port.
 - 8) Broken gate-arm monitoring.
 - 9) Programmable automatic, **as directed**, timer.
 - 10) Internal resettable **OR** non-resettable, **as directed**, counters.
 - 11) Thermal-overload protection with manual reset.
 - 12) Plug-in connectors for two **OR** three, **as directed**, vehicle loop detectors.
 - 13) Thermostatically controlled heater with on/off/auto switch.
 - 14) Diagnostic mode for on-site testing, with LEDs for inputs and outputs, **as directed**.
 - 15) Automatic and continuous testing of inputs and outputs.
 - 16) Switch to test motor and limit switches.
 - 17) Emergency manual disconnect.
 - 18) Battery backup.
 - 19) Single, 115-V ac grounded power receptacle.
 - 20) Reversible arm capability for right- or left-handed operation.
4. Cabinets: Fabricated from metal sheet with seams welded and ground smooth; approximately **15 inches square by 40 inches tall (381 mm square by 1016 mm tall)**. Provide single, gasketed access door for each cabinet with flush-mounted locks. Furnish two keys for each lock, all locks keyed alike, **as directed**. Fabricate cabinet with internal reinforcing and four mounting holes accessible only from inside cabinet.
 - a. Material: Not less than **0.097-inch- (2.5-mm-)** thick, galvanized-, **as directed**, steel sheet **OR** **0.125-inch- (3.2-mm-)** thick aluminum sheet.
 - 1) Finish cabinet, interior and exterior, with manufacturer's standard white **OR** yellow, **as directed**, baked-enamel finish over primer.
 - b. Material: Not less than **0.109-inch- (2.8-mm-)** thick, stainless-steel sheet.
 - 1) Finish cabinet exterior with No. 4 finish.
OR
Finish cabinet, interior and exterior, with manufacturer's standard white **OR** yellow, **as directed**, baked-enamel finish over primer.
5. Straight Gate Arm: **1-by-4-inch nominal- (19-by-89-mm actual-)** size pine or redwood **OR** **0.097-inch- (2.5-mm-)** thick steel **OR** Fiberglass, PVC, or polycarbonate **OR** Aluminum, **as directed**, with painted finish and black diagonal stripes on traffic-side face. Provide mounting flange with breakaway feature to ensure clean break if arm is struck by vehicle.
 - a. Length: **10 feet (3.0 m) OR 12 feet (3.7 m) OR** As indicated on Drawings, **as directed**.
6. Folding Gate Arm: Two pieces of **1-by-4-inch nominal- (19-by-89-mm actual-)** size pine or redwood joined together with metal side brackets; with painted finish and black diagonal stripes on traffic-side face. Provide mounting flange with breakaway feature to ensure clean break if arm is struck by vehicle.
 - a. Length: **10 feet (3.0 m) OR 12 feet (3.7 m) OR** As indicated on Drawings, **as directed**.
7. Straight Gate Arm with Counterbalance: **1-by-6-inch nominal- (19-by-140-mm actual-)** size pine or redwood with steel counterweights; with painted finish and black diagonal stripes on traffic-side face. Provide mounting flange with breakaway feature to ensure clean break if arm is struck by vehicle.
 - a. Length: **16 feet (4.9 m) OR** As indicated on Drawings, **as directed**.
8. Wishbone-Style Gate Arm: **1-by-4-inch nominal- (19-by-89-mm actual-)** size pine or redwood **OR** **0.097-inch- (2.5-mm-)** thick steel, **as directed**, formed into wishbone configuration, with steel

counterweights; with painted finish and black diagonal stripes on traffic-side face. Provide mounting flange with breakaway feature to ensure clean break if arm is struck by vehicle.

- a. Length: **14 feet (4.3 m) OR** As indicated on Drawings, **as directed**.
9. Operator: 1/3 **OR** 1/2, **as directed**, hp; 60-Hz, single-phase, instant-reversing, continuous-duty motor for operating gate arm. Transmit power to gate-arm drive shaft through speed reducer to harmonic-acting crank and connecting rod. Fabricate crank, rod, and drive shaft of galvanized solid bar steel. Provide an operable cam for adjusting arm travel.
 - a. Opening Time: Three **OR** Six, **as directed**, seconds.
 - b. Inherently adjustable torque limiting clutch for safety.
10. Accessories:
 - a. Audible alarm that activates as part of a safety device system.
 - b. Additional obstruction detector; noncontact infrared **OR** photoelectric **OR** radio-frequency barrier, **as directed**.
 - c. Barrier-arm warning safety signs on both sides of unit limiting traffic to vehicular traffic.
 - d. Low-voltage yellow **OR** red, **as directed**, warning lights that illuminate when gate is in down position.
 - e. Low-voltage light on cabinet top that flashes or changes from red to green when barrier gate is operating.
 - f. Manually operated crank for emergency operation.
 - g. Local authorities' emergency access as directed by the Owner.
 - h. Gate-arm tip support with electromagnetic lock, **as directed**.

C. Vehicle Detectors

1. Vehicle Loop Detector System: Provide self-tuning electronic presence detector with adjustable detection patterns, adjustable sensitivity and frequency settings, and panel indicator light designed to detect presence or transit of a vehicle over an embedded loop of wire and to emit signal activating gate-arm operator. Include automatic closing timer with adjustable time delay before closing, timer cut-off switch, **as directed**, and vehicle loop detector designed to open and close gate arm **OR** hold gate arm open until traffic clears, **as directed**. Provide number of loops consisting of multiple strands of wire, number of turns, loop size, and method of placement at location shown on Drawings, as recommended in writing by detection system manufacturer for function indicated.
 - a. Field-Assembled Loop: Wire, in size indicated for field assembly, and sealant; style for pave-over **OR** saw-cut, **as directed**, installation.
 - b. Factory-Formed Loop: Wire, preformed in size indicated; style for pave-over **OR** saw-cut, **as directed**, installation.
 - c. System Performance: Capable of the following:
 - 1) Recognize two vehicles within **6 inches (152 mm)** of each other on standard-sized loop.
 - 2) Recognize vehicle direction by detecting vehicle moving from one loop to another.
 - 3) Generate reverse count if vehicle backs up after generating directional count in forward direction.
 - 4) Continuous diagnostic monitoring for intermittently operating and failed loops.
 - 5) Crosstalk test between adjacent loops.
2. Active Infrared Vehicle Detector: Provide retroreflective **OR** emitter/receiver, **as directed**, type presence detector with adjustable detection zone pattern and sensitivity, designed to detect the presence or transit of vehicle in gate-arm pathway by interrupting infrared beam in zone pattern and to emit signal activating gate-arm operator. Include automatic closing timer with adjustable time delay before closing, timer cut-off switch, **as directed**, and vehicle presence detector designed to open and close gate arm **OR** hold gate arm open until traffic clears, **as directed**.

D. Traffic Controllers

1. Penetrating Type: Provide directional enforcement system consisting of multiple raised teeth that allow vehicular traffic in one direction and that puncture tires of vehicular traffic in the other direction. Fabricate system from steel plate contained in welded steel frame.

- a. Mounting: Surface **OR** Recessed, **as directed**.
 - b. Operation: Manual, with each tooth controlled by torsion spring **OR** Electromechanical **OR** Hydraulic, **as directed**.
 - c. Latch Down: Allow disarming for two-way traffic flow. Provide one, **as directed**, tool(s) for latch-down operation.
 - d. Illuminated Warning Signs: Single **OR** Double, **as directed**, -faced warning signs consisting of fluorescent lamps with cold-start ballasts contained in welded steel bodies with baked-enamel finish and fiberglass sign faces. Provide base sleeves and posts for post mounting, **as directed**.
 - 1) Sign Copy: "Wrong Way, Stop, Severe Tire Damage" **OR** "Warning, Do Not Back Up, Tire Damage," **as directed**.
 2. Nonpenetrating Type: Provide directional enforcement system consisting of spring-activated steel curb that allows traffic in only one direction. Fabricate system from steel plate contained in welded steel frame.
 - a. Mounting: Surface **OR** Recessed, **as directed**.
 - b. Operation: Manual **OR** Electromechanical **OR** Hydraulic, **as directed**.
- E. Entry Terminal Ticket Dispensers
1. General: Provide entry terminal ticket dispensers, consisting of ticket-printing and issuing mechanisms, ticket magazines, thermal printers, and controllers housed in cabinet enclosures.
 - a. Features: Include the following:
 - 1) Time and date display.
 - 2) Time Indicator: 24-hour cycle with A.M. and P.M. **OR** military-time, **as directed**, clock mechanism.
 - 3) Voice annunciation.
 - 4) Tickets: Standard paper **OR** Magnetic-stripe **OR** Barcode, **as directed**, type.
 - 5) Removable ticket tray with capacity of 5000, **as directed**, fan-folded tickets.
 - 6) Operation: Standalone **OR** Online communication to remote computer, **as directed**.
 - 7) Battery backup for clock and RAM memory.
 - 8) RS-422 communication port.
 - 9) Thermostatically controlled heater with on/off/auto switch.
 - 10) Access **OR** Credit, **as directed**, card acceptance with activation slot and "Insert Ticket/Card" message.
 - 11) License plate recognition.
 - 12) Multiple ticket option for valet parking.
 - 13) Intercom.
 2. System Performance: Activation by button with "Push for Ticket" message **OR** vehicle detector **OR** card reader, **as directed**. On activation, unit automatically records entry time and date on ticket, sounds buzzer, **as directed**, and dispenses ticket.
 - a. Automatic ticket validation.
 - b. Program ticket numbering.
 - c. Low-ticket alarm.
 - d. Out-of-ticket alarm.
 - e. Ticket jam detection.
 - f. Print test ticket.
 3. Cabinets: Fabricated from metal sheet with seams welded and ground smooth, approximately **15 inches square by 40 inches tall (381 mm square by 1016 mm tall)**; consisting of base and top components. Provide single, gasketed access door for each base component with flush-mounted locks. Furnish two keys for each lock, all locks keyed alike, **as directed**. Fabricate cabinet with internal reinforcing and four mounting holes accessible only from inside cabinet. Fabricate top component so it can be unlocked and opened for ticket loading and maintenance. Include flush-mounted lock in rear of top, keyed the same as base component lock.
 - a. Material: Not less than **0.097-inch- (2.5-mm-)** thick, galvanized-, **as directed**, steel sheet or **0.125-inch- (3.2-mm-)** thick aluminum sheet.
 - 1) Finish cabinet, interior and exterior, with manufacturer's standard white **OR** yellow, **as directed**, baked-enamel finish over primer.

- b. Material: Not less than **0.109-inch- (2.8-mm-)** thick, stainless-steel sheet.
 - 1) Finish cabinet exterior with No. 4 finish.
 - OR**
 - Finish cabinet, interior and exterior, with manufacturer's standard white **OR** yellow, **as directed**, baked-enamel finish over primer.
- 4. Ticket-Dispensing Mechanisms: Removable assembly, with self-sharpening ticket cutter or ticket burster and plug-in controller.

F. Exit Terminals

- 1. General: Provide exit terminals consisting of ticket collectors, magnetic-stripe ticket readers, LCD, **as directed**, displays, thermal printers, and controllers housed in cabinet enclosures. Provide "Please Insert Ticket" sign on side of cabinet visible to driver.
 - a. Features: Include the following:
 - 1) Operation: Standalone **OR** Online communication to remote computer, **as directed**.
 - 2) Battery backup for clock and RAM memory.
 - 3) Thermostatically controlled heater with on/off/auto switch.
 - 4) RS-422 communication port.
 - 5) Access **OR** Credit, **as directed**, card acceptance with activation slot and "Insert Ticket/Card" message.
 - 6) Intercom.
- 2. System Performance: Capable of the following:
 - a. Activated by vehicle detector **OR** card reader, **as directed**.
 - b. Print receipts on demand.
 - c. Voice annunciation.
 - d. Program facility code.
 - e. Program grace period.
 - f. Program display.
 - g. Program timer for closing barrier gate.
 - h. Reports for events and exception events.
 - i. Built-in service diagnostics.
- 3. Operation: Inserting exit ticket into exit ticket reader results in the following actions:
 - a. Valid Exit Ticket: Exit ticket reader captures ticket and automatically sends signal to raise barrier gate.
 - b. Invalid Exit Ticket: Exit ticket reader rejects ticket and displays "Pay Cashier First" message.
 - c. Exit Ticket with Elapsed Grace Time: Exit ticket reader rejects ticket and displays "Return to Cashier" message.
- 4. Cabinets: Fabricated from metal sheet with seams welded and ground smooth; approximately **15 inches square by 40 inches tall (381 mm square by 1016 mm tall)**. Provide single, gasketed access door for each cabinet with flush-mounted locks. Furnish two keys for each lock, all locks keyed alike, **as directed**. Fabricate cabinet with internal reinforcing and four mounting holes accessible only from inside cabinet.
 - a. Material: Not less than **0.097-inch- (2.5-mm-)** thick, galvanized-, **as directed**, steel sheet or **0.125-inch- (3.2-mm-)** thick aluminum sheet.
 - 1) Finish cabinet, interior and exterior, with manufacturer's standard white **OR** yellow, **as directed**, baked-enamel finish over primer.
 - b. Material: Not less than **0.109-inch- (2.8-mm-)** thick, stainless-steel sheet.
 - 1) Finish cabinet exterior with No. 4 finish.
 - OR**
 - Finish cabinet, interior and exterior, with manufacturer's standard white **OR** yellow, **as directed**, baked-enamel finish over primer.

G. Pay Stations

- 1. General: Provide self-contained cashiering central **OR** entry **OR** exit, **as directed**, pay stations designed for self-service operation; consisting of magnetic-stripe ticket dispensers and, **as**

directed, readers/validators, LCD, **as directed**, displays, fee computers, controllers, **as directed**, and thermal printers housed in a combined enclosure.

- a. Features: Include the following:
 - 1) Operation: Standalone **OR** Online communication to remote computer, **as directed**.
 - 2) Battery backup for clock and RAM memory.
 - 3) Thermostatically controlled heater with on/off/auto switch.
 - 4) Access card acceptance.
 - 5) Intercom.
2. System Performance: Capable of the following:
 - a. Compute multiple parking fees based on entry times on ticket from ticket dispenser.
 - b. Compute multiple taxes by percent and fixed amount.
 - c. Program lost ticket function.
 - d. Display fee.
 - e. Accept payment by cash credit card **OR** debit card **OR** merchant ticket, **as directed**.
 - f. Compute change.
 - g. Print receipts on demand.
 - h. Print validation on ticket.
 - i. Voice annunciation.
 - j. Print audit trail.
 - k. Program six, **as directed**, fee structures.
 - l. Program time.
 - m. Program merchant validations.
 - n. Test mode to verify accuracy of fee structure program.
 - o. Built-in service diagnostics.
 - p. Print cash audit, revenue, operational, and statistical reports on demand.
 - q. Duress alarm output for emergencies.
 - r. Battery backup.
3. Cabinets: Fabricated from cold-rolled steel sheet with seams welded and ground smooth, approximately **36 inches wide by 18 inches deep by 60 inches tall (914 mm wide by 457 mm deep by 1524 mm tall)**. Provide single, gasketed access door with flush-mounted locks. Furnish two keys for each lock, all locks keyed alike, **as directed**. Fabricate cabinet with internal reinforcing and four mounting holes accessible only from inside cabinet.
 - a. Finish cabinet, interior and exterior, with manufacturer's standard white **OR** yellow, **as directed**, baked-enamel finish over primer.

H. Fee Computers

1. Fee Computer System: Provide modular PC-based, **as directed**, system consisting of fee computer terminal, cash drawer, **OR** two cash drawers, **as directed**, standard ticket reader, **OR** magnetic-stripe ticket reader, **OR** barcode ticket reader, **as directed**, and detachable printer. Register permanent record of each transaction in computer's memory.
 - a. Features: Provide the following:
 - 1) Battery backup for clock and RAM memory.
 - 2) RS-422 communication port.
 - 3) Keyed **OR** Keyless-membrane, **as directed**, keypad.
2. System Performance: Capable of the following:
 - a. Compute multiple parking fees based on entry times on ticket from ticket dispenser.
 - b. Compute multiple taxes by percent and fixed amount.
 - c. Program lost ticket function.
 - d. Display fee on remote fee display device.
 - e. Accept payment by cash check **OR** credit card **OR** debit card **OR** merchant ticket, **as directed**.
 - f. Control independent cash drawer.
 - g. Compute change.
 - h. Print receipts.
 - i. Print validation on ticket.
 - j. Print audit trail.

- k. Interface to automatic barrier gate.
- l. Program six, **as directed**, fee structures.
- m. Program time.
- n. Program keys.
- o. Program special events validations.
- p. Program automatic activation for limited date(s) and time(s) validations.
- q. Program merchant validations.
- r. Program valet parking.
- s. Program hotel guest parking.
- t. Three levels of security, including cashier, supervisor, and master.
- u. Recall last transaction.
- v. Test mode to verify accuracy of fee structure program.
- w. Built-in service diagnostics.
- x. View cash audit, revenue, operational, and statistical reports on screen or print on demand.
- y. Duress alarm output for emergencies.
- z. Battery backup.
- 3. Cash Drawer: Fabricated with a removable tray and drawer, with five compartments for paper currency and five compartments for coins.
- 4. Remote Fee Display: Single-faced signs designed for use with fee computer, consisting of **1-inch- (25-mm-)** tall, LCD or LED displays contained in welded steel bodies with baked-enamel finish.
 - a. Messages: Amount due, "Thank You," "Closed," and time in A.M./P.M. format.
 - b. Mounting: Front of cashier's booth **OR 42-inch- (1067-mm-)** high pedestal, **as directed**.
- I. Miscellaneous Parking Control Equipment
 - 1. Lot "Full" Signs: Single-faced signs consisting of illumination source contained in welded steel bodies with extended hood and baked-enamel finish. Sign copy shall be **4 inches (102 mm)**, **as directed**, tall.
 - a. Type: Flashing **OR** Nonflashing, **as directed**.
 - b. Operation: Manual by push button **OR** Automatic by barrier gate controller, **as directed**.
 - c. Illumination: Traffic signal lamps and colored **OR** Neon tube and clear, **as directed**, fiberglass sign face.
 - d. Mounting: Top of barrier gate cabinet **OR 42-inch- (1067-mm-)** high pedestal, **as directed**.
- J. Parking Facility Management Software
 - 1. General: Manufacturer's standard software that is compatible with security access control system and that provides automatic facility monitoring, supervision, and remote control of parking control equipment from one or more locations.
 - a. System Performance: Capable of the following:
 - 1) Collect data for revenue and activity reporting.
 - 2) Collect data for access and space control.
 - 3) Track tickets.
 - 4) Program parking control equipment.
- K. Access Control Units
 - 1. General: Provide access control unit that activates barrier gates.
 - a. Unit Housing: Fabricate from welded cold-rolled steel or aluminum sheet **OR** plastic, **as directed**, with weatherproof front access panel equipped with flush-mounted lock and two keys. Provide face-lighted unit fully visible at night.
 - 1) Steel Finish: Manufacturer's standard baked-enamel coating system.
 - 2. Card Reader Controlled Unit: Functions only when authorized card is presented.
 - a. System: Magnetically coded, single-code system activated by coded card **OR** Programmable, multiple-code capability permitting validating or voiding of individual cards, **as directed**.
 - 1) Permit four different access time periods.

- b. Reader: Swipe type for magnetic-stripe **OR** barcode **OR** Wiegand, **as directed**, cards.
OR
Reader: Insertion type for magnetic-stripe **OR** barcode **OR** Wiegand, **as directed**, cards.
OR
Reader: Proximity type for proximity cards.
 - c. Operation: Standalone **OR** Online communication to remote parking control system computer **OR** Online communication to remote security access control system computer, **as directed**.
 - d. Features: Timed antipassback **OR** Limited-time usage **OR** Capable of monitoring and auditing barrier gate activity **OR** LCD display **OR** Programmable by PDA (personal digital assistant) by infrared interface, **as directed**.
 - e. Mounting: With pedestal **OR** Wall **OR** In enclosed cabinet **OR** As indicated on Drawings, **as directed**.
 - f. Cards: Provide number as directed by the Owner..
 - 1) Imprint cards: as directed by the Owner.
 - 3. Digital Keypad Controlled Unit: Functions only when authorized code is entered on keyed **OR** keyless-membrane, **as directed**, keypad.
 - a. System: Multiple-code capability of not less than five **OR** 100 **OR** 500, **as directed**, possible individual codes.
OR
System: Programmable, multiple-code capability permitting validating or voiding of not less than 100 **OR** 2500 **OR** 10,000, **as directed**, possible individual codes, consisting of one to six, **as directed**, digits, and permitting four different access time periods, **as directed**.
 - b. Operation: Standalone **OR** Online communication to remote parking control system computer **OR** Online communication to remote security access control system computer, **as directed**.
 - c. Features: Timed antipassback **OR** Limited-time usage **OR** Capable of monitoring and auditing barrier gate activity, **as directed**.
 - d. Mounting: With pedestal **OR** Wall **OR** As indicated on Drawings, **as directed**.
 - 4. Radio-Controlled System: Digital access control system consisting of code-compatible universal coaxial receiver, one per barrier gate, **OR**, where indicated on Drawings, **as directed**, remote antenna with coaxial cable and mounting brackets, and one permanently mounted **OR** four portable, **as directed**, transmitter(s) per receiver designed to operate barrier gates. Provide programmable transmitter with multiple-code capability permitting validating or voiding of not less than 1000 **OR** 10,000, **as directed**, codes per channel configured for the following functions:
 - a. Transmitters: Single-button operated, with open **OR** open and close, **as directed**, functions.
OR
Transmitters: Triple-button operated, with open, close, and stop functions.
 - 1) Provide transmitters featuring two **OR** three **OR** four, **as directed**, independent channel settings controlling separate receivers for operating more than one barrier gate from each transmitter.
 - L. Aluminum Finishes
 - 1. Baked-Enamel or Powder-Coat Finish: AAMA 2603 except with a minimum dry film thickness of 1.5 mils (0.04 mm). Comply with coating manufacturer's written instructions for cleaning, conversion coating, and applying and baking finish.
 - a. Color and Gloss: As indicated by manufacturer's designations **OR** Match sample **OR** As selected from manufacturer's full range, **as directed**.
 - M. Steel Finishes
 - 1. Galvanizing: Hot-dip galvanize items as indicated to comply with the following:
 - a. ASTM A 123/A 123M for iron and steel parking control equipment.
 - b. ASTM A 153/A 153M and ASTM F 2329 for iron and steel hardware for parking control equipment.



2. Galvanized-Steel and Steel Finish: Immediately after cleaning and pretreating, apply manufacturer's standard two-coat, baked-on finish consisting of prime coat and thermosetting topcoat.
 - a. Color and Gloss: As indicated by manufacturer's designations **OR** Match sample **OR** As selected from manufacturer's full range, **as directed**.

N. Stainless-Steel Finishes

1. Surface Preparation: Remove tool and die marks and stretch lines, or blend into finish.
2. Polished Finishes: Grind and polish surfaces to produce uniform finish, free of cross scratches.
 - a. Run grain of directional finishes with long dimension of each piece.
 - b. When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.

1.3 EXECUTION

A. Preparation

1. Excavation for Traffic Controllers: Saw cut existing pavement for recessed traffic controllers and hand-excavate recesses to dimensions and depths and at locations as required by traffic controller manufacturer's written instructions and as indicated on Drawings.

B. Installation

1. General: Install parking control equipment as required for a complete and integrated installation.
 - a. Rough-in electrical connections according to requirements specified in Division 22..
2. Automatic Barrier Gates: Anchor cabinets to concrete bases with anchor bolts or expansion anchors and mount barrier gate arms.
 - a. Install barrier gates according to UL 325.
3. Vehicle Loop Detectors: Cut grooves in pavement and bury **OR** Bury, **as directed**, and seal wire loop at locations indicated on Drawings according to manufacturer's written instructions. Connect to parking control equipment operated by detector.
4. Traffic Controllers: Anchor controllers to recessed concrete bases **OR** driveway surfaces, **as directed**, with anchor bolts or expansion anchors.
5. Entry Terminal Ticket Dispensers, Pay Stations and Exit Terminals: Attach cabinets to concrete bases with anchor bolts or expansion anchors.
 - a. Connect equipment to remote computer.
 - b. Load ticket dispenser with supply of tickets.
6. Fee Computers: Install computers at locations indicated, including connecting to peripheral equipment and remote computers, **as directed**.
7. Connect wiring according to Division 26 Section "Low-voltage Electrical Power Conductors And Cables".
8. Ground equipment according to Division 26 Section "Grounding And Bonding For Electrical Systems".

C. Field Quality Control

1. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
2. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.
3. Perform tests and inspections.
 - a. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.
4. Tests and Inspections:
 - a. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.

- b. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
 - c. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
 - 5. Parking control equipment will be considered defective if it does not pass tests and inspections.
 - 6. Prepare test and inspection reports.
- D. Adjusting
 - 1. Adjust parking control equipment to function smoothly and lubricate as recommended by manufacturer.
 - 2. Confirm that locks engage accurately and securely without forcing or binding.
 - 3. After completing installation of exposed, factory-finished parking control equipment, inspect exposed finishes and repair damaged finishes.
- E. Protection
 - 1. Remove barrier gate arms during the construction period to prevent damage, and install them immediately before Final Completion.

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SECTION 11 12 16 00a - PREFABRICATED CONTROL BOOTHS

1.1 GENERAL

A. Description Of Work

1. This specification covers the furnishing and installation of materials for prefabricated control booths. Products shall be as follows or as directed by the Owner. Installation procedures shall be in accordance with the product manufacturer's recommendations. Demolition and removal of materials shall be as required to support the work.

B. Summary

1. Section includes prefabricated steel and aluminum control booths.

C. Definition

1. ADA-ABA Accessibility Guidelines: U.S. Architectural & Transportation Barriers Compliance Board's "Americans with Disabilities Act (ADA) Accessibility Guidelines for Buildings and Facilities; Architectural Barriers Act (ABA) Accessibility Guidelines."

D. Performance Requirements

1. Structural Performance: Control booths shall withstand the effects of gravity loads and the loads and stresses within limits and under conditions indicated according to ASCE/SEI 7.

E. Submittals

1. Product Data: For each type of product indicated.
2. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
3. Samples: For control booths with factory-applied color finishes.
4. Delegated-Design Submittal: For control booths indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
5. Welding certificates.
6. Maintenance data.
7. Warranty: Sample of special warranty.

F. Quality Assurance

1. Welding Qualifications: Qualify procedures and personnel according to the following:
 - a. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
 - b. AWS D1.2/D1.2M, "Structural Welding Code - Aluminum."
 - c. AWS D1.3, "Structural Welding Code - Sheet Steel."
2. Regulatory Requirements: Comply with applicable provisions in the U.S. Architectural & Transportation Barriers Compliance Board's ADA-ABA Accessibility Guidelines and ICC/ANSI A117.1.
3. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
4. Safety Glazing Products: Category II materials complying with testing requirements in 16 CFR 1201.
5. Preinstallation Conference: Conduct conference at Project site.

G. Warranty

1. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair finish or replace wall panels that fail in materials or workmanship within five years from date of Final Completion.

1.2 PRODUCTS

A. Materials

1. Aluminum: Alloy and temper recommended by aluminum producer and manufacturer for type of use and finish indicated, and as follows:
 - a. Sheet: **ASTM B 209** (**ASTM B 209M**).
 - b. Extruded Shapes: **ASTM B 221** (**ASTM B 221M**).
 - c. Rolled Tread Plate: ASTM B 632/B 632M, Alloy 6061-T4 or Alloy 6061-T6.
2. Zinc-Coated (Galvanized) Steel Sheet: ASTM A 653/A 653M, commercial quality, **G90** (**Z275**) coating designation; mill phosphatized.
3. Galvanized, Rolled Steel Tread Plate: ASTM A 786/A 786M, rolled from steel plate complying with ASTM A 572/A 572M, Grade **55** (**380**); hot-dip galvanized according to ASTM A 123/A 123M.
4. Steel Structural Tubing: ASTM A 500, Grade B.
5. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.
6. Steel Mechanical Tubing: ASTM A 513, welded steel mechanical tubing.
7. Zinc-Coated (Galvanized) Steel: Hot-dip galvanized according to ASTM A 123/A 123M.
8. Stainless-Steel Sheet: ASTM A 666, Type 304.
9. Plastic Laminate: NEMA LD 3, HGS or HGL grade.
10. Plywood: DOC PS 1, Exterior grade.
11. Particleboard: ANSI A208.1, Grade M-2.
12. Clear Float Glass: ASTM C 1036, Type I, Class 1, Quality q3.
13. Clear Tempered Float Glass: ASTM C 1048, Kind FT, Condition A, Type I, Class 1, and Quality q3.
14. Insulating Glass: Units complying with ASTM E 774 for Class CBA and consisting of two lites of 2.5-mm-thick clear float glass and dehydrated air space, with a total overall unit thickness of **7/16 inch** (**11 mm**) and with manufacturer's standard dual seal.
15. Ballistics-Resistant Glazing: Comply with requirements specified in Division 08 Section "Security Glazing".
16. Anchorages: Anchor bolts; hot-dip galvanized according to ASTM A 153/A 153M or ASTM F 2329 **OR** stainless steel, **as directed**.

B. Prefabricated Control Booths, General

1. General: Provide a complete, integrated set of mutually dependent components that form a completely assembled, prefabricated control booth, ready for installation on Project site.
 - a. Building Style: Standard square corners **OR** Radius corners **OR** Round corners **OR** Butt-glazed corners **OR** Wraparound type, with single rounded building end **OR** Wraparound type, with both building ends rounded **OR** As indicated on Drawings, **as directed**.
 - b. Doors: Sliding door on one side **OR** Sliding doors on both sides **OR** Swinging door on back **OR** As indicated on Drawings, **as directed**.
2. Windows: Extruded-aluminum sash frames glazed with 6-mm-thick, clear tempered glass **OR** clear insulating glass **OR** ballistics-resistant glazing, UL 752 Level **as directed**.
 - a. Frame Finish: Mill **OR** Clear anodic, **as directed**.
 - b. Provide insect screens for each operable window.
 - c. Provide galvanized-steel security screens for each window.
 - d. Corner Shape: Square **OR** Round, **as directed**.
3. Horizontal Sliding Windows: Extruded-aluminum sash frames glazed with 3-mm-thick, clear tempered float glass. Equip windows with cam locks, weather stripping, and stainless-steel **OR** nylon, **as directed**, ball-bearing rollers.
 - a. Frame Finish: Mill **OR** Clear anodic, **as directed**.
 - b. Provide insect screens for each operable window.
 - c. Corner Shape: Square **OR** Round, **as directed**.
4. Work Counters: Full width of control booth, reinforced; with **16-inch-** (**406-mm-**) wide storage **OR** cash, **as directed**, drawer below each counter, and an access opening for electrical cords at each rear corner of counter.

- a. Material: **0.078-inch- (1.98-mm-)** thick, stainless-steel sheet **OR** **0.079-inch (2.01-mm)** nominal-thickness, galvanized-steel sheet **OR** **1/2-inch- (13-mm-)** thick particleboard with plastic-laminate finish, **as directed**.
 - b. Depth: **22 inches (559 mm)** **OR** **20 inches (508 mm)** **OR** **18 inches (457 mm)**, **as directed**.
 5. Electrical Power Service: 125-A, 120/240-V ac, single-phase, three-wire load center, with no fewer than four open circuits **OR** service with 8-16 circuit-breaker panel, **as directed**; located under one end of work counter. Run copper wiring in **1/2-inch (13-mm)** EMT conduit.
 - a. Provide one 120-V ground-fault circuit interrupter (GFCI) power receptacle(s).
 6. Lighting Fixtures: One **OR** Two, **as directed**, ceiling-mounted fluorescent lighting fixture(s), **48 inches (1219 mm)** long, with acrylic lens and two 40-W lamps in each fixture. Provide single-pole switch mounted adjacent to door to control lighting fixture.
 7. Heating Unit: Wall-mounted **OR** Roof-mounted, **as directed**, thermostatically controlled, 110-V, 1500-W electric heater with fan-forced operation and with capacity of not less than **5000 Btu/h (1465 W)**. Enclose in enameled-steel cabinet and mount under work counter.
 8. Cooling Unit: Wall-mounted **OR** Roof-mounted, **as directed**, thermostatically controlled air conditioner with cooling capacity of not less than **13,500 Btu/h (3956 W)**. Enclose in enameled-steel cabinet.
 9. Accessories: Provide the following for each control booth:
 - a. Through-wall transaction drawers and speaking apertures complying with requirements specified in Division 08 Section "Security Windows".
 - b. Antifatigue mats.
 - c. Exterior stainless-steel counter.
 - d. Floor-mounted **OR** Wall-mounted, **as directed**, safe.
 - e. Signage: **<Insert requirements>**.
 - f. Ventilation fan.
 - g. Intercom.
 - h. Traffic control lights.
- C. Prefabricated Steel Control Booths
1. Structural Framework: Fabricated from **2-by-2-by-0.075-inch (50-by-50-by-1.90-mm)** steel structural or mechanical tubing. Connect framework by welding.
 2. Base/Floor Assembly: **4-inch- (102-mm-)** **OR** **3-inch- (76-mm-)**, **as directed**, high assembly consisting of perimeter frame welded to structural framework of booth. Fabricate frame from **2-by-4-inch (51-by-102-mm)** galvanized-steel structural tubing; **0.108-inch (2.74-mm)** nominal-thickness, C-shaped, galvanized-steel sheet channels; or galvanized structural-steel angles. Include anchor clips fabricated from **1/4-inch- (6-mm-)** thick galvanized-steel plate, predrilled and welded to exterior of integral floor frame.
 - a. Finished Floor: **0.108-inch (2.74-mm)** nominal-thickness, galvanized, rolled steel tread plate.
 - b. Subfloor and Finished Floor: Assembly consisting of **0.079-inch (2.01-mm)** nominal-thickness, galvanized-steel sheet underside with rigid insulation core; covered by **0.125-inch- (3.18-mm-)** thick, aluminum rolled tread plate; with overall assembly thickness of **2 inches (51 mm)**.

OR

Subfloor and Finished Floor: Assembly consisting of one **OR** two, **as directed**, layer(s) of **3/4-inch- (19-mm-)** thick plywood or oriented strand board with **0.125-inch- (3.18-mm-)** thick, aluminum rolled tread plate **OR** vinyl composition flooring **OR** carpeting, **as directed**.

OR

Base/Floor Assembly: No perimeter frame, with finished floor fabricated from **0.108-inch (2.74-mm)** nominal-thickness, galvanized, rolled steel tread plate.

OR

Base/Floor Assembly: No perimeter frame, with surface of supporting concrete base as finished floor.
 3. Wall Panel Assembly: Assembly consisting of exterior face panel fabricated from **0.079-inch (2.01-mm)** nominal-thickness, galvanized-steel sheet; and interior face panel fabricated from **0.064-inch (1.63-mm)** **OR** **0.052-inch (1.32-mm)**, **as directed**, nominal-thickness, galvanized-

steel sheet; with **2-inch- (51-mm-)** OR **3-inch- (76-mm-)**, **as directed**, thick, rigid fiberglass or polystyrene board insulation in cavity between exterior and interior face panels.

- a. Thermal Resistance Value (R-Value): R-7.
4. Flat Roof/Ceiling Assembly: Consisting of exterior roof panels, interior ceiling panels, and insulation between exterior and interior panels; sloped to drain at booth perimeter.
 - a. Exterior Roof Panel: Fabricated from **0.079-inch (2.01-mm)** OR **0.064-inch (1.63-mm)**, **as directed**, nominal-thickness, galvanized-steel sheet; with painted finish OR EPDM membrane, **as directed**, continuously welded seams, and full-perimeter gutter.
 - b. Interior Ceiling Panel: Fabricated from **0.079-inch (2.01-mm)** nominal-thickness, galvanized-steel sheet; with fiberglass insulation in cavity between ceiling and roof.
 - 1) Thermal Resistance Value (R-Value): R-17.
 - c. Insulated Exterior/Interior Panel: Fabricated from **0.028-inch (0.71-mm)** nominal-thickness, galvanized-steel OR **0.032-inch- (0.81-mm-)** thick, aluminum, **as directed**, sheet faces and expanded-foam insulation core.
 - 1) Thermal Resistance Value (R-Value): R-17.
 - d. Canopy Fascia: Fabricated from **0.079-inch (2.01-mm)** nominal-thickness, galvanized-steel sheet, of manufacturer's standard design OR custom design indicated on Drawings, **as directed**.
 - 1) Height: **6 inches (152 mm)** OR **8 inches (203 mm)**, **as directed**.
 - 2) Overhang: **3 inches (76 mm)** beyond OR Flush with, **as directed**, face of walls below.
 - e. Downspouts: Integral, extending **3 inches (76 mm)** beyond booth walls.
 - f. Roof scuppers.
 - g. Rooftop finial.
5. Sliding Door: Top suspended from aluminum track with ball-bearing rollers; **1-3/4 inches (44 mm)** thick; tubular-frame design fabricated from clear-anodized aluminum OR galvanized steel, **as directed**; with top half of door glazed. Equip door with deadlock, lock support, guide hardware, and full weather stripping.
 - a. Glazing: Fixed OR Horizontal sliding, **as directed**, unit with 6-mm-thick, clear tempered float glass.
 - b. Deadlock: Mortised, laminated-hook bolt type with removable cylinder capable of being master keyed.
6. Swinging Door: **1-3/4 inches (44 mm)** thick; tubular-frame design fabricated from clear-anodized aluminum OR galvanized steel, **as directed**; with top half of door glazed. Equip door with deadlock, three butt hinges, closer, and full weather stripping.
 - a. Glazing: Fixed OR Horizontal sliding, **as directed**, unit with 6-mm-thick, clear tempered float glass.
 - b. Deadlock: Mortised, with lever handle and removable cylinder capable of being master keyed.
7. Finish: Finish exposed metal surfaces, including structural framework, walls, canopy, and ceiling with rust-inhibitive primer and one finish coat of industrial air-dry acrylic OR polyurethane, **as directed**, enamel.
 - a. Color: As selected from manufacturer's full range.

D. Prefabricated Aluminum Control Booths

1. Structural Framework: Fabricated from **2-by-2-by-0.125-inch (51-by-51-by-3.18-mm)** aluminum tubing, channel, angle, or tee extrusions; with clear OR color, **as directed**, anodic finish. Connect framework with exposed, **as directed**, mechanical fasteners.
2. Base/Floor Assembly: **4-inch- (102-mm-)** high assembly consisting of perimeter frame welded to structural framework of booth. Fabricate frame from **2-by-4-by-0.125-inch (51-by-102-by-3.18-mm)** aluminum tubing or aluminum angles. Include anchor clips fabricated from **1/4-inch- (6-mm-)** thick aluminum, predrilled and welded to exterior of integral floor frame.
 - a. Subfloor and Finished Floor: Assembly consisting of **0.032-inch- (0.81-mm-)** thick, aluminum sheet underside, plywood and rigid insulation core; covered by **0.125-inch-**

(3.18-mm-) thick, aluminum rolled tread plate; with overall assembly thickness of **2 inches** (51 mm).

OR

Subfloor and Finished Floor: Assembly consisting of one **OR** two, **as directed**, layer(s) of **3/4-inch-** (19-mm-) thick plywood or oriented strand board with **0.125-inch-** (3.18-mm-) thick, aluminum rolled tread plate **OR** vinyl composition flooring **OR** carpeting, **as directed**.

OR

Base/Floor Assembly: No perimeter frame, with surface of supporting concrete base as finished floor.

3. Wall Panel Assembly: Assembly consisting of exterior face panel fabricated from **0.032-inch-** (0.81-mm-) **OR** **0.063-inch-** (1.60-mm-), **as directed**, thick aluminum sheet, and interior face panel fabricated from **0.032-inch-** (0.81-mm-) **OR** **0.050-inch-** (1.27-mm-), **as directed**, thick aluminum sheet; with **2-inch-** (51-mm-) thick, polystyrene or polyisocyanurate board insulation in cavity between exterior and interior face panels.
 - a. Thermal Resistance Value (R-Value): R-7.
4. Flat Roof/Ceiling Assembly: Consisting of exterior roof panels, interior ceiling panels, and insulation between exterior and interior panels; sloped to drain at booth perimeter.
 - a. Exterior Roof Panel: Fabricated from **0.032-inch-** (0.81-mm-) thick aluminum sheet with protective plastic sheet finish and full-perimeter gutter.
 - b. Interior Ceiling Panel: Fabricated from **0.125-inch-** (3.18-mm-) thick hardboard; with polyisocyanurate board insulation in cavity between ceiling and roof.
 - 1) Thermal Resistance Value (R-Value): R-19.
 - c. Insulated Exterior/Interior Panel: Fabricated from **0.032-inch-** (0.81-mm-) thick, aluminum **OR** **0.021-inch-** (0.53-mm) nominal-thickness, galvanized-steel, **as directed**, sheet faces and expanded-foam insulation core.
 - 1) Thermal Resistance Value (R-Value): R-19.
 - d. Canopy Fascia: Fabricated from **0.063-inch-** (1.60-mm-) thick aluminum sheet, of manufacturer's standard design **OR** custom design indicated on Drawings, **as directed**.
 - 1) Height: **6 inches** (152 mm) **OR** **8 inches** (203 mm), **as directed**.
 - 2) Overhang: **3 inches** (76 mm) beyond **OR** Flush with, **as directed**, face of walls below.
 - e. Downspouts: Integral, extending **3 inches** (76 mm) beyond booth walls.
 - f. Roof scuppers.
 - g. Rooftop finial.
5. Sliding Door: Top suspended from aluminum track with ball-bearing rollers; **1-3/4 inches** (44 mm) thick; tubular-frame design fabricated from aluminum matching exterior and interior wall panels; with top half of door glazed and with extruded-aluminum door frame. Equip door with deadlock, lock support, guide hardware, and full weather stripping.
 - a. Glazing: Fixed **OR** Horizontal sliding, **as directed**, unit with 6-mm-thick, clear tempered float glass.
 - b. Deadlock: Mortised, laminated-hook bolt type with removable cylinder capable of being master keyed.
6. Swinging Door: **1-3/4 inches** (44 mm) thick; tubular-frame design fabricated from aluminum matching exterior and interior wall panels; with top half of door glazed and with extruded-aluminum door frame. Equip door with deadlock, three butt hinges, closer, and full weather stripping.
 - a. Glazing: Fixed **OR** Horizontal sliding, **as directed**, unit with 6-mm-thick, clear tempered float glass.
 - b. Deadlock: Mortised, with lever handle and removable cylinder capable of being master keyed.
7. Finish: Finish exposed metal surfaces, including structural framework, walls, canopy, and ceiling with clear anodizing **OR** color anodizing **OR** baked enamel or powder coat, **as directed**.
 - a. Color: As selected from manufacturer's full range.

E. Fabrication

1. Fabricate control booths completely in factory.

2. Preglaze windows and doors at factory.
3. Prewire control booths at factory, ready for connection to service at Project site.
4. Fabricate control booths with forklift pockets in base of booth **OR** removable lifting eye centered in roof, **as directed**.
5. Accessible Control Booths: Where indicated to be accessible, fabricate control booths as follows:
 - a. Provide service windows located no higher than **34 inches (865 mm)** above exterior grade.
 - b. Provide door opening with minimum **32-inch (813-mm)** clear width.
 - c. Provide minimum **60-inch (1525-mm)** clear turning spacing within the booth.
 - d. Provide minimum **27-inch (685-mm)** clearance beneath interior work surfaces. Locate work surfaces **28 inches (710 mm)** minimum and **34 inches (865 mm)** maximum above the floor.
 - e. Locate controls and operable parts no lower than **15 inches (381 mm)** and no higher than **48 inches (1219 mm)** above the floor where reach is unobstructed. Where side reach is obstructed, locate controls and operable parts no lower than **15 inches (381 mm)** and no higher than **46 inches (1219 mm)** above the floor.

F. General Finish Requirements

1. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
2. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

G. Finishes

1. Steel and Galvanized-Steel Factory Finish: Immediately after cleaning and pretreating, apply manufacturer's standard two-coat, baked-on finish consisting of prime coat and thermosetting topcoat.
 - a. Color and Gloss: As selected from manufacturer's full range.

H. Aluminum Finishes

1. Clear Anodic Finish: AAMA 611, AA-M12C22A41, Class I, 0.018 mm **OR** AA-M12C22A31, Class II, 0.010 mm, **as directed**, or thicker.
2. Color Anodic Finish: AAMA 611, AA-M12C22A42/A44, Class I, 0.018 mm **OR** AA-M12C22A32/A34, Class II, 0.010 mm, **as directed**, or thicker.
 - a. Color: Light bronze **OR** Medium bronze **OR** Dark bronze **OR** Black **OR** As selected from full range of industry colors and color densities, **as directed**.
3. Baked-Enamel or Powder-Coat Finish: AAMA 2603 except with a minimum dry film thickness of **1.5 mils (0.04 mm)**. Comply with coating manufacturer's written instructions for cleaning, conversion coating, and applying and baking finish.
 - a. Color and Gloss: As selected from manufacturer's full range.

1.3 EXECUTION

A. Installation

1. Install control booths according to manufacturer's written instructions.
2. Accessible Control Booths: Install with interior floor surface at same elevation as adjacent paved surfaces.
3. Set control booths plumb and aligned. Level baseplates true to plane with full bearing on concrete bases.
4. Fasten control booths securely to cast-in anchor bolts **OR** concrete bases with expansion anchors, **as directed**.
5. Connect electrical power service to power distribution system according to requirements specified in Division 22.

- B. Adjusting
1. Adjust doors, operable windows, and hardware to operate smoothly, easily, properly, and without binding. Confirm that locks engage accurately and securely without forcing or binding.
 2. Lubricate hardware and other moving parts.
 3. After completing installation, inspect exposed finishes and repair damaged finishes.

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Task	Specification	Specification Description
11 12 23 00	11 12 16 00	Parking Control Equipment
11 12 23 00	11 12 16 00a	Prefabricated Control Booths
11 12 26 13	11 12 16 00	Parking Control Equipment
11 12 26 13	11 12 16 00a	Prefabricated Control Booths

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SECTION 11 13 13 00 - LOADING DOCK EQUIPMENT

1.1 GENERAL

A. Description Of Work

1. This specification covers the furnishing and installation of materials for loading dock equipment. Products shall be as follows or as directed by the Owner. Installation procedures shall be in accordance with the product manufacturer's recommendations. Demolition and removal of materials shall be as required to support the work.

B. Summary

1. Section Includes:
 - a. Dock levelers.
 - b. Truck levelers.
 - c. Truck restraints.
 - d. Light-communication systems.
 - e. Dock bumpers.
 - f. Dock lifts (scissors lifts).
 - g. Dock seals.
 - h. Dock shelters.
 - i. Transparent-strip door curtains.

C. Definitions

1. Operating Range: Maximum amount of travel above and below the loading dock level.
2. Working Range: Recommended amount of travel above and below the loading dock level for which loading and unloading operations can take place.

D. Submittals

1. Product Data: For each type of product indicated.
2. Shop Drawings: For loading dock equipment. Include plans, elevations, sections, details, and attachments to other work.
 - a. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
 - b. Wiring Diagrams: For power, signal, and control wiring.
3. Samples: For each type of dock-seal and -shelter fabric indicated.
4. Qualification Data: For qualified Installer.
5. Welding certificates.
6. Product Test Reports.
7. Operation and Maintenance Data.
8. Warranty: Sample of special warranty.

E. Quality Assurance

1. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for installation of units required for this Project.
2. Welding Qualifications: Qualify procedures and personnel according to the following:
 - a. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
 - b. AWS D1.3, "Structural Welding Code - Sheet Steel."
3. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
4. Preinstallation Conference: Conduct conference at Project site.

F. Delivery, Storage, And Handling

1. Store and handle dock seals and shelters in a manner to avoid significant or permanent damage to fabric or frame.

- a. Comply with manufacturer's written instructions for minimum and maximum temperature requirements for storage.

G. Project Conditions

- 1. Field Measurements: Verify actual dimensions of construction contiguous with loading dock equipment, including recessed pit dimensions, slopes of driveways, and heights of loading docks, by field measurements before fabrication.

H. Warranty

- 1. Special Warranty for Dock Levelers: Manufacturer's standard form in which manufacturer agrees to repair or replace dock-leveler components that fail in materials or workmanship within specified warranty period.
 - a. Failures include, but are not limited to, the following:
 - 1) Structural failures including cracked or broken structural support members, load-bearing welds, and front and rear hinges.
 - 2) Faulty operation of operators, control system, or hardware.
 - 3) Deck plate failures including cracked plate or permanent deformation in excess of **1/4 inch (6 mm)** between deck supports.
 - 4) Hydraulic system failures including failure of hydraulic seals and cylinders.
 - b. Warranty Period for Structural Assembly: 10 years from date of Final Completion.
 - c. Warranty Period for Hydraulic System: Five years from date of Final Completion.
 - d. Warranty shall be for unlimited usage of leveler for the specified rated capacity over the term of the warranty.

1.2 PRODUCTS

A. Materials

- 1. Steel Plates, Shapes, and Bars: ASTM 36/A 36M.
- 2. Rolled-Steel Floor Plate: ASTM A 786/A 786M, rolled from steel plate complying with ASTM A 572/A 572M, Grade **55 (380)**.
- 3. Steel Tubing: ASTM A 500, cold formed.
- 4. Welding Rods and Bare Electrodes: Select according to AWS specifications for metal alloy welded.
- 5. Wood: DOC PS 20 dimension lumber, select structural grade, kiln dried.
- 6. Pressure-Treated Wood: DOC PS 20 dimension lumber, select structural grade, kiln dried, and pressure treated with waterborne preservatives to comply with AWPA C2.

B. Recessed Dock Levelers

- 1. General: Recessed, hinged-lip-type dock levelers designed for permanent installation in concrete pits preformed in the edge of loading platform; of type, function, operation, capacity, size, and construction indicated; and complete with controls, safety devices, and accessories required.
- 2. Standard: Comply with MH 30.1, except for structural testing to establish rated capacity, **as directed**.
- 3. Rated Capacity: Capable of supporting total gross load without permanent deflection or distortion.
- 4. Platform: Not less than **3/16-inch- (5-mm-) OR 1/4-inch- (6-mm-) OR 3/8-inch- (9.5-mm-), as directed**, thick, nonskid steel plate.
 - a. Platform Size: As indicated on Drawings, **as directed**.
 - b. Frame: Manufacturer's standard **OR** Clean-pit type, designed to support leveler at sides of pit, with no side-to-side supports at front of pit floor, **as directed**.
 - c. Toe Guards: Equip open sides of dock leveler over range indicated with metal toe guards.
 - 1) Toe-Guard Range: Entire upper operating **OR** working, **as directed**, range.
- 5. Hinged Lip: Not less than **1/2-inch- (13-mm-) OR 5/8-inch- (16-mm-) OR 3/4-inch- (19-mm-) OR 1-inch- (25-mm-), as directed**, thick, nonskid steel plate.

- a. Hinge: Full width, piano-type hinge with heavy-wall hinge tube and greased fittings, **as directed**, with gussets on lip and ramp for support.
 - b. Safety Barrier Lip: Designed to protect material-handling equipment from an accidental fall from loading platform edge of the dock leveler when the leveler is not in use.
6. Function: Dock levelers shall compensate for differences in height between truck bed and loading platform.
 - a. Vertical Travel: Operating range above platform level of sufficient height to enable lip to extend and clear truck bed before contact with the following minimum working range:
 - 1) Above Adjoining Platform: **12 inches (305 mm) OR 18 inches (457 mm) OR** As indicated on Drawings, **as directed**.
 - 2) Below Adjoining Platform: **12 inches (305 mm) OR 14 inches (356 mm) OR** As indicated on Drawings, **as directed**.
 - b. Automatic Vertical Compensation: Floating travel of ramp with lip extended and resting on truck bed shall compensate automatically for upward or downward movement of truck bed during loading and unloading.
 - c. Automatic Lateral Compensation: Tilting of ramp with lip extended and resting on truck bed shall compensate automatically for canted truck beds of up to **4 inches (102 mm)** over width of ramp.
 - d. Lip Operation: Manufacturer's standard mechanism that automatically extends and supports hinged lip on ramp edge with lip resting on truck bed over dock leveler's working range, allows lip to yield under impact of incoming truck, and automatically retracts lip when truck departs.
 - 1) Length of Lip Extension: **16 inches (406 mm) OR 18 inches (457 mm) OR 20 inches (508 mm) OR** As indicated on Drawings, **as directed**.
 - e. Automatic Ramp Return: Automatic return of unloaded ramp, from raised or lowered positions to stored position, level with platform, as truck departs.
 - f. Interlock: Leveler will not operate while overhead door is in closed position **OR** leveler night lock is engaged **OR** truck restraint is not engaged **OR** inflatable dock seal is not inflated **OR** inflatable dock shelter is not inflated, **as directed**.
7. Mechanical Operating System: Manual control; counterbalance and spring operation. Spring-operated raising and walk-down lowering of unloaded ramp. Equip leveler with an upward-biased-spring counterbalancing mechanism controlled by a hold-down device. Ramp raises to top limit of operating range by operating recessed control handle in ramp to disengage hold-down device. Ramp lowers below platform level with lip retracted by operating auxiliary, recessed control handle to release support legs.
 - a. Free-Fall Protection: Manufacturer's standard protection system to limit free fall of loaded ramps with front edge supported by truck bed.
8. Hydraulic Operating System: Electric control from a remote-control station; fully hydraulic operation. Electric-powered hydraulic raising and hydraulic lowering of ramp. Equip leveler with a packaged unit including a unitized, totally enclosed, nonventilated electric motor, pump, manifold reservoir, and valve assembly of proper size, type, and operation for capacity of leveler indicated. Include means for lowering ramp below platform level with lip retracted behind dock bumpers. Provide a hydraulic velocity fuse connected to main hydraulic cylinder to limit loaded ramp's free fall to not more than **3 inches (76 mm)**.
 - a. Remote-Control Station: Weatherproof single **OR** Single, **as directed**, -button station of the constant-pressure type, enclosed in NEMA ICS 6, Type 4 **OR** Type 12, **as directed**, box. Ramp raises by depressing and holding button; ramp lowers at a controlled rate by releasing button.
 - b. Remote-Control Station with Emergency Stop: Weatherproof multibutton **OR** Multibutton, **as directed**, control station with an UP button of the constant-pressure type and an emergency STOP button of the momentary-contact type, enclosed in NEMA ICS 6, Type 4 **OR** Type 12, **as directed**, box. Ramp raises by depressing and holding UP button; ramp lowers at a controlled rate by releasing UP button. All ramp movement stops, regardless of position of ramp or lip, by depressing STOP button. Normal operation resumes by engaging a manual reset button or by pulling out STOP button.



- 1) Dual-Panel Control Station: Remote-control station for operating side-by-side dock levelers.
- 2) Master Panel: Control panel with integral fused disconnecting means for operating dock leveler, dock door, and truck restraints.
- c. Independent Lip Operation: Electric-powered hydraulic raising and hydraulic lowering of lip, controlled independent of raising and lowering of ramp.
9. Electric Operating System: Electric control from a remote-control station; motorized operation. Electric activation for raising of ramp and automatic extending of lip. Equip leveler with a packaged unit including a unitized electric motor and shaft assembly of proper size, type, and operation for capacity of leveler indicated. Include means for lowering ramp below platform level with lip retracted behind dock bumpers.
 - a. Remote-Control Station: Weatherproof single **OR** Single, **as directed**, -button station of the constant-pressure type, enclosed in NEMA ICS 6, Type 4 **OR** Type 12, **as directed**, box. Ramp raises by depressing and holding button; ramp lowers at a controlled rate by releasing button.
 - b. Remote-Control Station with Emergency Stop: Weatherproof multibutton **OR** Multibutton, **as directed**, control station with an UP button of the constant-pressure type and an emergency STOP button of the momentary-contact type, enclosed in NEMA ICS 6, Type 4 **OR** Type 12, **as directed**, box. Ramp raises by depressing and holding UP button; ramp lowers at a controlled rate by releasing UP button. All ramp movement stops, regardless of position of ramp or lip, by depressing STOP button. Normal operation resumes by engaging a manual reset button or by pulling out STOP button.
10. Air-Bag Operating System: Electric control from a remote-control station; pneumatic operation. High-volume, low-pressure lifting of ramp. Equip leveler with a packaged unit including a PVC-coated, reinforced polyester lifting bag and two-stage, single-speed electric fan of proper size, type, and operation for capacity of leveler indicated. Include dock-leveler supports controlled by release chain for lowering ramp below platform level without extending lip.
 - a. Remote-Control Station: Weatherproof single **OR** Single, **as directed**, -button station of the constant-pressure type, enclosed in NEMA ICS 6, Type 4, **as directed**, box. Ramp raises by depressing and holding button; ramp lowers at a controlled rate by releasing button.
11. Construction: Fabricate dock-leveler frame, platform supports, and lip supports from structural- or formed-steel shapes. Weld platform and hinged lip to supports. Fabricate entire assembly to withstand deformation during both operating and stored phases of service. Chamfer lip edge to minimize obstructing wheels of material-handling vehicles.
 - a. Cross-Traffic Support: Manufacturer's standard method of supporting ramp at platform level in stored position with lip retracted. Provide a means to release supports to allow ramp to descend below platform level.
 - b. Maintenance Strut: Integral strut to positively support ramp in up position during maintenance of dock leveler.
12. Integral Molded-Rubber Dock Bumpers: Fabricated from **4-inch- (102-mm-) OR 6-inch- (152-mm-), as directed**, thick, heavy molded-rubber compound reinforced with nylon, rayon, or polyester cord; with Type A Shore durometer hardness of 80, plus or minus 5, when tested according to ASTM D 2240. Provide two dock bumpers for each recessed dock leveler, attached to face of loading dock with expansion bolts.
13. Integral Laminated-Tread Dock Bumper: Fabricated from **4-1/2-inch- (114-mm-) OR 6-inch- (152-mm-), as directed**, thick, multiple, uniformly thick plies cut from fabric-reinforced rubber tires. Laminate plies under pressure on not less than two **3/4-inch- (19-mm-)** diameter, steel supporting rods that are welded at one end to **1/4-inch- (6-mm-)** thick, structural-steel end angle and secured with a nut and angle at the other end. Fabricate angles with predrilled anchor holes and sized to provide not less than **1 inch (25 mm)** of tread plies extending beyond the face of closure angles.
14. Accessories:
 - a. Curb Angles: **3-by-3-by-1/4-inch (76-by-76-by-6-mm)** galvanized-steel curb angles for edge of recessed leveler pit, with **1/2-inch- (13-mm-)** diameter by **6-inch- (152-mm-)** long concrete anchors welded to angle at **6 inches (152 mm)** o.c.

- b. Self-Forming Pan: Manufacturer's standard prefabricated, self-forming steel form system for poured-in-place construction of concrete pit.
- c. Night Locks: Manufacturer's standard means to prevent extending lip and lowering ramp when overhead doors are locked.
- d. Side and rear weatherseals.
- e. Foam insulation under dock-leveler platform.
- f. Abrasive skid-resistant **OR** Smooth, **as directed**, surface.
15. Finish: Paint **OR** Hot-dip galvanize, **as directed**, dock levelers after assembly and testing, **as directed**.
 - a. Toe Guards: Paint yellow **OR** orange, **as directed**, to comply with ANSI Z535.1.
- C. Edge-Of-Dock Levelers
 1. General: Surface-mounted, hinged-lip-type, edge-of-dock levelers designed for permanent installation on face of loading dock platform; of type, function, operation, capacity, size, and construction indicated; and complete with controls, safety devices, and accessories required.
 2. Standard: Comply with MH 30.1, except for structural testing to establish rated capacity, **as directed**.
 3. Rated Capacity: Capable of supporting total gross load without permanent deflection or distortion.
 4. Platform Ramp Width: 66 inches (1676 mm) **OR** 72 inches (1829 mm) **OR** 78 inches (1981 mm) **OR** 84 inches (2134 mm) **OR** As indicated on Drawings, **as directed**.
 5. Hinged Lip: Not less than 3/8-inch- (9.5-mm-) **OR** 7/16-inch- (11-mm-) **OR** 1/2-inch- (13-mm-), **as directed**, thick, nonskid steel tread plate.
 - a. Hinge: Full width, piano-type hinge with heavy-wall hinge tube and greased fittings, **as directed**, with gussets on lip and ramp for support.
 6. Function: Dock levelers shall compensate for differences in height between truck bed and loading platform.
 - a. Vertical Travel: Operating range above platform level of sufficient height to enable lip to extend and clear truck bed before contact with the following minimum working range:
 - 1) Above Adjoining Platform: 5 inches (127 mm) **OR** 6 inches (152 mm) **OR** As indicated on Drawings, **as directed**.
 - 2) Below Adjoining Platform: 5 inches (127 mm) **OR** As indicated on Drawings, **as directed**.
 - b. Automatic Vertical Compensation: Floating travel of ramp with lip extended and resting on truck bed shall compensate automatically for upward or downward movement of truck bed during loading and unloading.
 - c. Automatic Lateral Compensation: Tilting of ramp with lip extended and resting on truck bed shall compensate automatically for canted truck beds of up to 3 inches (76 mm) over width of ramp.
 - d. Lip Operation: Manufacturer's standard mechanism that automatically extends and supports hinged lip on ramp edge with lip resting on truck bed over dock leveler's working range, allows lip to yield under impact of incoming truck, and automatically retracts lip when truck departs.
 - 1) Length of Lip Extension: 15 inches (381 mm) **OR** 17 inches (432 mm) **OR** As indicated on Drawings, **as directed**.
 - e. Automatic Ramp Return: Automatic return of unloaded ramp, from raised or lowered positions to stored position, level with platform, as truck departs. Leveler shall be capable of retracting to stored position while truck is at loading dock.
 7. Mechanical Operating System: Manual control; counterbalance and spring operation. Spring-operated raising and walk-down lowering of unloaded ramp. Equip leveler with a torsion-spring counterbalancing mechanism controlled by a hold-down device.
 - a. Lever Handle: Self-storing lever handle for raising unloaded ramp with minimal lifting force by pulling lever back to extend lip and pushing lever forward to lower ramp and lip.
 - b. Removable Lifting Handle: For raising unloaded ramp by lifting action.
 8. Hydraulic Operating System: Electric control from a remote-control station; fully hydraulic operation. Electric-powered hydraulic raising and hydraulic lowering of ramp. Equip leveler with

a packaged unit including a unitized, totally enclosed, nonventilated electric motor, pump, manifold reservoir, and valve assembly of proper size, type, and operation for capacity of leveler indicated. Provide a hydraulic velocity fuse connected to main hydraulic cylinder to limit loaded ramp's free fall to not more than **3 inches (76 mm)**.

- a. Remote-Control Station: Weatherproof single **OR** Single, **as directed**, -button station of the constant-pressure type, enclosed in NEMA ICS 6, Type 12, **as directed**, box. Ramp and lip raise to vertical position and extend to truck bed by depressing and holding button.
9. Construction: Fabricate dock-leveler frame, platform supports, and lip supports from structural- and formed-steel shapes. Weld platform and hinged lip to supports. Fabricate entire assembly to withstand deformation during both operating and stored phases of service. Chamfer lip edge to minimize obstructing wheels of material-handling vehicles.
 - a. Cross-Traffic Support: Manufacturer's standard method of supporting ramp at platform level in stored position with lip retracted. Provide a means to release supports to allow ramp to descend below platform level.
 - b. Maintenance Strut: Integral strut to positively support ramp in up position during maintenance of dock leveler.
10. Integral Molded-Rubber Dock Bumpers: Fabricated from **4-inch- (102-mm-) OR 6-inch- (152-mm-), as directed**, thick, heavy molded-rubber compound reinforced with nylon, rayon, or polyester cord; with Type A Shore durometer hardness of 80, plus or minus 5, when tested according to ASTM D 2240. Provide two dock bumpers for each recessed dock leveler, attached to face of loading dock with expansion bolts.
11. Integral Laminated-Tread Dock Bumper: Fabricated from **4-1/2-inch- (114-mm-) OR 6-inch- (152-mm-), as directed**, thick, multiple, uniformly thick plies cut from fabric-reinforced rubber tires. Laminate plies under pressure on not less than two **3/4-inch- (19-mm-)** diameter, steel supporting rods that are welded at one end to **1/4-inch- (6-mm-)** thick, structural-steel end angle and secured with a nut and angle at the other end. Fabricate angles with predrilled anchor holes and sized to provide not less than **1 inch (25 mm)** of tread plies extending beyond the face of closure angles.
12. Accessories:
 - a. Self-forming pan.
 - b. Cast-in-place design.
 - c. Run-off guards.
 - d. Ramp approach plate.
13. Dock-Leveler Finish: Painted in manufacturer's standard color.

D. Top-Of-Dock Levelers

1. General: Surface-mounted, hinged-lip-type, top-of-dock levelers designed for permanent installation on top edge of loading dock platform without concrete pit; of type, function, operation, capacity, size, and construction indicated; and complete with controls, safety devices, and accessories required.
2. Standard: Comply with MH 30.1, except for structural testing to establish rated capacity, **as directed**.
3. Rated Capacity: Capable of supporting total gross load without permanent deflection or distortion.
4. Platform Width: **72 inches (1829 mm) OR** As indicated on Drawings, **as directed**.
5. Hinged Lip: Not less than **3/8-inch- (9.5-mm-) OR 7/16-inch- (11-mm-), as directed**, thick, nonskid steel plate.
 - a. Hinge: Full width, piano-type hinge with heavy-wall hinge tube and greased fittings, **as directed**, with gussets on lip and ramp for support.
6. Function: Dock levelers shall compensate for differences in height between truck bed and loading platform.
 - a. Vertical Travel: Operating range above platform level of sufficient height to enable lip to extend and clear truck bed before contact with a minimum working range of **10 inches (250 mm), as directed**, above and **4 inches (102 mm), as directed**, below adjoining platform level.

- b. Automatic Vertical Compensation: Floating travel of ramp with lip extended and resting on truck bed shall compensate automatically for upward or downward movement of truck bed during loading and unloading.
 - c. Lip Operation: Manufacturer's standard mechanism that automatically extends and supports hinged lip on ramp edge with lip resting on truck bed over dock leveler's working range, allows lip to yield under impact of incoming truck, and automatically retracts lip when truck departs.
 - 1) Length of Lip Extension: **15 inches (381 mm) OR** As indicated on Drawings, **as directed**.
 - d. Automatic Ramp Return: Automatic return of unloaded ramp, from raised or lowered positions to stored position, level with platform, as truck departs. Leveler shall be capable of retracting to stored position while truck is at loading dock.
 7. Mechanical Operating System: Manual control; counterbalance and spring operation. Spring-operated raising and walk-down lowering of unloaded ramp. Equip leveler with a torsion-spring counterbalancing mechanism controlled by a hold-down device.
 - a. Removable Lifting Hook: For raising unloaded ramp by lifting action and pushing forward to lower ramp and lip.
 8. Hydraulic Operating System: Electric control from a remote-control station, fully hydraulic operation. Electric-powered hydraulic raising and hydraulic lowering of ramp. Equip leveler with a packaged unit including a unitized, totally enclosed, nonventilated electric motor, pump, manifold reservoir, and valve assembly of proper size, type, and operation for capacity of leveler indicated.
 - a. Remote-Control Station: Weatherproof single **OR** Single, **as directed**, -button station of the constant-pressure type, enclosed in NEMA ICS 6, Type 12, **as directed**, box. Ramp and lip raise to vertical position and extend to truck bed by depressing and holding button.
 9. Construction: Fabricate dock-leveler frame, platform supports, and lip supports from structural- or formed-steel shapes. Weld platform and hinged lip to supports. Fabricate entire assembly to withstand deformation during both operating and stored phases of service. Chamfer lip edge to minimize obstructing wheels of material-handling vehicles.
 10. Integral Molded-Rubber Dock Bumpers: Fabricated from **4-inch- (102-mm-) OR 6-inch- (152-mm-)**, **as directed**, thick, heavy molded-rubber compound reinforced with nylon, rayon, or polyester cord; with Type A Shore durometer hardness of 80, plus or minus 5, when tested according to ASTM D 2240. Provide two dock bumpers for each recessed dock leveler, attached to face of loading dock with expansion bolts.
 11. Integral Laminated-Tread Dock Bumper: Fabricated from **4-1/2-inch- (114-mm-) OR 6-inch- (152-mm-)**, **as directed**, thick, multiple, uniformly thick plies cut from fabric-reinforced rubber tires. Laminate plies under pressure on not less than two **3/4-inch- (19-mm-)** diameter, steel supporting rods that are welded at one end to **1/4-inch- (6-mm-)** thick, structural-steel end angle and secured with a nut and angle at the other end. Fabricate angles with predrilled anchor holes and sized to provide not less than **1 inch (25 mm)** of tread plies extending beyond the face of closure angles.
 12. Dock-Leveler Finish: Painted in manufacturer's standard color.
- E. Vertical-Storing Dock Levelers
1. General: Recessed, hinged-lip-type, vertical-storing dock levelers designed for permanent installation in shallow concrete pits preformed in the edge of loading platform; of type, function, operation, capacity, size, and construction indicated; and complete with controls, safety devices, and accessories required.
 2. Standard: Comply with MH 30.1, except for structural testing to establish rated capacity, **as directed**.
 3. Rated Capacity: Capable of supporting total gross load without permanent deflection or distortion.
 4. Platform: Not less than **3/16-inch- (5-mm-) OR 1/4-inch- (6-mm-)**, **as directed**, thick, nonskid steel plate.
 - a. Platform Size: As indicated on Drawings, **as directed**.
 5. Hinged Lip: Not less than **1/2-inch- (13-mm-) OR 5/8-inch- (16-mm-)**, **as directed**, thick, nonskid steel plate.

- a. Hinge: Full width, piano-type hinge with heavy-wall hinge tube and greased fittings, **as directed**, with gussets on lip and ramp for support.
6. Function: Dock levelers shall compensate for differences in height between truck bed and loading platform.
 - a. Vertical Travel: Operating range above platform level of sufficient height to enable lip to extend and clear truck bed before contact with the following minimum working range:
 - 1) Above Adjoining Platform: **6 inches (152 mm) OR 10 inches (250 mm) OR 12 inches (305 mm) OR As indicated on Drawings, as directed.**
 - 2) Below Adjoining Platform: **6 inches (152 mm) OR As indicated on Drawings, as directed.**
 - b. Automatic Vertical Compensation: Floating travel of ramp with lip extended and resting on truck bed shall compensate automatically for upward or downward movement of truck bed during loading and unloading.
 - c. Automatic Lateral Compensation: Tilting of ramp with lip extended and resting on truck bed shall compensate automatically for canted truck beds of up to **4 inches (102 mm)** over width of ramp.
 - d. Lip Operation: Manufacturer's standard mechanism that automatically extends and supports hinged lip on ramp edge with lip resting on truck bed over dock leveler's working range, allows lip to yield under impact of incoming truck, and automatically retracts lip when truck departs.
 - 1) Length of Lip Extension: **16 inches (406 mm) OR 18 inches (457 mm) OR 20 inches (508 mm) OR As indicated on Drawings, as directed.**
7. Hydraulic Operating System: Electric control from a remote-control station; fully hydraulic operation. Electric-powered hydraulic raising and hydraulic lowering of ramp. Equip leveler with a packaged unit including a unitized, totally enclosed, nonventilated electric motor, pump, manifold reservoir, and valve assembly of proper size, type, and operation for capacity of leveler indicated. Provide a hydraulic velocity fuse connected to main hydraulic cylinder to limit loaded ramp's free fall to not more than **3 inches (76 mm)**. Provide mechanical lock that prevents leveler from lowering without hydraulic pressure.
 - a. Remote-Control Station: Weatherproof single **OR Single, as directed**, button station of the constant-pressure type, enclosed in NEMA ICS 6, Type 12, **as directed**, box. Ramp lowers at a controlled rate.
 - b. Remote-Control Station with Emergency Stop: Weatherproof multibutton **OR Multibutton, as directed**, control station with an UP button of the constant-pressure type and an emergency STOP button of the momentary-contact type, enclosed in NEMA ICS 6, Type 12, **as directed**, box. Ramp raises by depressing and holding UP button; ramp lowers at a controlled rate by releasing UP button. All ramp movement stops, regardless of position of ramp or lip, by depressing STOP button. Normal operation resumes by engaging a manual reset button or by pulling out STOP button.
 - 1) Master Panel: Control panel with integral fused disconnecting means for operating dock leveler, dock door, and truck restraints.
 - c. Independent Lip Operation: Electric-powered hydraulic raising and lowering of lip, controlled independent of raising and lowering of ramp.
8. Construction: Fabricate dock-leveler frame, platform supports, run-off guards, **as directed**, and lip supports from structural- or formed-steel shapes. Weld platform and hinged lip to supports. Fabricate entire assembly to withstand deformation during both operating and stored phases of service. Chamfer lip edge to minimize obstructing wheels of material-handling vehicles.
9. Integral Molded-Rubber Dock Bumpers: Fabricated from **4-inch- (102-mm-) OR 6-inch- (152-mm-), as directed**, thick, heavy molded-rubber compound reinforced with nylon, rayon, or polyester cord; with Type A Shore durometer hardness of 80, plus or minus 5, when tested according to ASTM D 2240. Provide two dock bumpers for each recessed dock leveler, attached to face of loading dock with expansion bolts.
10. Integral Laminated-Tread Dock Bumper: Fabricated from **4-1/2-inch- (114-mm-) OR 6-inch- (152-mm-), as directed**, thick, multiple, uniformly thick plies cut from fabric-reinforced rubber tires. Laminate plies under pressure on not less than two **3/4-inch- (19-mm-)** diameter, steel supporting

rods that are welded at one end to **1/4-inch- (6-mm-)** thick, structural-steel end angle and secured with a nut and angle at the other end. Fabricate angles with predrilled anchor holes and sized to provide not less than **1 inch (25 mm)** of tread plies extending beyond the face of closure angles.

11. Accessories:
 - a. Interlock: Leveler will not operate while overhead door is in closed position **OR** truck restraint is not engaged, **as directed**.
 - b. Curb Angles: **3-by-3-by-1/4-inch (76-by-76-by-6-mm)** galvanized-steel curb angles for edge of recessed leveler pit, with **1/2-inch- (13-mm-)** diameter by **6-inch- (152-mm-)** long concrete anchors welded to angle at **6 inches (152 mm)** o.c.
12. Finish: Paint **OR** Hot-dip galvanize, **as directed**, dock levelers after assembly and testing, **as directed**.

F. Truck Levelers

1. General: Two-cylinder, hydraulic ramp designed to raise and lower end of truck at loading dock. Equip leveler with a packaged unit including a unitized electric motor, pump, manifold reservoir, and valve assembly of proper size, type, and operation for capacity indicated. Provide manufacturer's standard means for limiting loaded ramp's free fall.
2. Rated Capacity: Capable of supporting total gross load without permanent deflection or distortion.
3. Travel Speed: Leveler raises and lowers at **3 fpm (0.015 m/s)**, measured at traveling end.
4. Surface-Mounted Units: Designed for mounting on surface of concrete driveway.
5. Shallow-Pit-Mounted Units: Designed for mounting in sloping shallow pit; capable of **18 inches (457 mm)** of vertical travel above and below level of driveway.
6. Full-Pit-Mounted Units: Designed for installation in a fully recessed pit, with top of platform in stored position flush with driveway.
 - a. Provide removable plate for access to pit for service.
7. Hydraulic Operating System: Electric control from a remote-control station; fully hydraulic operation. Self-contained, electric-powered hydraulic raising and hydraulic lowering of lift.
 - a. Remote-Control Station: Weatherproof, multibutton control station of the constant-pressure type with UP and DOWN push buttons. Controller shall consist of magnetic motor starter with three-pole adjustable overloads and 24-V control transformer with 4-A, fused secondary prewired to terminal strips and enclosed in NEMA ICS 6, Type 12, **as directed**, box.
 - 1) Upper-Travel-Limit Switch: Equip unit with manufacturer's standard, adjustable, upper-travel-limit switch.
8. Construction: Fabricate truck leveler from structural- and formed-steel shapes; fabricate platform from nonskid steel plate. Construct platform with notch at loading-dock end to provide clearance for truck restraint.
 - a. Cylinders: Equip truck leveler with not less than two heavy-duty, high-pressure, hydraulic, ram-type cylinders. Rams shall be manufacturer's standard, either direct-displacement plunger or rod-and-piston type with positive internal stops. Cylinder rods shall be chrome plated and polished.
9. Truck-Leveler Finish: Manufacturer's standard finish.

G. Truck Restraints

1. General: Manufacturer's standard device designed to engage truck's rear-impact guard and hold truck at loading dock. Restraint shall consist of an iron or steel restraining arm that raises until contacting rear-impact guard. Arm shall move vertically, automatically adjusting to varying height of truck due to loading and unloading operations.
2. Standard: Comply with MH 30.3.
3. Rated Capacity: Capable of supporting total gross load of **<Insert capacity>** without permanent deflection or distortion.
4. Operating Range: Capable of restraining rear-impact guards within a range from:
 - a. Vertical: **12 inches (305 mm) OR 30 inches (762 mm) OR** As indicated on Drawings, **as directed**, above driveway.

- b. Horizontal: **12 inches (305 mm)** **OR** As indicated on Drawings, **as directed**, in front of dock bumpers.
- 5. Power Operating System: Manufacturer's standard electromechanical or hydraulic unit.
 - a. Remote-Control Station: Single-button station of the constant-pressure type, enclosed in NEMA ICS 6, Type 12, **as directed**, box. Restraint is engaged by depressing and holding button; restraint is released by releasing button.
 - b. Interlock: Leveler will not operate while truck restraint is not engaged.
- 6. Mechanical Operating System: Restraint operates by use of a lifting rod or hook to raise engagement device.
- 7. Rear-Impact-Guard Sensor: Detects presence of rear-impact guard and automatically returns to stored position if rear-impact guard is not engaged, **as directed**.
- 8. Caution Signs: Exterior, surface mounted; designed to inform both dock attendant and truck driver; with sign copy as follows. Provide one sign at each truck-restraint location.
 - a. Sign Copy in Forward and Reverse Text: Manufacturer's standard text permitting truck movement with green light, **as directed**.
 - b. Interior Sign Copy: Manufacturer's standard text permitting truck movement with green light, **as directed**.
- 9. Light-Communication System: Red and green illuminated signal-light sets, with lens approximately **4 inches (102 mm)** in diameter, designed to indicate status to both dock attendant and truck driver. Equip system with steel control panel located at interior of dock that includes illuminated lights indicating **OR** indicates, **as directed**, status of exterior signal lights. Provide signal-light set and control panel at each location indicated for light-communication system. Enclose exterior signal-light sets in steel or plastic housing with sunshade.
 - a. Manual Operation: System is activated by push button or switch located on interior **OR** truck-restraint, **as directed**, control panel.
 - b. Automatic Operation: System is activated automatically by limit switch **OR** photoelectric sensor **OR** magnetic switch, **as directed**, mounted on overhead door track. Provide on-off switch located on light-communication system **OR** truck-restraint, **as directed**, control panel.
 - c. Automatic Operation: System is activated automatically when device engages rear-impact guard. Provide on-off switch located on truck-restraint control panel.
 - d. Mounting: Wall **OR** Driveway **OR** Pit, **as directed**.
- 10. Alarm: Audible **OR** Visual **OR** Audible and visual, **as directed**, system indicating that rear-impact guard is not engaged, with manual reset.
- 11. Accessories: Interlock to dock leveler **OR** Key switch, **as directed**.
- 12. Truck-Restraint Finish: Painted **OR** Hot-dip galvanized, **as directed**.

H. Light-Communication Systems

- 1. General: Provide communication system consisting of signal-light sets, caution signs, alarms, and controls for each location indicated.
- 2. Caution Signs: Surface mounted; designed to inform both dock attendant and truck driver; with sign copy as follows:
 - a. Exterior Sign Copy in Forward and Reverse Text: Manufacturer's standard text permitting truck movement with green light, **as directed**.
 - b. Interior Sign Copy: Manufacturer's standard text permitting truck movement with green light, **as directed**.
- 3. Signal-Light Sets: Red and green illuminated signal-light sets, with lens approximately **4 inches (102 mm)** in diameter, designed to indicate status to both dock attendant and truck driver. Equip system with steel control panel that includes illuminated lights indicating **OR** indicates, **as directed**, status of exterior signal lights; located at interior of dock. Provide signal-light set and control panel at each location indicated for light-communication system. Enclose signal lights in steel or plastic housing, with exterior signal-light sets equipped with sunshade.
 - a. Manual Operation: Lights are activated by push button or switch located on interior signal-light enclosure **OR** control panel, **as directed**.

- b. Automatic Operation: Lights are activated automatically by limit switch **OR** photoelectric sensor **OR** magnetic switch, **as directed**, mounted on overhead door track. Provide on-off switch located on control panel.
- I. Dock Bumpers
1. Laminated-Tread Dock Bumper: Fabricated from multiple, uniformly thick plies cut from fabric-reinforced rubber tires. Laminate plies under pressure on not less than two **3/4-inch- (19-mm-)** diameter, steel supporting rods that are welded at one end to **1/4-inch- (6-mm-)** thick, structural-steel end angle and secured with a nut and angle at the other end. Fabricate angles with predrilled anchor holes and sized to provide not less than **1 inch (25 mm)** of tread plies extending beyond the face of closure angles.
 - a. Thickness: **4-1/2 inches (114 mm) OR 6 inches (152 mm) OR** As indicated on Drawings, **as directed**.
 - b. Horizontal Style: **6 inches (152 mm) OR 10 inches (250 mm) OR 12 inches (305 mm), as directed**, high by length indicated on Drawings, **as directed**.
 - c. Vertical Style: **8 inches (203 mm)** wide by **20 inches (508 mm)** high **OR 24 inches (610 mm)** high **OR 36 inches (914 mm)** high **OR** height indicated on Drawings, **as directed**.
 2. Molded-Rubber Bumpers: Fabricated from molded-rubber compound reinforced with nylon, rayon, or polyester cord; with Type A Shore durometer hardness of 80, plus or minus 5, when tested according to ASTM D 2240; of size and configuration indicated. Fabricate units with not less than two predrilled anchor holes.
 - a. Configuration: T shape **OR** Inverted-L shape **OR** Square **OR** Rectangular **OR** As indicated on Drawings, **as directed**.
 - b. Thickness: **2 inches (50 mm) OR 3 inches (76 mm) OR 4 inches (102 mm) OR 6 inches (152 mm) OR** As indicated on Drawings, **as directed**.
 3. Extruded-Rubber Bumpers: Fabricated from ASTM D 2000, extruded synthetic rubber with Type A Shore durometer hardness of 75, plus or minus 5, when tested according to ASTM D 2240; of size and configuration indicated. Furnish units with predrilled anchor holes and concealed, flat, steel mounting bar.
 - a. Configuration: Flat or ribbed, with **2-inch (50-mm)** nominal thickness and **9-inch (229-mm)** height **OR 4-1/2-inch- (114-mm-)** wide base and **4-inch (102-mm)** depth with half-oval shape that compresses and returns to original shape **OR** As indicated on Drawings, **as directed**.
 4. Steel-Face, Laminated-Tread Bumpers: Fabricated from multiple, uniformly thick plies cut from fabric-reinforced rubber tires and with **3/8-inch (9.5-mm)** steel face plate of same size as rubber surface. Laminate plies under pressure on not less than two **3/4-inch- (19-mm-)** diameter, steel supporting rods that are welded at one end to **1/4-inch- (6-mm-)** thick, structural-steel end angle and secured with a nut and angle at the other end. Fabricate angles with predrilled anchor holes and sized to provide not less than **1 inch (25 mm)** of tread plies extending beyond the face of closure angles. Weld face plate to two steel support brackets, which shall extend back to and engage **3/4-inch- (19-mm-)** diameter support rods in elongated holes, allowing steel face to float on impact.
 - a. Thickness: **4-1/2 inches (114 mm) OR 6 inches (152 mm) OR** As indicated on Drawings, **as directed**.
 - b. Horizontal Style: **6 inches (152 mm) OR 10 inches (250 mm) OR 12 inches (305 mm), as directed**, high by length indicated, **as directed**.
 - c. Vertical Style: **8 inches (203 mm)** wide by **20 inches (508 mm)** high **OR 24 inches (610 mm)** high **OR 36 inches (914 mm)** high **OR** height indicated, **as directed**.
 5. Anchorage Devices: Hot-dip galvanized-steel anchor bolts, nuts, washers, bolts, sleeves, cast-in-place plates, and other anchorage devices as required to fasten bumpers securely in place and to suit installation type indicated.
- J. Dock Lifts
1. General: Built-in, scissors-type, single-leg, hydraulic dock lift of capacity, size, and construction indicated; complete with controls, safety devices, and accessories required.
 2. Standard: MH 29.1.



3. Rated Capacity: Lifting capacity of not less than **8000 lb (3629 kg)** with **6500-lb (2948-kg)** **OR** indicated on Drawings, **as directed**, axle load at ends and **5000-lb (2268-kg)** **OR** indicated on Drawings, **as directed**, axle load at sides.
4. Platform: Nonskid, safety-tread **OR** Smooth-surface, **as directed**, heavy steel deck plate.
 - a. Platform Size: As indicated on Drawings, **as directed**.
 - b. Platform Guarding: Bevel toe guards **OR** Toe sensor **OR** Indicator bar **OR** Skirts **OR** Enclosure, **as directed**, to comply with requirements in MH 29.1.
 - c. Removable **OR** Fixed, **as directed**, Handrails: Equip lift with handrails on two sides of platform with a single, removable chain across each end. Provide handrails not less than **39 inches (991 mm)** high with midrail and **4-inch- (102-mm-)** high kick plate at bottom. Mount rail sockets flush with platform surface, **as directed**.
5. Bridge: Nonskid, safety-tread steel **OR** High-tensile aluminum, **as directed**, plate.
 - a. Hinged Bridge: Hinged, throw-over bridge bolted to full-length, heavy-duty, piano-type hinge welded to toe guard at end of platform. Provide bridge complete with heavy-duty lifting chains. Chamfer edge of bridge to minimize obstructing wheels of material-handling vehicles.
 - b. Size: **18 inches (457 mm)** long by **60 inches (1524 mm)** wide **OR** **18 inches (457 mm)** long by **72 inches (1829 mm)** wide **OR** As indicated on Drawings, **as directed**.
 - c. Locations: Ends **OR** Sides **OR** As indicated on Drawings, **as directed**.
6. Function: Dock lifts shall compensate for differences in height between truck bed and loading platform.
 - a. Vertical Travel: Maximum of **60 inches (1524 mm)**, **as directed**, from a lowered height of **12 inches (305 mm)**, **as directed**, for a total raised height of **72 inches (1829 mm)**, **as directed**.
 - b. Travel Speed: Nominal raising speed of **8 fpm (0.04 m/s)** **OR** **10 fpm (0.05 m/s)** **OR** **12 fpm (0.06 m/s)**, **as directed**.
 - c. Vertical Travel and Travel Speed: As indicated on Drawings, **as directed**.
 - d. Hinged Throw-Over Bridges Operation: Manual **OR** Manual-assist bridge winch **OR** Automatic powered, **as directed**.
7. Hydraulic Operating System: Self-contained, electric, hydraulic power unit for raising and lowering lift; of size, type, and operation needed for capacity of lift indicated; controlled from a remotely located push-button station.
 - a. Power Unit: Consisting of continuous-duty motor, high-pressure gear pump, valve manifold, oil-line filters, and oil reservoir.
 - 1) Equip manifold with relief valve, check valve, pressure-compensated flow-control valve, and solenoid valve and with provisions for lowering lift manually if power fails.
 - 2) Equip reservoir, valve manifold, and pressure line with oil-line filters.
 - b. Cylinders: Equip lift with not less than two heavy-duty, high-pressure, hydraulic, ram-type cylinders. Rams shall be manufacturer's standard, either direct-displacement plunger or rod-and-piston type with positive internal stops. Cylinder rods shall be chrome plated and polished.
 - 1) Rate of Descent Protection: Pressure-compensated flow control or hydraulic velocity fuse to limit down speed for each cylinder.
 - c. Remote-Control Station: Multibutton control station of the constant-pressure type with UP and DOWN push buttons. Controller shall consist of magnetic motor starter with three-pole adjustable overloads and 24-V control transformer with 4-A, fused secondary prewired to terminal strips and enclosed in NEMA ICS 6, Type 12, **as directed**, box.
 - 1) Upper-Travel-Limit Switch: Equip unit with manufacturer's standard, adjustable, upper-travel-limit switch.
8. Construction: Fabricate lift from structural-steel shapes rigidly welded and reinforced for maximum strength, safety, and stability. Design assembly to withstand deformation during both operating and stored phases of service. Provide mounting brackets and removable lifting eyes for ease of installation.
 - a. Scissors Mechanism: Fabricate leg members from heavy, steel-formed tube or plate members to provide maximum strength and rigidity.

- b. Scissors Configuration: Single leg **OR** Multiple width **OR** Multiple length, **as directed**.
 - c. Bearings: Pivot points with permanently lubricated antifriction bushings or sealed ball-bearings for minimum maintenance.
 - d. Maintenance Leg: Removable, safety maintenance leg or hinged, safety maintenance bars.
 - e. Mounting: Surface **OR** Pit, **as directed**.
- 9. Dock Lift Finish: Painted **OR** Hot-dip galvanized, **as directed**.
 - a. Toe Guards: Paint yellow **OR** orange, **as directed**, to comply with ANSI Z535.1.
- K. Foam-Pad Dock Seals
 - 1. General: Dock seals consisting of fabric-covered foam pads designed to compress **4 to 5 inches (102 to 127 mm)** under pressure of truck body to form an airtight seal at jams and head of loading dock openings; of type, size, and construction indicated.
 - 2. Door Opening Size: As indicated on Drawings, **as directed**.
 - 3. Stationary Head Pad: **8 inches (203 mm) OR 12 inches (305 mm) OR 18 inches (457 mm) OR 24 inches (610 mm)**, **as directed**, high and same depth as jamb pads; beveled, **as directed**; sized for opening width.
 - 4. Adjustable Head Pad: **18 inches (457 mm) OR 24 inches (610 mm) OR 30 inches (762 mm)**, **as directed**, high and same depth as jamb pads; sized for opening width; with manufacturer's standard hardware and tension spring or counterweight mechanism for adjusting height of pad.
 - 5. Jamb Pads: Square **OR** Beveled; tapered to reduce opening width, **as directed**.
 - a. Nominal Size: **12 inches (305 mm) OR** As indicated on Drawings, **as directed**, wide and sized for opening height.
 - 6. Construction: Consisting of single- or double-ply, coated, fabric-covered, urethane-foam core with supporting frame. Fabricate jamb and head pads of same depth and sized for opening width.
 - a. Pressure-Treated, **as directed**, Wood Support Frame: Factory painted; with steel mounting hardware.
 - b. Steel Support Frame: Steel channel frame of manufacturer's standard weight, shape, and finish; with steel mounting hardware.
 - c. Tapered Side Panels: Taper side panels to angle required to accommodate sloped loading dock approach grades and make sealing edge of dock shelter parallel to back edge of truck. Taper for declined **OR** inclined, **as directed**, approach.
 - d. Cover Fabric: Vinyl-coated nylon or polyester with minimum total weight of **22 oz./sq. yd. (746 g/sq. m) OR 40 oz./sq. yd. (1356 g/sq. m)**, **as directed**.
 - 1) Color: Black **OR** Green **OR** Blue **OR** Brown **OR** Tan **OR** As indicated by manufacturer's designations **OR** Match sample **OR** As selected from manufacturer's full range, **as directed**.
 - e. Cover Fabric: Neoprene-coated nylon with minimum total weight of **16 oz./sq. yd. (543 g/sq. m) OR 40 oz./sq. yd. (1356 g/sq. m) OR 45 oz./sq. yd. (1526 g/sq. m)**, **as directed**.
 - 1) Color: Black **OR** Green **OR** Blue **OR** Brown **OR** Tan **OR** As indicated by manufacturer's designations **OR** Match sample **OR** As selected from manufacturer's full range, **as directed**.
 - f. Cover Fabric: Hypalon-coated nylon with minimum total weight of **16 oz./sq. yd. (543 g/sq. m) OR 40 oz./sq. yd. (1356 g/sq. m)**, **as directed**.
 - 1) Color: Black **OR** Green **OR** Blue **OR** Brown **OR** Tan **OR** As indicated by manufacturer's designations **OR** Match sample **OR** As selected from manufacturer's full range, **as directed**.
 - g. Cover Fabric: Manufacturer's proprietary cover fabric complying with the following minimum requirements:
 - 1) Tearing strength of not less than **300 by 300 lbf (1334 by 1334 N)** when tested according to ASTM D 2261.
 - 2) Abrasion resistance of not less than 6000 cycles when tested according to FED-STD-191A-5306.
 - 3) Tensile strength of not less than **1200 by 1200 lbf (5338 by 5338 N)** when tested according to FED-STD-191A-5100.1.

- 4) Cold resistance to **minus 40 deg F (minus 40 deg C)** when tested according to FED-STD-191A-5874.
- 5) Color: Black **OR** Green **OR** Blue **OR** Brown **OR** Tan **OR** As indicated by manufacturer's designations **OR** Match sample **OR** As selected from manufacturer's full range, **as directed**.
- h. Guide Strips: **4-inch- (102-mm-)** wide, coated, nylon guide strips on jamb pads.
- i. Pleated Protectors: On face of jamb pads of overlapping layers of coated fabric attached to base fabric; **4-inch (102-mm) OR 8-inch (203-mm) OR 16-inch (406-mm)**, **as directed**, wear exposure.

L. Inflatable Dock Seals

- 1. General: Inflatable dock seals consisting of one-piece jamb, sill, **as directed**, and header seals designed to inflate by motor/blower and compress against truck bodies to form airtight seals at loading dock openings; of type, size, and construction indicated.
- 2. Door Opening Size: As indicated on Drawings, **as directed**.
- 3. Head Members: One **OR** Two, **as directed**.
- 4. Jamb Members: One **OR** Two, **as directed**.
- 5. Construction: Fabricate header seal full width over jamb seals. Mount seals on pressure-treated wood frame with hot-dip galvanized-steel mounting hardware. Inflate seals by use of 1/2-hp motor/blower with on-off switch, mounted above header seal in galvanized-steel hood. Provide bottom of header and jamb seals with grommets to allow for release of moisture and excess air.
 - a. Fabric: Neoprene-coated nylon with minimum total weight of **14 oz./sq. yd. (475 g/sq. m)**.
 - 1) Color: Black **OR** Gray **OR** Blue **OR** Brown **OR** As indicated by manufacturer's designations **OR** Match sample **OR** As selected from manufacturer's full range, **as directed**.
 - b. Fabric: Manufacturer's proprietary fabric complying with the following minimum requirements:
 - 1) Tearing strength of not less than **110 by 85 lbf (489 by 378 N)** when tested according to ASTM D 2261.
 - 2) Abrasion resistance of not less than 490 cycles when tested according to FED-STD-191A-5306.
 - 3) Tensile strength of not less than **500 by 440 lbf (2224 by 1957 N)** when tested according to FED-STD-191A-5100.1.
 - 4) Cold resistance to **minus 40 deg F (minus 40 deg C)** when tested according to FED-STD-191A-5874.
 - 5) Color: Black **OR** Gray **OR** Blue **OR** Brown **OR** As indicated by manufacturer's designations **OR** Match sample **OR** As selected from manufacturer's full range, **as directed**.

M. Frame-Type Dock Shelters

- 1. General: Dock shelters designed to form a seal with sides and top of truck body while leaving entire width and height of truck's rear opening unobstructed; of type, size, and construction indicated.
- 2. Door Opening Size: As indicated on Drawings, **as directed**.
- 3. Rigid-Frame Type: Fabricated from translucent, fabric-covered **OR** fiberglass, **as directed**, side and top panels attached to fixed supporting framework. Provide head and side curtains with built-in flexible stays, wind straps between head curtain and side frame, pleated protectors on head curtain, and a yellow aim patch on side curtains. Slope head frame from center for drainage. Provide replaceable, fabric-covered, tapered, foam-bottom pads and protective steel bumpers of size and type required for application shown.
- 4. Flexible-Frame Type: Fabricated from fabric-covered side and top panels attached to retractable supporting framework with independent spring-tension extension arms. Provide head and side curtains with built-in flexible stays, pleated protectors on head curtain, and a yellow aim patch on side curtains. Provide replaceable, fabric-covered, tapered, foam-bottom pads of size and type required for application shown.

5. Head-Pad Height: **12 inches (305 mm) OR 18 inches (457 mm) OR 24 inches (610 mm) OR 30 inches (762 mm), as directed.**
6. Construction: Fabricate framework, pads, bumpers, fabric for curtains and panels, and other components to sizes and shapes indicated or required to fit door opening sizes shown and allow for not less than **18 inches (457 mm)** of truck-body penetration when truck is docked.
 - a. Wood Framework: Factory painted, mechanically fastened together using nails and lag bolts or metal connectors to form a rigid assembly.
 - b. Steel Framework: Zinc-plated steel tubing of size and thickness standard with manufacturer, with joints welded.
 - c. Top and Side Panels: White, translucent fiberglass, **0.045 inch (1.1 mm)** thick, weighing **6 oz./sq. ft. (1831 g/sq. m).**
 - d. Top and Side Panels: White, translucent vinyl, weighing **14 oz./sq. ft. (4272 g/sq. m).**
 - e. Tapered Side Panels: Taper side panels to angle required to accommodate sloped loading dock approach grades and make sealing edge of dock shelter parallel to back edge of truck. Taper for declined **OR** inclined, **as directed**, approach.
 - f. Cover Fabric: Vinyl-coated nylon with minimum total weight of **22 oz./sq. yd. (746 g/sq. m) OR 40 oz./sq. yd. (1356 g/sq. m), as directed.**
 - 1) Color: Black **OR** Green **OR** Blue **OR** Brown **OR** Tan **OR** As indicated by manufacturer's designations **OR** Match sample **OR** As selected from manufacturer's full range, **as directed.**
 - g. Cover Fabric: Polyurethane-coated nylon with minimum total weight of **25 oz./sq. yd. (848 g/sq. m).**
 - 1) Color: Black **OR** Green **OR** Blue **OR** Brown **OR** Tan **OR** As indicated by manufacturer's designations **OR** Match sample **OR** As selected from manufacturer's full range, **as directed.**
 - h. Cover Fabric: Neoprene-coated nylon with minimum total weight of **16 oz./sq. yd. (543 g/sq. m) OR 40 oz./sq. yd. (1356 g/sq. m) OR 45 oz./sq. yd. (1526 g/sq. m), as directed.**
 - 1) Color: Black **OR** Green **OR** Blue **OR** Brown **OR** Tan **OR** As indicated by manufacturer's designations **OR** Match sample **OR** As selected from manufacturer's full range, **as directed.**
 - i. Cover Fabric: Hypalon-coated nylon with minimum total weight of **16 oz./sq. yd. (543 g/sq. m) OR 40 oz./sq. yd. (1356 g/sq. m), as directed.**
 - 1) Color: Black **OR** Green **OR** Blue **OR** Brown **OR** Tan **OR** As indicated by manufacturer's designations **OR** Match sample **OR** As selected from manufacturer's full range, **as directed.**
 - j. Cover Fabric: Manufacturer's proprietary cover fabric complying with the following minimum requirements:
 - 1) Tearing strength of not less than **300 by 300 lbf (1334 by 1334 N)** when tested according to ASTM D 2261.
 - 2) Abrasion resistance of not less than 6000 cycles when tested according to FED-STD-191A-5306.
 - 3) Tensile strength of not less than **1200 by 1200 lbf (5338 by 5338 N)** when tested according to FED-STD-191A-5100.1.
 - 4) Cold resistance to **minus 40 deg F (minus 40 deg C)** when tested according to FED-STD-191A-5874.
 - 5) Color: Black **OR** Green **OR** Blue **OR** Brown **OR** Tan **OR** As indicated by manufacturer's designations **OR** Match sample **OR** As selected from manufacturer's full range, **as directed.**
 - k. Pleated Protectors: Overlapping layers of same fabric as cover.
7. Accessories:
 - a. Buffer flaps.
 - b. Bottom filler curtain.
 - c. Bottom seal pads.

N. Inflatable Dock Shelters

1. General: Inflatable dock shelters designed to inflate by motor/blower and compress against truck bodies to form airtight seals at loading dock openings; of type, size, and construction indicated.
2. Door Opening Size: As indicated on Drawings, **as directed**.
3. Rigid Canopy: Consisting of rigid canopy, fabric-covered header curtain, and one-piece inflatable header and jamb seals. Fabricate canopy from white, translucent plastic attached to rigid support framework.
4. Rigid Canopy and Sides: Consisting of rigid canopy and sides, fabric-covered header curtain, and one-piece, inflatable header and jamb seals. Fabricate canopy and sides from white, translucent plastic attached to rigid support framework.
5. Construction: Fabricate header seal full width over jamb seals. Mount seals on pressure-treated wood frame with hot-dip galvanized-steel mounting hardware. Provide header curtain with built-in flexible stays and two yellow aim patches. Slope canopy frame from center for drainage. Provide two protective steel bumpers of size and type required for application shown. Inflate seals by use of a 1/2-hp motor/blower with on-off switch, mounted under canopy frame. Provide bottom of header and jamb seals with grommets to allow for release of moisture and excess air.
 - a. Shape and Size: Fabricate framework, fabric for curtains, and other components to sizes and shapes indicated or required to fit door opening sizes shown and allow for not less than **12 inches (305 mm)** of truck-body penetration when truck is docked.
 - b. Wood Framework: Fasten members together mechanically using nails and lag bolts or metal connectors to form a rigid assembly.
 - c. Steel Framework: Zinc-plated steel tubing of size and thickness standard with manufacturer, with joints welded.
 - d. Fabric: Polyurethane **OR** Vinyl, **as directed**, -coated nylon with minimum total weight of **14 oz./sq. yd. (475 g/sq. m)**.
 - 1) Color: Black **OR** Green **OR** Blue **OR** Brown **OR** As indicated by manufacturer's designations **OR** Match sample **OR** As selected from manufacturer's full range, **as directed**.
 - e. Fabric: Manufacturer's proprietary fabric complying with the following minimum requirements:
 - 1) Tearing strength of not less than **110 by 85 lbf (489 by 378 N)** when tested according to ASTM D 2261.
 - 2) Abrasion resistance of not less than 490 cycles when tested according to FED-STD-191A-5306.
 - 3) Tensile strength of not less than **500 by 440 lbf (2224 by 1957 N)** when tested according to FED-STD-191A-5100.1.
 - 4) Cold resistance to **minus 40 deg F (minus 40 deg C)** when tested according to FED-STD-191A-5874.
 - 5) Color: Black **OR** Green **OR** Blue **OR** Brown **OR** As indicated by manufacturer's designations **OR** Match sample **OR** As selected from manufacturer's full range, **as directed**.

O. Transparent-Strip Door Curtains

1. General: Door curtains consisting of overlapping strips suspended from top of opening to form a sealed door curtain. Provide strips of length required to suit opening height and with sufficient number in unit to close opening width with overlap indicated.
2. Strip Material: Curved, clear, transparent, extruded PVC. Fabricate strips for manufacturer's standard method of attachment to overhead mounting system indicated.
 - a. Standard Grade: Designed to withstand temperature range of **0 to plus 150 deg F (minus 18 to plus 66 deg C)**.
 - b. Low-Temperature Grade: USDA accepted, designed to withstand temperature range of **minus 30 to plus 150 deg F (minus 34 to plus 66 deg C)**.
 - c. Strip Width and Thickness:
 - 1) **6 inches (152 mm)** wide and **0.060 inch (1.5 mm)** thick.
OR
8 inches (203 mm) wide and **0.080 inch (2 mm)** thick.

OR

12 inches (305 mm) wide and 0.120 inch (3 mm) thick.

OR

16 inches (406 mm) wide and 0.160 inch (4 mm) thick.

- d. Overlap: None **OR** One-third **OR** One-half **OR** Two-thirds **OR** Three-quarters **OR** Full, **as directed**.
- 3. Header Mounting: Consisting of an angle bolted or welded to opening lintel; equip angle with permanently attached mounting pins and a steel-angle or -plate retaining strip attached to angle with wing nuts.
- 4. Wall Surface Mounting:
 - a. Consisting of a steel plate bolted to side of lintel; equip plate with permanently attached, threaded, mounting pins and steel-angle or -plate retaining strip attached to plate with wing nuts.
 - OR**
 - Consisting of steel pipe attached to side of lintel by manufacturer's standard, winged-U-type suspension brackets.
 - OR**
 - Consisting of a rigid, vinyl wall-mounting unit bolted to side of lintel above opening; equip unit with a similarly formed, rigid, vinyl retainer attached to unit with wing nuts.
- P. General Finish Requirements
 - 1. Finish loading dock equipment after assembly and testing.
- Q. Steel Finishes
 - 1. Galvanizing: Hot-dip galvanize components as indicated to comply with the following:
 - a. ASTM A 123/A 123M for iron and steel loading dock equipment.
 - b. ASTM A 153/A 153M or ASTM F 2329 for iron and steel hardware for loading dock equipment.
 - 2. Galvanized-Steel and Steel Finish: Immediately after cleaning and pretreating, apply manufacturer's standard two-coat, baked-on finish consisting of prime coat and thermosetting topcoat in manufacturer's standard color.

1.3 EXECUTION

- A. Preparation
 - 1. Coordinate size and location of loading dock equipment indicated to be attached to or recessed into concrete or masonry, and furnish anchoring devices with templates, diagrams, and instructions for their installation.
 - 2. Set curb angles in concrete edges of dock-leveler recessed pits with tops flush with loading platform. Fit exposed connections together to form hairline joints.
 - 3. Set curb angles in concrete edges of truck-leveler recessed pits with tops flush with driveway. Fit exposed connections together to form hairline joints.
 - 4. Place self-forming pan system for recessed dock **OR** edge-of-dock, **as directed**, levelers in proper relation to loading platform before pouring concrete.
 - 5. Clean recessed pits of debris.
- B. Installation
 - 1. General: Install loading dock equipment, including motors, pumps, control stations, wiring, safety devices, light-communication systems, and accessories as required for a complete installation.
 - a. Rough-in electrical connections according to requirements specified in Division 22..
 - 2. Recessed Dock Levelers: Attach dock levelers securely to loading dock platform, flush with adjacent loading dock surfaces and square to recessed pit.
 - 3. Edge **OR** Top, **as directed**,-of-Dock Levelers: Attach dock levelers to loading dock platform in a manner that complies with requirements indicated for arrangement and position relative to top of platform.

- a. Weld anchor holes in contact with continuous embedded loading dock edge channel. Weld or bolt bumper blocks to face of loading dock.
 4. Truck Levelers: Attach truck levelers securely to driveway construction with expansion anchors and bolts.
 5. Truck Restraints: Attach truck restraints in a manner that complies with requirements for arrangement and height required for device to engage vehicle rear-impact guard. Interconnect control panel and signals with dock leveler, **as directed**.
 - a. Wall-Mounted Units: Weld truck restraints to steel curb angle **OR** edge channel **OR** mounting plate, **as directed**, embedded in loading dock edge.
 - b. Wall-Mounted Units: Anchor truck restraints to face of loading dock with expansion anchors and bolts.
 - c. Driveway-Mounted Units: Anchor truck restraints to driveway with expansion anchors and bolts.
 - d. Pit-Mounted Units: Anchor truck restraints to concrete pit with expansion anchors and bolts.
 6. Dock Bumpers: Attach dock bumpers to face of loading dock in a manner that complies with requirements indicated for spacing, arrangement, and position relative to top of platform and anchorage.
 - a. Welded Attachment: Plug-weld anchor holes in contact with steel inserts and fillet weld at other locations.
 - b. Bolted Attachment: Attach dock bumpers to preset anchor bolts embedded in concrete or to cast-in-place inserts or threaded studs welded to embedded-steel plates or angles. If preset anchor bolts, cast-in-place inserts, or threaded studs welded to embedded-steel plates or angles are not provided, attach dock bumpers by drilling and anchoring with expansion anchors and bolts.
 - c. Screw Attachment: Attach dock bumpers to wood construction with lag bolts as indicated.
 7. Dock Lifts: Attach dock lifts securely to loading platform **OR** floor of recessed pit **OR** surface of driveway, **as directed**.
 8. Dock Seals: Attach dock-seal support frames securely to building structure in proper relation to openings, dock bumpers, and dock levelers to ensure compression of dock seals when trucks are positioned against dock bumpers.
 9. Dock Shelters: Attach dock shelters securely to building structure in proper relation to openings, dock bumpers, and dock levelers to ensure an effective seal of dock-shelter curtains with sides and top of truck body when trucks are positioned against dock bumpers.
 10. Transparent-Strip Door Curtains: Attach door-curtain mounting system to lintel with screw anchors or toggle bolts. Mount curtain strips to achieve overlap indicated.
- C. Adjusting
1. Adjust loading dock equipment to function smoothly and safely, and lubricate as recommended by manufacturer.
 2. Test dock levelers and lifts for vertical travel within operating range indicated.
 3. After completing installation of exposed, factory-finished loading dock equipment, inspect exposed finishes and repair damaged finishes.

END OF SECTION 11 13 13 00



Task	Specification	Specification Description
11 13 16 13	11 13 13 00	Loading Dock Equipment
11 13 16 23	11 13 13 00	Loading Dock Equipment
11 13 19 13	11 13 13 00	Loading Dock Equipment
11 13 19 26	11 13 13 00	Loading Dock Equipment
11 13 19 33	11 13 13 00	Loading Dock Equipment
11 13 23 23	11 13 13 00	Loading Dock Equipment
11 13 26 00	11 13 13 00	Loading Dock Equipment

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SECTION 11 14 13 16 - TURNSTILES

1.1 GENERAL

- A. Description Of Work
 - 1. This specification covers the furnishing and installation of turnstiles. Installation procedures shall be in accordance with the product manufacturer's recommendations. Demolition and removal of materials shall be as required to support the work.
- B. Submittals
 - 1. Shop Drawings: Drawings showing individual turnstile construction, overall dimensions for installation, and installation details including trim and accessories.
 - 2. Materials List showing major components, materials and material thicknesses.
 - 3. Product Sample: Manufacturer shall demonstrate field up-gradability of the rotary gates from mechanical control to electronic control.
- C. Product Handling: Store turnstiles in a dry well ventilated place in the original crating and protective wrappings and protect all finished from damage during handling.

1.2 PRODUCTS

- A. Security Turnstiles
 - 1. Type B Rotary Gate
 - a. Mechanism: All steel and machined cast iron with two ratchets each 1-1/4" thick hardened steel. Two locking pawls 1-1/4" thick hardened steel. Automatic control with free turning one direction **OR** free turning both directions, **as directed**.
 - b. Arms: Hot dip galvanized steel tubing, wall thickness of 0.105" and 1.31" o.d.. Arm ends spun closed under heat and pressure, for a smooth safe finish. Heel guards on bottom arms of rotor "U" shaped sheet steel channels surrounding the lower arms and extending to the flooring.
 - c. Rotor and Barrier Vertical Members: 1/4" thick steel angles, hot dip galvanized. Arms pinned into rotor with malleable iron clamps. Non-welded construction.
 - d. Vertical Passage Members: Tubing with 1/8" wall thickness and 1" o.d., hot dip galvanized.
 - e. Bottom Bearing: Machined grey iron casting 1-1/2" thick, 12" diameter.
 - f. Height: As required to meet project requirements.
 - 2. Type AA Rotary Gate
 - a. Mechanism: All steel and machined cast iron. Two control ratchets each 1-1/4" thick hardened steel. Two locking pawls each 1-1/4" thick hardened steel. Automatic control with free turning one direction **OR** free turning both directions, **as directed**.
 - b. Arms: Square steel tubing, walls 0.097" thick, ends spun closed, bottom arms with heel guards.
 - c. Rotor and Barrier Columns: Five angles of 1/4" thick steel, sixty-three malleable cast iron clamps, non-welded construction.
 - d. Vertical Cage Members: 3 "U" channels 0.097" wall thickness, passage sheet 4' high by 5'2" length of 0.048" thick steel, 7 reinforcing bands of 0.38" thick steel.
 - e. Bottom Bearing: Machined grey iron casting 1-1/2" thick, 12" diameter.
 - f. Ceiling: Full round steel sheet 0.052" thick with 1" x 1" circular reinforcing angle at edge.
 - g. Height: As required to meet project requirements.
 - 3. Type SA Rotary Gate
 - a. Mechanism: All steel and machine cast iron. Two control ratchets each 1-1/4" thick hardened steel. Two locking pawls each 1-1/4" thick hardened steel. Time delay and power



- relays with 10 amp contact ratings and ten million operation life. One-way operation **OR** two-way, **as directed**, agent operated.
- b. Arms: ANSI 304 stainless steel (brushed finish); 4" reinforcing plugs at rotor end, spun closed ends, walls 0.065" thick.
 - c. Rotor: One piece solid aluminum extrusion weighing 140 lbs., three wing cross section, anodized.
 - d. Vertical Columns: One barrier support column of 3" by 3" solid aluminum, three passageway support columns of 2" by 2" aluminum tubing with 1/8" wall thickness.
 - e. Passageway Sheeting: ANSI 304 stainless steel (brushed finish) 0.065" thick **OR** 1/4" thick curved polycarbonate sheet, **as directed**, rising from 4" above floor level to 4" below mechanism housing.
 - f. Ceiling: Full ceiling 6 ft. diameter, 5" deep.
 - g. Height: As required to meet project requirements.
4. Type Dual Rotary Gate
- a. Mechanism: All steel and machine cast iron. Two control ratchets each 1.25" thick hardened steel. Two locking pawls each 1-1/4" thick hardened steel. Time delay and power relays with 10 amp contact ratings and ten million operation life. One-way operation **OR** two-way, **as directed**, agent operated.
 - b. Arms: ANSI 304 stainless steel (brushed finish); 4" reinforcing plugs at rotor end, spun closed ends, walls 0.065" thick. Press fit 3.5" into rotor sockets.
 - c. Rotors: One piece solid aluminum extrusions weighing 140 lbs. each, three wing cross section, clear anodized.
 - d. Barriers: Two columns of 2" by 2" solid aluminum, 21 arms 54" in length bent 1" o.d. ANSI 302 Tubing with 0.080" wall thickness, force fit and pin secured.
 - e. Passageway Columns: Four columns of 2" by 2" clear anodized aluminum tubing with 1/8" wall thickness.
 - f. Passageway Sheeting: ANSI 304 stainless steel (brushed finish) 0.065" thick **OR** 1/4" thick curved polycarbonate sheet, **as directed**, rising from 4" above floor level to 4" below mechanism housing.
 - g. Ceiling: Full ceiling 8' by 4'6", 5" deep.
 - h. Height: As required to meet project requirements.
5. 24" Diameter Manual Turnstiles
- a. Cover: Deep drawn ANSI #304 stainless steel (brushed finish), 0.078" thick, corners with 1-3/8" radii.
 - b. Frame: ANSI #304 stainless steel (brushed finish) **OR** painted mild steel, **as directed**. Welded double wall (cavity) construction. Each wall 0.078" thick. 2" blending outer wall radii, 1/4" thick stainless steel base plate.
 - c. Mechanical Mechanism: Ratchet of 1" x 6-1/2" machined cast iron. Use aided by springs of 0.175" diameter spring steel. Motion stabilized by large rotary shock absorber and cast iron two-lobe cam. Self centered by 1/2" steel compression shoe.
 - 1) Unlocking Controls: One continuous-duty rated 24VDC solenoid with 620% of required strength. Solenoid shall operate for 45 milliseconds per passage. All unlocking elements shall be mechanical. No time relays or transformers.
 - 2) Mechanism shall be field upgradable from mechanical counting to electronic counting both local and remote, without cutting, filing or other structural modifications. Mechanism shall be field upgradable from mechanical unlocking control to electronic unlocking control, both single passage and escrow control, without cutting, filing or other structural modifications.
 - d. Arms: ANSI #304 stainless steel tubing (brushed finish), 0.049" thick walls, spun closed ends. Arms shall be press fit into grey cast iron hub and held to main shaft with drill rod taper pin.
 - e. Hub: Grey cast iron, taper pin mounting.
 - f. Portable: 0.063" thick machined cast iron floor tread, force fit ANSI #304 stainless steel railing (brushed finish), with 0.0112" wall thickness hand-grip loops, 3-1/2" diameter solid rubber wheels recessed into cabinet.



1.3 EXECUTION:

- A. Installation: Install turnstiles in accordance with manufacturer's instructions.

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Task	Specification	Specification Description
11 14 13 19	11 14 13 16	Turnstiles

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SECTION 11 21 63 00 - FOOD SERVICE EQUIPMENT

1.1 GENERAL

A. Description Of Work

1. This specification covers the furnishing and installation of materials for food service equipment. Products shall be as follows or as directed by the Owner. Installation procedures shall be in accordance with the product manufacturer's recommendations. Demolition and removal of materials shall be as required to support the work.

B. Summary

1. Section Includes:
 - a. Fabricated equipment.
 - b. Food waste machines.
 - c. Cooking equipment.
 - d. Self-contained refrigeration equipment.
 - e. Walk-in refrigeration equipment.
 - f. Powered food-preparation equipment.
 - g. Warewashing equipment.
 - h. Serving equipment.
 - i. Utility distribution systems.
2. Owner-Furnished Equipment: Where indicated, the Owner will furnish equipment for installation by Contractor.

C. Submittals

1. Product Data: For each type of product indicated. Include the following:
 - a. Manufacturer's model number.
 - b. Accessories and components that will be included for Project.
 - c. Clearance requirements for access and maintenance.
 - d. Utility service connections for water, drainage, power, and fuel; include roughing-in dimensions.
2. Shop Drawings: For fabricated equipment. Include plans, elevations, sections, roughing-in dimensions, fabrication details, utility service requirements, and attachments to other work.
3. Samples: For each factory-applied color finish required, in manufacturer's standard sizes.
4. Coordination Drawings: For foodservice facilities.
 - a. Indicate locations of foodservice equipment and connections to utilities.
 - b. Key equipment using same designations as indicated on Drawings.
 - c. Include plans and elevations; clearance requirements for equipment access and maintenance; details of equipment supports; and utility service characteristics.
 - d. Include details of seismic bracing for equipment.
5. Operation and Maintenance Data: For foodservice equipment to include in emergency, operation, and maintenance manuals. Include the following:
 - a. Product Schedule: For each foodservice equipment item, include the following:
 - 1) Designation indicated on Drawings.
 - 2) Manufacturer's name and model number.
 - 3) List of factory-authorized service agencies including addresses and telephone numbers.
6. Warranty: Samples of special warranty.

D. Quality Assurance

1. NSF Standards: Provide equipment that bears NSF Certification Mark or UL Classification Mark certifying compliance with applicable NSF standards.
2. BISSC Standards: Provide bakery equipment that complies with BISSC/Z50.2.

- a. Provide BISSC-certified equipment, with certification verified by a third-party agency, **as directed**.
 3. UL Certification: Provide electric and fuel-burning equipment and components that are evaluated by UL for fire, electric shock, and casualty hazards according to applicable safety standards, and that are UL certified for compliance and labeled for intended use.
 4. Steam Equipment: Provide steam-generating and direct-steam heating equipment that is fabricated and labeled to comply with ASME Boiler and Pressure Vessel Code.
 5. Regulatory Requirements: Install equipment to comply with the following:
 - a. ASHRAE 15, "Safety Code for Mechanical Refrigeration."
 - b. NFPA 54, "National Fuel Gas Code."
 - c. NFPA 70, "National Electrical Code."
 - d. NFPA 96, "Ventilation Control and Fire Protection of Commercial Cooking Operations."
 6. Seismic Restraints: Comply with SMACNA's "Kitchen Ventilation Systems and Food Service Equipment Fabrication and Installation Guidelines," Appendix A, "Seismic Restraint Details," unless otherwise indicated.
 7. Preinstallation Conference: Conduct conference at Project site.
 - E. Project Conditions
 1. Field Measurements: Verify actual dimensions of construction contiguous with foodservice equipment by field measurements before fabrication. Indicate measurements on Coordination Drawings.
 - F. Coordination
 1. Coordinate foodservice equipment layout and installation with other work, including layout and installation of lighting fixtures, HVAC equipment, and fire-suppression system components.
 2. Coordinate locations and requirements of utility service connections.
 3. Coordinate sizes, locations, and requirements of the following:
 - a. Overhead equipment supports.
 - b. Equipment bases.
 - c. Floor depressions.
 - d. Insulated floors.
 - e. Floor areas with positive slopes to drains.
 - f. Floor sinks and drains serving foodservice equipment.
 - g. Roof curbs, equipment supports, and penetrations.
 - G. Warranty
 1. Refrigeration Compressor Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace compressors that fail in materials or workmanship within specified warranty period.
 - a. Failure includes, but is not limited to, inability to maintain set temperature.
 - b. Warranty Period: Five years from date of Final Completion.
- 1.2 PRODUCTS
- A. Fabricated Equipment
 1. Stainless-Steel Sinks:
 - a. Description: One **OR** Two **OR** Three **OR** Four, **as directed**,-compartment sink(s). Fabricate units of welded stainless steel, sound deadened.
 - 1) Bowls: Stainless steel, Type 304, **0.078 inch (1.98 mm) OR 0.062 inch (1.59 mm)**, **as directed**, thick.
 - 2) Integral Drainboards: Stainless steel, Type 304, **0.078 inch (1.98 mm) OR 0.062 inch (1.59 mm)**, **as directed**, thick.
 - 3) Body: Stainless steel, Type 304, **0.078 inch (1.98 mm) OR Type 304, 0.062 inch (1.59 mm) OR Type 430, 0.062 inch (1.59 mm)**, **as directed**, thick.

- a) Back Splash: Manufacturer's standard height **OR 13 inches (330 mm) OR 18 inches (457 mm), as directed.**
 - b) Side Splash: Manufacturer's standard height **OR 13 inches (330 mm) OR 18 inches (457 mm), as directed.**
 - 4) Legs and Feet: Stainless-steel tubing legs with adjustable bullet feet.
 - 5) Accessories:
 - a) Faucets and Spouts: as directed by the Owner.
 - b) Prerinse Faucet: as directed by the Owner.
 - c) Vacuum breaker.
 - d) Lever waste with **OR without, as directed, overflow.**
 - e) Basket strainer.
 - f) Continuous waste.
 - g) Scrap trough.
 - h) Control bracket for food waste disposer controls.
 - i) Scrap block and hole.
 - j) Stainless-steel pot rack.
 - b. Stainless-Steel Sheet: ASTM A 240/A 240M, austenitic stainless steel, type as indicated.
 - c. Fabrication: Prepare sink for installation of the following equipment items:
 - 1) Water heater.
 - 2) Food waste disposer; weld disposer cone or collar into sink.
 - 3) Undercounter dishwasher.
 - d. Stainless-Steel Finish: Directional satin finish, No. 4.
2. Stainless-Steel Tables:
 - a. Description: Flat-countertop **OR Prep OR Equipment-stand OR Mixer-stand OR Dish, as directed, table.**
 - 1) Tops: Stainless steel, Type 304, **0.078 inch (1.98 mm) OR Type 304, 0.062 inch (1.59 mm) OR Type 430, 0.062 inch (1.59 mm), as directed,** thick, reinforced and sound deadened.
 - a) Back Splash: Manufacturer's standard height **OR 1-1/2 inches (38 mm) OR 5 inches (127 mm), as directed.**
 - b) Edge: Bullnose on four sides **OR Bullnose on front edge, straight on sides and back OR Marine edge, as directed.**
 - 2) Welded **OR Adjustable, as directed,** Undershelf: Stainless steel, Type 304, **0.050 inch (1.27 mm) thick OR Metallic-coated steel, 0.052-inch (1.32-mm) nominal thickness, as directed.**
 - 3) Crossbracing: Stainless-steel **OR Metallic-coated steel, as directed,** tubing, bolted **OR welded, as directed,** to legs.
 - 4) Cabinet:
 - a) Body: Stainless steel, Type 430, **0.050 inch (1.27 mm) thick.**
 - b) Doors: Sliding **OR Hinged, as directed,** stainless steel, Type 304, **0.038 inch (0.95 mm) thick.**
 - c) Drawers: Stainless-steel drawer and faceplate **OR Galvanized-steel drawer and stainless-steel faceplate OR Stainless-steel front and liner OR Stainless-steel front and galvanized-steel liner, as directed.**
 - 5) Sink: Stainless steel, Type 304, **0.078 inch (1.98 mm) thick,** welded into tabletop and including the following:
 - a) Faucet and Spout: as directed by the Owner.
 - b) Vacuum breaker.
 - c) Leverwaste with **OR without, as directed, overflow.**
 - d) Basket strainer.
 - e) Tail piece.
 - 6) Legs: Stainless-steel **OR Metallic-coated steel, as directed,** tubing.
 - 7) Feet: Stainless-steel adjustable bullets **OR Plastic adjustable bullets OR Stainless-steel, flanged, adjustable bullets OR Casters, as directed.**
 - 8) Accessories:
 - a) Control panel.

- b) Control bracket for food waste disposer controls.
 - c) Aluminum pan rack slides, six **OR** three, **as directed**, slides each.
 - d) Urn trough.
 - e) Spice bins.
 - b. Materials:
 - 1) Stainless-Steel Sheet: ASTM A 240/A 240M, austenitic stainless steel, type as indicated.
 - 2) Metallic-Coated Steel Sheet: ASTM A 653/A 653M, Commercial Steel (CS), Type B; with minimum **G90 (Z275)** coating.
 - c. Fabrication: Prepare table for installation of the following equipment items:
 - 1) Food waste disposer; weld disposer cone or collar into sink.
 - 2) Heat lamp.
 - d. Stainless-Steel Finish: Directional satin finish, No. 4.
- 3. Stainless-Steel Shelf Units:
 - a. Description: Table mounted, single deck **OR** Table mounted, double deck **OR** Wall mounted, **as directed**. Fabricate units of stainless steel, Type 304, **0.062 inch (1.59 mm)** **OR** Type 304, **0.050 inch (1.27 mm)** **OR** Type 430, **0.050 inch (1.27 mm)**, **as directed**, thick.
 - b. Stainless-Steel Sheet: ASTM A 240/A 240M, austenitic stainless steel, type as indicated.
 - c. Stainless-Steel Finish: Directional satin finish, No. 4.
- 4. Pot Racks:
 - a. Description: Wall mounted **OR** Ceiling hung **OR** Corner, **as directed**. Fabricate units of stainless steel **OR** painted, cold-rolled steel, **as directed**.
 - 1) Bars: Double **OR** Single, **as directed**.
 - 2) Hooks: 18 per unit.
 - b. Materials:
 - 1) Stainless-Steel Sheet: ASTM A 240/A 240M, austenitic stainless steel, Type 304.
 - 2) Cold-Rolled Steel Sheet: ASTM A 1008/A 1008M, Commercial Steel (CS), Type B, suitable for exposed applications.
 - c. Finishes:
 - 1) Stainless Steel: Directional satin finish, No. 4.
 - 2) Cold-Rolled Steel: Powder-coat painted finish.
- 5. Stainless-Steel Hand Sinks:
 - a. Description: Lavatory sink. Fabricate units of stainless steel, Type 304, **0.050 inch (1.27 mm)** **OR** **0.038 inch (0.95 mm)**, **as directed**, thick.
 - 1) Operation: Electronic **OR** Knee valve **OR** Foot pedal **OR** Wrist handle **OR** Handle, **as directed**.
 - 2) Faucet and Spout: as directed by the Owner.
 - 3) Accessories:
 - a) Chrome-plated tail piece and P trap, **NPS 1-1/2 (DN 40)**, with **0.045-inch (1.1-mm)** minimum wall thickness.
 - b) Strainer basket with metal post.
 - c) Liquid soap dispenser, splash **OR** deck, **as directed**, mounted.
 - d) Liquid soap and towel dispenser.
 - e) Towel dispenser.
 - f) Tubular wall supports.
 - g) Skirt assembly for support.
 - h) Side splashes.
 - b. Stainless-Steel Sheet: ASTM A 240/A 240M, austenitic stainless steel, type as indicated.
 - c. Stainless-Steel Finish: Directional satin finish, No. 4.
- 6. Floor Troughs **OR** Water Receptacles, **as directed**:
 - a. Description: **4-inch (102-mm)** **OR** **2-inch (50-mm)**, **as directed**, nominal depth excluding tailpiece.
 - 1) Body: Stainless steel, Type 304, **0.078 inch (1.98 mm)** thick.
 - 2) Grate: Stainless-steel bar, Type 304 **OR** Fiberglass, **as directed**.

- 3) Waste Connection: **NPS 3 (DN 80)**.
 - b. Materials:
 - 1) Stainless-Steel Sheet: ASTM A 240/A 240M, austenitic stainless steel, type as indicated.
 - 2) Stainless-Steel Bars: ASTM A 276, austenitic stainless steel, type as indicated.
 - c. Stainless-Steel Finish: Directional satin finish, No. 4.
- B. Food Waste Machines
1. Food Waste Disposer Units:
 - a. Description: **3 OR 5 OR 7, as directed**, hp, with dual-direction shredding elements, and the following:
 - 1) Stainless-steel **OR** Corrosion-resistant, **as directed**, housing.
 - 2) Flow control.
 - 3) Solenoid valve.
 - 4) Vacuum breaker.
 - 5) Fixed nozzle.
 - 6) Control Panel:
 - a) Autoreversing and internal timed water flush.
 - b) Stainless-steel mounting bracket.
 - 7) Preinse: Backsplash mounted with hot- and cold-water mixing valve and with stainless-steel **OR** corrosion-resistant, **as directed**, exposed metal parts and the following:
 - a) Wall support bracket.
 - b) Flexible, **3/8-inch (10-mm)** metal-encased hose with a minimum length of **29 inches (737 mm)** and supported by spiral spring.
 - c) Spray-head assembly with lockable lever handle.
 - 8) Accessories:
 - a) Collar adaptor for sink **OR** trough, **as directed**.
 - b) Cone with adaptor ring.
 - i. Size: **12 inches (305 mm) OR 15 inches (381 mm) OR 18 inches (457 mm)**, **as directed**.
 - c) Cone cover in size that matches cone.
 - d) Silver accumulator.
 - 9) Electrical Service: Equip unit for connection to service indicated on Drawings.
 2. Food Waste Pulper and Water Extractor Systems:
 - a. Description: Stainless-steel pulper unit, extractor unit, and control panel with water-level control and push-button start.
 - 1) Capacity: Not less than **600 lb (272 kg) OR 700 lb (318 kg) OR 900 lb (408 kg)**, **as directed**, of waste per hour.
 - 2) Accessories:
 - a) Feed trough connection.
 - b) Feed tray.
 - c) Feed hood assembly.
 - d) Under-dish-table lid.
 - e) Remote Water Extractor:
 - i. Dam, to prevent siphoning of water from pulper tank.
 - ii. Remote piping system, overhead **OR** below floor, **as directed**.
 - 3) Electrical Service: Equip unit for connection to service indicated on Drawings.
 3. Food Waste Grinder and Water Extractor Systems:
 - a. Description: Stainless-steel construction; with off and on controls on unit, food waste hopper, silver saver, internal disposer, removable water extraction auger with internal water sprays, and discharge chute.
 - 1) Capacity: Not less than **600 lb (272 kg) OR 700 lb (318 kg)**, **as directed**, of waste per hour.
 - 2) Accessories:
 - a) Reel rinse unit with spray valve.

- b) Recirculation water pump.
- c) Trough mount.
- 3) Electrical Service: Equip unit for connection to service indicated on Drawings.
4. Undercounter Food Waste Grinder and Water Extractors:
- a. Description: Stainless-steel, undercounter, cleanable assembly including the following:
- 1) Capacity: Not less than **600 lb (272 kg) OR 700 lb (318 kg), as directed**, of waste per hour.
 - 2) Separate water-extractor and disposer units.
 - a) Disposer: Corrosion-resistant housing, dual-direction shredding elements.
 - 3) Piping between disposer and water extractor.
 - 4) Vacuum breaker.
 - 5) Solenoid valve.
 - 6) Flow control.
 - 7) Time-delayed relay.
 - 8) Control Panel:
 - a) Autoreversing and internal timed water flush.
 - b) Stainless-steel mounting bracket.
 - 9) Prerinse: Backsplash mounted with hot- and cold-water mixing valve and with stainless-steel **OR** corrosion-resistant, **as directed**, exposed metal parts and the following:
 - a) Wall support bracket.
 - b) Flexible, **3/8-inch (10-mm)** metal-encased hose with a minimum length of **29 inches (737 mm)** and supported by spiral spring.
 - c) Spray-head assembly with lockable lever handle.
 - 10) Accessories:
 - a) Cone with adaptor ring.
 - i. Size: **12 inches (305 mm) OR 15 inches (381 mm) OR 18 inches (457 mm), as directed.**
 - b) Cone cover in size that matches cone.
 - c) Silver sorter.
 - d) Trough collar connection.
 - 11) Electrical Service: Equip unit for connection to service indicated on Drawings.
- C. Cooking Equipment
1. Ranges:
- a. Description:
- 1) Top Configuration:
 - a) Open-Burner Unit:
 - i. Standard Burners: Four **OR** Six **OR** Eight **OR** Four, step-up type, **as directed.**
 - ii. Wok **OR** Saute, **as directed**, Head: as directed by the Owner.
 - b) Griddle: Flat **OR** Raised, **as directed.**
 - c) Radiant Broiler: as directed by the Owner.
 - 2) Base Configuration:
 - a) Standard Oven(s): One **OR** Two, **as directed.**
 - b) Convection Oven(s): One **OR** Two, **as directed.**
 - c) Storage Base: One.
 - 3) Accessories:
 - a) High **OR** Double-deck, **as directed**, back shelf.
 - b) Stainless-steel sides.
 - c) Stainless-steel back.
 - d) Legs for curb base.
 - e) Toe Base: **4 inches (102 mm)** high.
 - f) Casters: as directed by the Owner.
 - g) Oven Rack(s): One for each oven.

- 4) Electrical Service: Equip unit for connection to service indicated on Drawings.
- 5) Gas Service: Natural **OR** Liquefied propane, **as directed**, gas.
2. Deep Fat Fryers:
 - a. Description: Electric fryer, solid-state controls **OR** Electric, programmable computer controls **OR** Gas fryer, **as directed**.
 - 1) Oil Capacity: **40 lb (18 kg) OR 85 lb (39 kg), as directed.**
 - 2) Accessories:
 - a) Stainless-steel sides.
 - b) Stainless-steel fry tank.
 - c) Stainless-steel fry tank cover.
 - d) Casters: as directed by the Owner.
 - e) Automatic basket lifts.
 - f) Single Fry Baskets: as directed by the Owner.
 - g) Twin Fry Baskets: as directed by the Owner.
 - h) Triple Fry Baskets: as directed by the Owner.
 - i) Quick gas-service disconnect and flexible hose.
 - 3) Electrical Service: Equip unit for connection to service indicated on Drawings.
 - 4) Gas Service: Natural **OR** Liquefied propane, **as directed**, gas.
3. Steam Jacketed Kettles:
 - a. Description: Stainless steel, Type 304.
 - 1) Type: Stationary **OR** Tilting, **as directed**.
 - 2) Steam Source: Electrically heated, self-contained **OR** Direct, **as directed**.
 - a) Maximum **OR** Operating, **as directed**, Steam Pressure: **50 psig (345 kPa) OR 25 psig (172 kPa), as directed.**
 - 3) Capacity: **10 quarts (9.5 L) OR 20 gal. (76 L), as directed.**
 - 4) Accessories:
 - a) Basket insert.
 - b) Lift-off cover.
 - c) Single **OR** Double, **as directed**,-pantry water filler.
 - d) Tangent Drawoff: **2 inches (50 mm) OR 3 inches (76 mm), as directed.**
 - e) Disc Strainer: **1/8 inch (3 mm), perforated OR solid, as directed.**
 - f) Interior Finish: Manufacturer's standard **OR** Stainless steel, Type 316, **as directed**.
 - g) Cold-water jacket cooling.
 - h) Steam trap assemblies.
 - i) Kettle brush kit.
 - 5) Electrical Service: Equip unit for connection to service indicated on Drawings.
 - b. Stainless-Steel Sheet: ASTM A 240/A 240M, austenitic stainless steel, type as indicated.
 - c. Stainless-Steel Finish: Directional satin finish, No. 4.
4. Ovens:
 - a. Description: Electric convection **OR** Gas convection **OR** Rotisserie, **as directed**.
 - 1) Single deck **OR** Double deck **OR** Single deck with open stand, **as directed**.
 - 2) Accessories:
 - a) Oven Rack(s): One per oven chamber.
 - b) Stainless-steel drip pan.
 - c) Down-draft flue diverter.
 - d) Stacking kit.
 - 3) Electrical Service: Equip unit for connection to service indicated on Drawings.
 - 4) Gas Service: Natural **OR** Liquefied propane, **as directed**, gas.
5. Microwave Ovens:
 - a. Description: 1200-W cooking power.
 - 1) Electrical Service: Equip unit with plug and cord for 120-V service.
6. Coffee Urns:
 - a. Description: Single **OR** Twin **OR** Triple, **as directed**, urn.
 - 1) Capacity: **3 gal. (11 L) OR 6 gal. (23 L) OR 10 gal. (38 L), as directed**, per liner.
 - 2) Type: Electric **OR** Gas **OR** Steam, **as directed**, heated.

- 3) Agitator: Automatic **OR** Push button, **as directed**.
- 4) Spray Arm: With **OR** Without, **as directed**, bypass.
- 5) Timer: Digital **OR** Electromechanical, **as directed**.
- 6) Accessories:
 - a) Fill/Dispense: as directed by the Owner.
 - b) Multiple Faucet: as directed by the Owner.
 - c) Filtering: Permanent, stainless-steel, woven-wire cloth **OR** Disposable filter paper, **as directed**.
 - d) Finish: Manufacturer's standard **OR** Brass body and trim **OR** Copper body and brass trim, **as directed**.
- b. Electrical Service: Equip unit for connection to service indicated on Drawings.
- c. Gas Service: Natural **OR** Liquefied propane, **as directed**, gas.
- d. Operating Steam Pressure: As indicated on Drawings **OR** As directed.

D. Self-Contained Refrigeration Equipment

1. Refrigerators **OR** Freezers, **as directed**:
 - a. Description: Reach-in **OR** Roll-in **OR** Pass-through, **as directed**, type.
 - 1) Exterior Finish: Stainless steel.
 - 2) Interior Finish: Stainless steel **OR** Manufacturer's standard, **as directed**.
 - 3) Doors: Full length **OR** Half length **OR** In configuration shown on Drawings, **as directed**.
 - 4) Accessories:
 - a) Casters.
 - b) Stainless-steel back with rear louvers.
 - c) Re-hinging feature for doors.
 - d) Hinged glass doors and fluorescent fixtures.
 - e) Tray Slides: For sheet pans.
 - f) Chrome-Plated **OR** Stainless-Steel, **as directed**, Shelves: Quantity, as directed by the Owner.
 - g) Loading Rack: as directed by the Owner.
 - h) Transfer Carriage: as directed by the Owner.
 - 5) Electrical Service: Equip unit with plug and cord for service indicated on Drawings.
2. Undercounter Refrigerators **OR** Freezers, **as directed**:
 - a. Description: Compact unit with rear-mounted, self-contained refrigeration system.
 - 1) Accessories:
 - a) Stainless-steel top with backsplash.
 - b) Stainless-steel back panel.
 - c) Casters: **6 inches (152 mm)** **OR** **4 inches (102 mm)** **OR** **3-1/2 inches (89 mm)**, **as directed**, high.
 - d) Utility Base: **6 inches (152 mm)** high.
 - e) Shelves: Description and quantity, as directed by the Owner.
 - f) Stacking kit.
 - 2) Electrical Service: Equip unit with plug and cord for service indicated on Drawings.
3. Merchandiser Refrigeration Units:
 - a. Description: Curved-glass, self-contained refrigerator **OR** Sliding-glass, self-contained refrigerator **OR** Sliding-glass, self-contained freezer, **as directed**.
 - 1) Exterior Finish: Manufacturer's standard **OR** Stainless steel, **as directed**.
 - 2) Interior Finish: Manufacturer's standard **OR** Stainless steel **OR** White, **as directed**.
 - 3) Accessories:
 - a) Door locks.
 - b) Fluorescent Light Fixtures: Quantity, as directed by the Owner.
 - c) Base: as directed by the Owner.
 - d) Casters: as directed by the Owner.
 - e) Legs: as directed by the Owner.
 - f) Chrome-Plated Shelves: Quantity, as directed by the Owner.

- 4) Electrical Service: Equip unit with plug and cord for service indicated on Drawings.
4. Ice-Making Machine:
 - a. Description: Undercounter **OR** Freestanding, **as directed**, units.
 - 1) Production: Ice cubes **OR** cubes, dice **OR** cubes, half dice **OR** flakes **OR** chiplets (compacted flake ice), **as directed**.
 - 2) Capacity: as directed by The Owner per 24-hour period.
 - 3) Accessories:
 - a) Storage Bin: as directed by the Owner..
 - i. Stainless-steel stand and legs.
 - b) Water filter.
 - 4) Electrical Service: Equip unit for connection to service indicated on Drawings.
- E. Walk-In Refrigeration Equipment
 1. Walk-in Refrigeration Units:
 - a. Description: Cooler **OR** Freezer **OR** Two-compartment unit, with cooler and freezer compartments, **as directed**.
 - 1) Wall and Ceiling Panels: Interlocking insulating panels.
 - 2) Floors: Insulated floor panels **OR** Field installed; provide manufacturer's standard insulated floor screed, **as directed**.
 - 3) Doors:
 - a) Hinges: Two per door **OR** Self-closing and spring loaded; three per door, **As directed**.
 - b) Latch: Edge-mounted, positive-type latch with cylinder lock.
 - c) Include an accessible safety-release handle that opens door from inside when door is locked per building code.
 - 4) Door Accessories:
 - a) Vision port: Install per building code. The bottom of the glass not higher than 43" AFF.
 - b) Pressure relief port.
 - c) Threshold: Stainless steel, factory installed per building code.
 - d) Antic condensate heater at freezer doors.
 - 5) Vaporproof Lighting Fixtures: Incandescent fixture with 100-W lamp.
 - a) Control: Neon pilot light and toggle switch located on exterior of door panel.
 - b) Quantity: One per compartment, located on door panel.
 - 6) Refrigeration System: Self-contained, mounted on unit **OR** Remote system with preassembled condensing unit and evaporator assemblies.
 - a) Exterior Condensing Units: Include winter control, crankcase heater, and enclosed weatherproof housing.
 - b) Operating Temperature: as directed by the Owner.
 - 7) Temperature Monitoring System: Electronic monitoring and remote audible alarm system that warns when temperatures register 10 deg F (6 deg C) above or below set temperature.
 - 8) Closure Panels and Trim: Include closure panels and trim.
 - 9) Electrical Service: Equip unit for connection to service indicated on Drawings.
 - b. Finishes:
 - 1) Exposed Exterior Finish: Stucco-patterned aluminum **OR** Smooth, mill-finished aluminum **OR** White-painted aluminum, **as directed**.
 - 2) Unexposed Exterior Finish: Stucco-patterned, metallic-coated steel.
 - 3) Interior Finish: Stucco-patterned aluminum **OR** Smooth, mill-finished aluminum **OR** White-painted aluminum, **as directed**.
 - 4) Closure Panels and Trim: Matched to exposed exterior finish of panels.
- F. Powered Food-Preparation Equipment
 1. Mixers **OR** Slicers **OR** Meat Saws **OR** Peelers, **as directed**:
 - a. Description: as directed by the Owner.
 - b. Accessories: as directed by the Owner.

- c. Electrical Service: Equip unit with plug and cord for service indicated on Drawings.

G. Warewashing Equipment

1. Warewashing Machines:

- a. Description: Dishwashing, single tank **OR** Dishwashing, double tank **OR** Dishwashing, rackless conveyor **OR** Dishwashing, with circular conveyor table **OR** Pot and pan washing, two racks **OR OR** Pot and pan washing, one rack, **as directed**.
- 1) Capacity: as directed by the Owner.
 - 2) Accessories: as directed by the Owner.
 - 3) Electrical Service: Equip unit for connection to service indicated on Drawings.

H. Serving Equipment

1. Modular Counters:

- a. Description: Hot food **OR** Refrigerated salad **OR** Ice-cooled salad **OR** Sliding-glass door refrigerated **OR** Frost-top **OR** Sandwich **OR** Pizza **OR** Refrigerated-chest **OR** Dual-temperature **OR** Tray-starter **OR** Storage **OR** Cashier, **as directed**, module.
- 1) Cabinet Face Panels: Manufacturer's standard.
 - 2) Accessories:
 - a) Tray slide.
 - b) Work shelf.
 - c) Casters.
 - d) Electrical receptacle.
 - e) Cam-action latch locks with trigger release to mate with adjoining modular counters.
 - f) Tempered-glass, food-protector shield.
 - 3) Electrical Service: Equip unit for connection to service indicated on Drawings.
 - 4) Color: As selected from manufacturer's full range.
 - 5) Install serving counters, tray slides, heights and reach depths per building code.

I. Utility Distribution Systems

1. Utility Distribution Systems:

- a. Description: Overhead **OR** Counter **OR** Island **OR** Tray-slide **OR** Steam **OR** Wall-mounted, **as directed**, system.
- b. Accessories: as directed by the Owner.

J. Miscellaneous Materials

1. Installation Accessories, General: NSF certified for end-use application indicated.
2. Elastomeric Joint Sealant: ASTM C 920; silicone **OR** urethane, **as directed**. Type S (single component), Grade NS (nonsag), Class 25, Use NT (nontraffic) related to exposure, and Use M, G, A, or O as applicable to joint substrates indicated.
 - a. Public Health and Safety Requirements:
 - 1) Sealant is certified for compliance with NSF standards for end-use application indicated.
 - 2) Washed and cured sealant complies with the FDA's regulations for use in areas that come in contact with food.
 - b. Cylindrical Sealant Backing: ASTM C 1330, Type C, closed-cell polyethylene, in diameter greater than joint width.

K. Finishes

1. Stainless-Steel Finishes:

- a. Surface Preparation: Remove tool and die marks and stretch lines, or blend into finish.
- b. Polished Finishes: Grind and polish surfaces to produce uniform finish, free of cross scratches.
 - 1) Run grain of directional finishes with long dimension of each piece.

- 2) When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.
2. Powder-Coat Finishes: Immediately after cleaning and pretreating, electrostatically apply manufacturer's standard, baked-polymer, thermosetting powder finish. Comply with resin manufacturer's written instructions for application, baking, and minimum dry film thickness.

1.3 EXECUTION

A. Installation

1. Install foodservice equipment level and plumb, according to manufacturer's written instructions.
 - a. Connect equipment to utilities.
 - b. Provide cutouts in equipment, neatly formed, where required to run service lines through equipment to make final connections.
2. Complete equipment assembly where field assembly is required.
 - a. Provide closed butt and contact joints that do not require a filler.
 - b. Grind field welds on stainless-steel equipment until smooth and polish to match adjacent finish.
3. Install equipment with access and maintenance clearances that comply with manufacturer's written installation instructions and with requirements of authorities having jurisdiction.
4. Install cabinets and similar equipment on bases in a bed of sealant.
5. Install closure-trim strips and similar items requiring fasteners in a bed of sealant.
6. Install joint sealant in joints between equipment and abutting surfaces with continuous joint backing unless otherwise indicated. Produce airtight, watertight, vermin-proof, sanitary joints.

B. Cleaning And Protecting

1. After completing installation of equipment, repair damaged finishes.
2. Clean and adjust equipment as required to produce ready-for-use condition.
3. Protect equipment from damage during remainder of the construction period.

C. Demonstration

1. Train the Owner's maintenance personnel to adjust, operate, and maintain foodservice equipment.

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SECTION 11 30 13 13 - RESIDENTIAL APPLIANCES

1.1 GENERAL

A. Description Of Work

1. This specification covers the furnishing and installation of materials for residential appliances. Products shall be as follows or as directed by the Owner. Installation procedures shall be in accordance with the product manufacturer's recommendations. Demolition and removal of materials shall be as required to support the work.

B. Summary

1. This Section includes:
 - a. Cooking appliances.
 - b. Kitchen exhaust ventilation.
 - c. Refrigeration appliances.
 - d. Cleaning appliances
 - e. Trash compactors.

C. Submittals

1. Product Data: For each type of product indicated. Include rated capacities, operating characteristics, dimensions, furnished accessories, and finishes for each appliance.
2. LEED Submittal:
 - a. Product Data for Credit EA 1.4 or LEED for Homes Credit EA9: For appliances, documentation indicating that products are ENERGY STAR rated.
3. Samples: For each exposed finish.
4. Product Schedule: For appliances; use same designations indicated on Drawings.
5. Qualification Data: For qualified Installer or manufacturer.
6. Product Certificates: For each type of appliance, from manufacturer.
7. Field quality-control reports.
8. Operation and Maintenance Data: For each residential appliance to include in operation and maintenance manuals.
9. Warranties: Special warranties specified in this Section.

D. Quality Assurance

1. Manufacturer Qualifications: Maintains a service center capable of providing training, parts, and emergency maintenance repairs.
2. Installer Qualifications: An employer of workers trained and approved by manufacturer for installation and maintenance of units required for this Project.
3. Source Limitations: Obtain residential appliances from single source and each type of residential appliance from single manufacturer.
4. High-Altitude and Propane Conversion: Provide gas-operated appliances with manufacturer's conversion kit installed by a qualified service agency according to manufacturer's written instructions for Project location and type of fuel.
5. Regulatory Requirements: Comply with the following:
 - a. NFPA: Provide electrical appliances listed and labeled as defined in NFPA 70, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
 - b. ANSI: Provide gas-burning appliances that comply with ANSI Z21 Series standards.
6. Accessibility: Where residential appliances are indicated to comply with accessibility requirements, comply with the U.S. Architectural & Transportation Barriers Compliance Board's ADA-ABA Accessibility Guidelines and ICC/ANSI A117.1," **as directed**.
7. Preinstallation Conference: Conduct conference at Project site.

E. Warranty

1. Special Warranties: Manufacturer's standard form in which manufacturer agrees to repair or replace residential appliances or components that fail in materials or workmanship within specified warranty period.
 - a. Warranty Period: Two **OR** Five years, **as directed**, from date of Final Completion.
2. Electric Cooktop **OR** Range: Full warranty including parts and labor **OR** Limited warranty including parts and labor for first year and parts thereafter for on-site service on surface-burner elements, **as directed**.
 - a. Warranty Period: Two **OR** Five years, **as directed**, from date of Final Completion.
3. Microwave Oven: Full warranty including parts and labor **OR** Limited warranty including parts and labor for first year and parts thereafter for on-site service on the magnetron tube, **as directed**.
 - a. Warranty Period: Two **OR** Five years, **as directed**, from date of Final Completion.
4. Refrigerator/Freezer **OR** Freezer **OR** Ice maker, Sealed System: Full warranty including parts and labor **OR** Limited warranty including parts and labor for first year and parts thereafter for on-site service on the product, **as directed**.
 - a. Warranty Period for Sealed Refrigeration System: Two **OR** Five years, **as directed**, from date of Final Completion.
 - b. Warranty Period for Other Components: Two years from date of Final Completion.
5. Dishwasher: Full warranty including parts and labor **OR** Limited warranty including parts and labor for first year and parts thereafter for on-site service on the product, **as directed**.
 - a. Warranty Period for Deterioration of Tub and Metal Door Liner: Three **OR** Five **OR** 10 years, **as directed**, from date of Final Completion.
 - b. Warranty Period for Other Components: Two years from date of Final Completion.
6. Clothes Washer: Full warranty including parts and labor **OR** Limited warranty including parts and labor for first year and parts thereafter for on-site service on the product, **as directed**.
 - a. Warranty Period: Two **OR** Three years, **as directed**, from date of Final Completion.

1.2 PRODUCTS

A. Cooktops:

1. Electric Cooktop:
 - a. Width: **12 inches (305 mm) OR 30 inches (762 mm) OR 36 inches (914 mm)**, **as directed**.
 - b. Electric Burner Elements: Two **OR** Four **OR** Six, **as directed**.
 - c. Coil Type: Manufacturer's standard **OR** Two 1200 W and two 2200 W **OR** One 1200 W, one 2200-W dual element, and two 2200 W, **as directed**.
 - d. Radiant Type: Two 1500 W and two 2000 W **OR** One 1200-W element, dual 1500-W/1500-W bridge element, and one 1200-W/2500-W expandable element **as directed**.
 - e. Induction Type: Manufacturer's standard **OR** Two 1200 W and two 1800 W **OR** One 1200 W, one 1800 W, one 2700 W, and one 3300 W, **as directed**.
 - f. Controls: Digital panel controls, located on front **OR** on left side **OR** on right side **OR** remotely, where indicated, **as directed**.
 - g. Downdraft Ventilation: Manufacturer's standard **OR** **550 cfm (260 L/s)** **as directed**, built-in downdraft ventilation, with remote blower and exterior weatherproof wall cap.
 - h. Other Features: Grill **OR** deep fryer **OR** wok burner and wok ring, **as directed**.
 - i. Electric Power Supply: 240 V, 60 Hz, 1 phase, 30 A, **as directed**.
 - j. Top Material: Manufacturer's standard **OR** Ceramic glass **OR** Porcelain-enamel steel **OR** Stainless steel, **as directed**.
 - 1) Color/Finish: White **OR** Black, **as directed**.
2. Gas Cooktop
 - a. Width: **12 inches (300 mm) OR 30 inches (760 mm) OR 36 inches (915 mm)**, **as directed**.
 - b. Gas Burners: Two **OR** Four **OR** Six, **as directed**.
 - 1) Power Ratings: Manufacturer's standard **OR** One **5000 Btu/h (1500 W)**, two **9100 Btu/h (2700 W)**, and one **12,000 Btu/h (3500 W)**, **as directed**.
 - 2) Grates: Individual **OR** Continuous, **as directed**.

- c. Controls: Digital panel **OR** Manual-dial controls, located on front **OR** left side **OR** right side, **as directed**.
- d. Downdraft Ventilation: Manufacturer's standard **OR** 550 cfm (260 L/s), **as directed**, with remote, **as directed**, blower and exterior weatherproof wall cap.
- e. Other Features: Sealed burners **OR** Auto-reigniting **OR** Grill **OR** deep fryer **OR** wok burner and wok ring, **as directed**.
- f. Electric Power Supply: 120 V, 60 Hz, 1 phase, 30 A, **as directed**.
- g. Top Materials: Porcelain-enamel steel **OR** Ceramic glass **OR** glass **OR** Stainless steel **OR** Manufacturer's standard, **as directed**.
 - 1) Color/Finish: White **OR** Black, **as directed**.

B. Range:

- 1. Electric Range: Freestanding **OR** Slide-in **OR** Drop-in range, **as directed**, with one **OR** two oven(s), **as directed** and complying with AHAM ER-1.
 - a. Width: 30 inch (762 mm) **OR** 36 inch (914 mm), **as directed**.
 - b. Electric Burner Elements: Four **OR** Six, **as directed**.
 - 1) Coil Type: Manufacturer's standard **OR** Two 1200 W and two 2200 W **OR** One 1200 W, one 2200-W dual element, and two 2200 W, **as directed**.
 - 2) Radiant Type: Two 1500 W and two 2000 W **OR** One 1200-W element, dual 1500-W/1500-W bridge element, and one 1200-W/2500-W expandable element, **as directed**.
 - 3) Induction Type: Manufacturer's standard **OR** Two 1200 W and two 1800 W **OR** One 1200 W, one 1800 W, one 2700 W, and one 3300 W, **as directed**.
 - 4) Controls: Digital panel controls, located on front **OR** left side **OR** right side **OR** splash panel at rear of rangetop, **as directed**.
 - c. Oven Features:
 - 1) Capacity: 3.3 cu. ft. (0.09 cu. m).
 - 2) Operation: Baking **OR** convection **as directed**, and self-cleaning.
 - 3) Broiler: Located in top of oven **OR** separate roll-out drawer on bottom **as directed**.
 - 4) Oven Door(s): Counterbalanced, removable, with observation window and full-width handle.
 - 5) Electric Power Rating:
 - a) Oven(s): Manufacturer's standard **OR** 2400 W **as directed**.
 - b) Broiler: Manufacturer's standard **OR** 3500 W **as directed**.
 - 6) Controls: Digital panel controls and timer display, located on front **OR** left side **OR** right side **OR** splash panel at rear of rangetop, **as directed**.
 - d. Anti-Tip Device: Manufacturer's standard.
 - e. Electric Power Supply: 240 V, 60 Hz, 1 phase, 30 A.
 - f. Material Porcelain-enamel **OR** Stainless, **as directed**, with manufacturer's standard, **as directed**, cooktop.
 - a) Color/Finish: White **OR** Black, **as directed**.
- 2. Gas Range: Freestanding **OR** Slide-in range with one **OR** two ovens, **as directed**.
 - a. Width: 30 inch (762 mm) **OR** 36 inch (914 mm), **as directed**.
 - b. Gas Burners: Four **OR** Six, **as directed**.
 - 1) Power Ratings: Manufacturer's standard **OR** One 5000 Btu/h (1500 W), **as directed**, two 9100 Btu/h (2700 W), and one 12,000 Btu/h (3500 W).
 - 2) Controls: Digital panel **OR** Manual-dial controls, **as directed** located on front **OR** left side **OR** right side **OR** splash panel at rear of rangetop, **as directed**.
 - 3) Grates: Individual **OR** Continuous, **as directed**.
 - 4) Other Feature(s): Sealed burners **OR** auto-re-igniting burners, **as directed**, and grill.
 - c. Oven Features:
 - 1) Capacity: 3.3 cu. ft. (0.09 cu. m).
 - 2) Operation: Baking **OR** convection **as directed**, and self-cleaning.
 - 3) Broiler: Located in top of oven **OR** separate roll-out drawer on bottom **as directed**.



- 4) Oven Door(s): Counterbalanced, removable, with observation window and full-width handle.
 - 5) Electric Power Rating:
 - a) Oven(s): Manufacturer's standard **OR 9100 Btu/h (2700 W) as directed.**
 - b) Broiler: Manufacturer's standard **OR 14,500 Btu/h (4200 W) as directed.**
 - 6) Controls: Digital panel controls and timer display, located on front **OR** left side **OR** right side **OR** splash panel at rear of rangetop, **as directed.**
 - d. Anti-Tip Device: Manufacturer's standard.
 - e. Electric Power Supply: 240 V, 60 Hz, 1 phase, 15 A.
 - f. Material Porcelain-enamel **OR** Stainless, **as directed**, with manufacturer's standard, **as directed**, cooktop.
 - a) Color/Finish: White **OR** Black, **as directed.**
3. Dual Fuel Range Freestanding **OR** Slide-in range, **as directed**, with gas burners and one **OR** two electric ovens, **as directed.**
- a. Width: **30 inch (762 mm) OR 36 inch (914 mm), as directed.**
 - b. Gas Burners: Four **OR** Six, **as directed.**
 - 1) Power Ratings: Manufacturer's standard **OR** One **5000 Btu/h (1500 W), as directed**, two **9100 Btu/h (2700 W)**, and one **12,000 Btu/h (3500 W)**
 - 2) Controls: Digital panel **OR** Manual-dial controls, **as directed** located on front **OR** left side **OR** right side **OR** splash panel at rear of rangetop, **as directed.**
 - 3) Grates: Individual **OR** Continuous, **as directed.**
 - 4) Other Feature(s): Sealed burners **OR** auto-re-igniting burners, **as directed**, and grill.
 - c. Oven Features:
 - 1) Capacity: **3.3 cu. ft. (0.09 cu. m).**
 - 2) Operation: Baking **OR** convection **as directed**, and self-cleaning.
 - 3) Broiler: Located in top of oven **OR** separate roll-out drawer on bottom **as directed.**
 - 4) Oven Door(s): Counterbalanced, removable, with observation window and full-width handle.
 - 5) Electric Power Rating:
 - a) Oven(s): Manufacturer's standard **OR 2400 W as directed.**
 - b) Broiler: Manufacturer's standard **OR 3500 W as directed.**
 - 6) Controls: Digital panel controls and timer display, located on front **OR** left side **OR** right side **OR** splash panel at rear of rangetop, **as directed.**
 - d. Anti-Tip Device: Manufacturer's standard.
 - e. Electric Power Supply: 240 V, 60 Hz, 1 phase, 30 A.
 - f. Material Porcelain-enamel **OR** Stainless, **as directed**, with manufacturer's standard, **as directed**, cooktop.
 - 1) Color/Finish: White **OR** Black, **as directed.**
- C. Wall Oven:
1. Electric Wall Oven(s): One **OR** Two-oven unit, **as directed.**
 - a. Mounting: Built-in wall **OR** undercounter .
 - b. Capacity: **3.3 cu. ft. (0.09 cu. m).**
 - c. Operation: Baking **OR** convection and self-cleaning, **as directed.**
 - d. Broiler: Located in top of oven **OR** separate roll-out drawer on bottom, **as directed.**
 - e. Oven Door(s): Counterbalanced, removable, with observation window and full-width handle.
 - f. Electric Power Rating:
 - 1) Oven(s): Manufacturer's standard **OR 2400 W, as directed.**
 - 2) Broiler: Manufacturer's standard **OR 3500 W, as directed.**
 - g. Electric Power Supply: 240 V, 60 Hz, 1 phase, 30 A
 - h. Controls: Digital panel **OR** Manual-dial controls and timer display, **as directed.**

- i. Material: Porcelain-enameled steel **OR** Stainless steel **OR** Manufacturer's standard, **as directed**.
 - 1) Color/Finish: White **OR** Black, **as directed**.
2. Gas Wall Oven(s): One **OR** Two-oven unit, **as directed**.
 - a. Mounting: Built-in wall **OR** undercounter .
 - b. Capacity: 3.3 cu. ft. (0.09 cu. m).
 - c. Operation: Baking **OR** convection and self-cleaning, **as directed**.
 - d. Broiler: Located in top of oven **OR** separate roll-out drawer on bottom, **as directed**.
 - e. Oven Door(s): Counterbalanced, removable, with observation window and full-width handle.
 - f. Electric Power Rating:
 - 1) Oven(s): Manufacturer's standard **OR** 9100 Btu/h (2700 W), **as directed**.
 - 2) Broiler: Manufacturer's standard **OR** 14,500 Btu/h (4200 W), **as directed**.
 - g. Electric Power Supply: 240 V, 60 Hz, 1 phase, 30 A
 - h. Controls: Digital panel **OR** Manual-dial controls and timer display, **as directed**.
 - i. Material: Porcelain-enameled steel **OR** Stainless steel **OR** Manufacturer's standard, **as directed**.
 - 1) Color/Finish: White **OR** Black, **as directed**.
- D. Microwave Oven:
 1. Microwave Oven(s):
 - a. Mounting: Undercabinet **OR** Wall cabinet, **as directed**.
 - b. Type: Conventional **OR** Convection, **as directed**.
 - c. Dimensions:
 - 1) Width: 24 inches (610 mm) **OR** 30 inches (762 mm), **as directed**.
 - 2) Depth: 19-1/2 inches (495 mm), **as directed**.
 - 3) Height: 14 inches (356 mm) **OR** 18 inches (457 mm), **as directed**.
 - d. Capacity: 1.5 cu. ft. (0.04 cu. m) **OR** 2.0 cu. ft. (0.06 cu. m), **as directed**.
 - e. Oven Door: Door with observation window and pull handle **OR** and push-button latch release, **as directed**.
 - f. Exhaust Fan: Variable **OR** Two **OR** Four-speed fan, , **as directed**, vented to outside **OR** nonvented, **as directed**, recirculating type with charcoal filter and with manufacturer's standard **OR** 300-cfm (140-L/s) capacity, **as directed**.
 - g. Microwave Power Rating: Manufacturer's standard **OR** 1000 W, **as directed**.
 - 1) Convection Element Power Rating: Manufacturer's standard **OR** 1450 W, **as directed**.
 - h. Electric Power Supply: 120 V, 60 Hz, 1 phase, 15 A.
 - i. Controls: Digital panel controls and timer display.
 - j. Other Features: Turntable **OR** temperature probe, **as directed**, and lock-out feature.
 - k. Material: Porcelain-enameled steel **OR** Stainless steel **OR** Manufacturer's standard, **as directed**.
 - 1) Color/Finish: White **OR** Black, **as directed**.
- E. Kitchen Exhaust Ventilation:
 1. Overhead Exhaust Hood
 - a. Type: Wall-mounted, **OR** Suspended-island-canopy, exhaust-hood system, **as directed**.
 - b. Dimensions:
 - 1) Width: 30 inches (762 mm) **OR** 36 inches (914 mm) **OR** 48 inches (1219 mm), **as directed**.
 - 2) Depth: 30 inches (762 mm) **OR** 36 inches (914 mm) **OR** 48 inches (1219 mm), **as directed**.
 - c. Exhaust Fan: Variable **OR** Two **OR** Three-speed fan, **as directed**, built into hood **OR** remotely located, , **as directed**, with separate housing and with manufacturer's standard **OR** 500-cfm (236-L/s) **OR** 900-cfm (425-L/s) capacity, **as directed**.
 - 1) Venting: Vented to outside through roof with weatherproof roof cap, backdraft damper, and rodent-proof screening **OR** Vented to outside through wall with

- weatherproof wall cap, backdraft damper, and rodent-proof screening **OR** Nonvented, recirculating type with charcoal filter, **as directed**.
- 2) Fan Control: Hood **OR** Wall-mounted touch-pad to control fan switch, with separate hood-light control switch, **as directed**.
- d. Duct Type: Manufacturer's standard **OR 7-inch- (175-mm-)** diameter round **OR 3-1/4 by 10 inches (82 by 250 mm)** rectangular, **as directed**.
 - e. Finish: Baked enamel **OR** Stainless steel, **as directed**.
 - 1) Color: White **OR as directed**.
 - f. Features:
 - 1) Permanent, washable aluminum mesh **OR** stainless-steel mesh **OR** baffle-type filter(s), **as directed**.
 - 2) Built-in halogen **OR** incandescent **OR** fluorescent lighting, **as directed**.
 - 3) Warming lamp socket(s).
2. Downdraft Exhaust:
 - a. Type: Retractable-downdraft exhaust system.
 - b. Width: **30 inches (762 mm) OR 36 inches (914 mm)**, **as directed**.
 - c. Exhaust Fan: Variable **OR** Two **OR** Three-speed fan built into cabinet below countertop **OR** remotely located, **as directed**, with separate housing and with manufacturer's standard **OR 500-cfm (236-L/s) OR 900-cfm (425-L/s)** capacity, **as directed**.
 - 1) Venting: Vented to outside through roof with weatherproof roof cap, backdraft damper, and rodent-proof screening **OR** Vented to outside through wall with weatherproof wall cap, backdraft damper, and rodent-proof screening **OR** Nonvented, recirculating type with charcoal filter, **as directed**.
 - 2) Fan Control: Countertop-mounted touch-pad to control fan switch.
 - d. Duct Type: Manufacturer's standard **OR 7-inch- (175-mm-)** diameter round **OR 3-1/4 by 10 inches (82 by 250 mm)** rectangular, **as directed**.
 - e. Finish: Baked enamel **OR** Stainless steel, **as directed**.
 - 1) Color: White **OR as directed**.
 - f. Features:
 - 1) Permanent, washable aluminum mesh **OR** stainless-steel mesh **OR** baffle-type filter(s), **as directed**.
- F. Refrigerator/Freezers
1. Refrigerator/Freezer One-door refrigerator with inside freezer compartment **OR** Two-door, side-by-side refrigerator/freezer **OR** Two-door refrigerator/freezer with freezer on top **OR** Two-door refrigerator/freezer with freezer on bottom, **as directed** and complying with AHAM HRF-1.
 - a. Type: Freestanding **OR** Built in **OR** Undercounter.
 - b. Dimensions:
 - 1) Width: **16 inches (406 mm) OR 24 inches (610 mm) OR 27 inches (686 mm) OR 30 inches (762 mm) OR 36 inches (914 mm) OR 42 inches (1067 mm) OR 48 inches (1220 mm)**, **as directed**.
 - 2) Depth: **24 inches (610 mm) OR 27 inches (686 mm) OR 33-1/4 inches (845 mm)**, **as directed**.
 - 3) Height: **34-1/2 inches (876 mm) OR 70 inches (1778 mm) OR 73 inches (1854 mm) OR 84 inches (2134 mm)**, **as directed**.
 - c. Storage Capacity:
 - 1) Refrigeration Compartment Volume: **15.6 cu. ft. (0.44 cu. m)**.
 - 2) Freezer Volume: **5.13 cu. ft. (0.15 cu. m)**.
 - 3) Shelf Area: Three adjustable wire **OR** glass shelves, **as directed**, **26 sq. ft. (2.42 sq. m)**.
 - d. General Features:
 - 1) Door Configuration: Framed **OR** Overlay.
 - 2) Revise first option in first subparagraph below if either crushed or cubed ice is required.
 - 3) Dispenser in door for ice and cold water dispenser lock.

- 4) Built-in water filtration system.
 - 5) Dual refrigeration systems.
 - 6) Separate touch-pad temperature controls for each compartment.
 - e. Refrigerator Features:
 - 1) Interior light in refrigeration compartment.
 - 2) Compartment Storage: Wine racks **OR** vegetable crisper **OR** meat compartment, **as directed**.
 - 3) Door Storage: Glazed door without storage **OR** Modular compartments **OR** **Gallon (3.8 L-)** milk-container storage, **as directed**.
 - 4) Temperature-controlled meat/deli bin.
 - f. Freezer Features: One **OR** Two freezer compartment(s) with door(s) **OR** configured as pull-out drawer(s), **as directed**.
 - 1) Automatic **OR** Manual defrost, **as directed**.
 - 2) Interior light in freezer compartment.
 - 3) Automatic icemaker and storage bin.
 - g. Energy Performance, ENERGY STAR: Provide appliances that qualify for the EPA/DOE ENERGY STAR product labeling program.
 - h. Front Panel(s): Manufacturer's standard **OR** Wood panel(s) to match kitchen cabinets **OR** Porcelain enamel **OR** Stainless steel **OR** Wood-panel insert(s) specified in Division 06 Section "Interior Architectural Woodwork" to match kitchen cabinets **OR** Wood-panel insert(s) specified in Division 12 Section "Residential Casework" to match kitchen cabinets **OR** Reversible panel(s) with choice of colors, **as directed**.
 - 1) Panel Color: White **OR** Black, **as directed**.
 - i. Appliance Color/Finish: White **OR** Black **OR** Stainless steel, **as directed**.
- G. Freezers
1. Freezer One **OR** Two freezer compartment(s) with door(s) **OR** configured as pull-out drawer(s), **as directed** and complying with AHAM HRF-1.
 - a. Type: Freestanding **OR** Built in **OR** Undercounter.
 - b. Dimensions:
 - 1) Width: **27 inches (686 mm)** **OR** **30 inches (762 mm)** **OR** **36 inches (914 mm)**, **as directed**.
 - 2) Depth: **24 inches (610 mm)** **OR** **27 inches (686 mm)**, **as directed**.
 - 3) Height: **34-1/2 inches (876 mm)** **OR** **70 inches (1778 mm)** **OR** **73 inches (1854 mm)** **OR** **84 inches (2134 mm)**, **as directed**.
 - c. Storage Capacity:
 - 1) Volume: **5.13 cu. ft. (0.15 cu. m)** **OR** **15.0 cu. ft. (0.42 cu. m)**, **as directed**.
 - 2) Shelf Area: Three adjustable wire **OR** glass shelves, **as directed**, **26 sq. ft. (2.42 sq. m)**.
 - d. Features:
 - 1) Door Configuration: Framed **OR** Overlay, **as directed**.
 - 2) Automatic **OR** Manual defrost, **as directed**.
 - 3) Interior light in compartment.
 - 4) Automatic icemaker and storage bin.
 - 5) Temperature touch-pad controls for each compartment.
 - 6) Defrost drain.
 - 7) Lock with key.
 - e. Energy Performance, ENERGY STAR: Provide appliances that qualify for the EPA/DOE ENERGY STAR product labeling program.
 - f. Front Panel(s): Manufacturer's standard **OR** Wood panel(s) to match kitchen cabinets **OR** Porcelain enamel **OR** Stainless steel **OR** Wood-panel insert(s) specified in Division 06 Section "Interior Architectural Woodwork" to match kitchen cabinets **OR** Wood-panel insert(s) specified in Division 12 Section "Residential Casework" to match kitchen cabinets, **as directed**.
 - 1) Panel Color: White **OR** Black, **as directed**.
 - g. Appliance Color/Finish: White **OR** Black **OR** Stainless steel, **as directed**.

H. Icemakers

1. Icemaker:

- a. Type: Undercounter.
- b. Dimensions:
 - 1) Width: 14-3/4 inches (375 mm) OR 15-1/4 inches (387 mm), as directed.
 - 2) Depth: 24 inches (610 mm) OR 25-1/4 inches (641 mm), as directed.
 - 3) Height: 33-5/8 inches (386 mm) OR 34-1/2 inches (876 mm), as directed.
- c. Ice Capacity:
 - 1) Production: 30 lb (13.6 kg) OR 50 lb (22.7 kg) per day, as directed.
 - 2) Storage: 25 lb (11.3 kg) OR 35 lb (15.9 kg), as directed.
- d. Features:
 - 1) Door Configuration: Framed OR Overlay, as directed.
 - 2) Automatic defrost.
 - 3) Automatic shutoff.
 - 4) Defrost drain with pump.
- e. Front Panel: Manufacturer's standard OR Wood panel to match kitchen cabinets OR Porcelain enamel OR Stainless steel OR Wood-panel insert specified in Division 06 Section "Interior Architectural Woodwork" to match kitchen cabinets OR Wood-panel insert specified in Division 12 Section "Residential Casework" to match kitchen cabinets, as directed.
 - a) Panel Color: White OR Black, as directed.
- f. Appliance Color/Finish: White OR Black OR Stainless steel, as directed.

I. Dishwashers

1. Dishwasher Complying with AHAM DW-1 and ASSE 1006.

- a. Type: Built-in undercounter OR Built-in under sink OR Portable, as directed.
- b. Dimensions:
 - 1) Width: 18 inches (457 mm) OR 24 inches (610 mm), as directed.
 - 2) Depth: 23 inches (584 mm) OR 25-3/4 inches (654 mm), as directed.
 - 3) Height: 34-1/2 inches (876 mm), as directed.
- c. Capacity:
 - 1) International Place Settings of China: Eight OR 12 OR 14, as directed.
 - 2) Water Consumption for Full Load: 3.2 gal. (12 L) per cycle.
- d. Sound Level: Maximum 42 OR 48 dB, as directed.
- e. Tub and Door Liner: Manufacturer's standard OR Porcelain-enameled steel OR Stainless steel OR Porcelain-enameled steel tub and molded-plastic door liner, as directed with sealed detergent and automatic rinsing-aid dispensers.
- f. Rack System: Nylon OR PVC-coated sliding dish racks, as directed, with removable cutlery basket OR top cutlery tray as directed.
- g. Controls: Touch-pad OR Rotary-dial controls, as directed, with four wash cycles and hot-air and heat-off drying cycle options.
- h. Features:
 - 1) Features in first three subparagraphs below are standard with most models.
 - 2) Waste food disposer.
 - 3) Self-cleaning food-filter system.
 - 4) Hot-water booster heater for 140 deg F (60 deg C) OR 160 deg F (71 deg C) wash water with incoming water at 100 deg F (38 deg C).
 - 5) Lock-out feature.
 - 6) Half-load option.
 - 7) Delay-wash option.
 - 8) Digital display panel.
 - 9) Water softener.
 - 10) Soil-sensing water use control system.

- i. Energy Performance, ENERGY STAR: Provide appliances that qualify for the EPA/DOE ENERGY STAR product labeling program.
 - j. Front Panel: Manufacturer's standard **OR** Wood panel to match kitchen cabinets **OR** Porcelain enamel **OR** Stainless steel **OR** Wood-panel insert specified in Division 06 Section "Interior Architectural Woodwork" to match kitchen cabinets **OR** Wood-panel insert specified in Division 12 Section "Residential Casework" to match kitchen cabinets **OR** Reversible panel with choice of colors, **as directed**.
 - 1) Panel Color: White **OR** Black, **as directed**.
 - k. Appliance Color/Finish: White **OR** Black **OR** Stainless steel, **as directed**.
- J. Clothes Washers And Dryers
- 1. Clothes Washer Complying with ASSE 1007:
 - a. Type: Freestanding **OR** Stacking **OR** Undercounter, top **OR** front-loading unit.
 - b. Dimensions:
 - 1) Width: 23-1/2 inches (597 mm) **OR** 27 inches (686 mm) **OR** 30 inches (762 mm), **as directed**.
 - 2) Depth: 24 inches (610 mm) **OR** 29 inches (737 mm) **OR** 31 inches (787 mm), **as directed**.
 - 3) Height: 34-1/2 inches (876 mm) **OR** 38 inches (965 mm) **OR** 45 inches (1143 mm), **as directed**.
 - c. Drum: Manufacturer's standard **OR** Perforated porcelain-enameled steel **OR** Perforated stainless steel, **as directed**.
 - 1) Capacity: 2.7 cu. ft. (0.08 cu. m) **OR** 3.2 cu. ft. (0.09 cu. m) **OR** 3.8 cu. ft. (0.11 cu. m).
 - d. Controls: Touch-pad **OR** Rotary-dial controls, **as directed**, for water-fill levels, wash/rinse water temperatures, and variable-speed and fabric selectors.
 - 1) Wash Cycles: Four **OR** Six **OR** 10 wash cycles, **as directed**, including regular, delicate, and permanent press.
 - 2) Wash Temperatures: Three settings.
 - 3) Speed Combinations: Two **OR** Four **OR** Five, **as directed**.
 - e. Electrical Power: 120 V, 60 Hz, 1 phase.
 - f. Motor: Manufacturer's standard with built-in overload protector.
 - g. Features:
 - 1) Agitator: Center spindle **OR** Impeller (without spindle), **as directed**.
 - 2) Self-cleaning lint filter.
 - 3) Unbalanced-load compensator.
 - 4) Inlet Hoses: Minimum length 60 inches (1525 mm).
 - 5) Drain Hoses: Minimum length 48 inches (1220 mm).
 - 6) Self-leveling legs.
 - 7) Automatic dispenser for bleach **OR** fabric softener **OR** and **OR** detergent, **as directed**.
 - 8) Spin-cycle safety switch.
 - 9) End-of-cycle signal.
 - 10) Extra-rinse option.
 - 11) Delay-wash option.
 - 12) Electronic temperature control.
 - 13) Water levels automatically set.
 - 14) Pedestal: 8-inch- (203-mm-) high **OR** 15-inch- (381-mm-) high **OR** Manufacturer's standard height laundry pedestal , **as directed**, with storage drawer, matching appliance finish.
 - h. Energy Performance, ENERGY STAR: Provide appliances that qualify for the EPA/DOE ENERGY STAR product labeling program.
 - i. Water-Efficient Clothes Washer: Provide clothes washer with modified energy factor greater than or equal to 2.0 and water factor less than 5.5.
 - j. Appliance Finish: Porcelain enamel on top and lid; baked enamel on front and sides **OR** Stainless steel, **as directed**.

- 1) Color: White **OR** Almond, **as directed**.
- k. Front-Panel Finish: Manufacturer's standard **OR** Wood panel to match kitchen cabinets **OR** Porcelain enamel **OR** Stainless steel **OR** Wood-panel insert specified in Division 06 Section "Interior Architectural Woodwork" to match kitchen cabinets **OR** Wood-panel insert specified in Division 12 Section "Residential Casework" to match kitchen cabinets, **as directed**.
 - 1) Panel Color: White **OR** Black, **as directed**.
2. Clothes Dryer Complying with AHAM HLD-1:
 - a. Type: Freestanding **OR** Stacking **OR** Undercounter, **as directed**, frontloading, gas **OR** electric **OR** electric, ventless unit, **as directed**.
 - b. Dimensions:
 - 1) Width: 23-1/2 inches (597 mm) **OR** 27 inches (686 mm), **as directed**.
 - 2) Depth: 24 inches (610 mm) **OR** 31 inches (787 mm), **as directed**.
 - 3) Height: 34-1/2 inches (876 mm) **OR** 36 inches (914 mm), **as directed**.
 - c. Drum: Manufacturer's standard **OR** Perforated porcelain-enameled steel **OR** Perforated stainless steel, **as directed**.
 - 1) Capacity: 5.7 cu. ft. (0.16 cu. m) **OR** 7.0 cu. ft. (0.20 cu. m), **as directed**.
 - d. Controls: Touch-pad **OR** Rotary-dial controls for drying cycle, **as directed**, temperatures, and fabric selectors.
 - e. Electric-Dryer Power: 240 V, 60 Hz, 1 phase, 30 A.
 - f. Gas-Dryer Power: 120 V, 60 Hz, 1 phase, 15 A electric; 22,000-Btu/h (6400-W) gas.
 - g. Features:
 - 1) Features in first five subparagraphs below are standard with most manufacturers.
 - 2) Removable lint filter.
 - 3) Electronic temperature and moisture level sensor control.
 - 4) End-of-cycle signal.
 - 5) Interior drum light.
 - 6) Self-leveling legs.
 - 7) Antibacterial cycle.
 - 8) Auxiliary drying rack.
 - 9) Built-in electrical power fuse.
 - 10) Stacking kit to stack dryer over washer.
 - 11) Pedestal: 8-inch- (203-mm-) high **OR** 15-inch- (381-mm-) high **OR** Manufacturer's standard height laundry pedestal, **as directed**, with storage drawer, matching appliance finish.
 - h. Appliance Finish: Porcelain enamel on top and lid; baked enamel on front and sides **OR** Stainless steel, **as directed**.
 - 1) Color: White **OR** Almond, **as directed**.
 - i. Front-Panel Finish: Manufacturer's standard **OR** Wood panel to match kitchen cabinets **OR** Porcelain enamel **OR** Stainless steel **OR** Wood-panel insert specified in Division 06 Section "Interior Architectural Woodwork" to match kitchen cabinets **OR** Wood-panel insert specified in Division 12 Section "Residential Casework" to match kitchen cabinets.
 - 1) Panel Color: White **OR** Black, **as directed**.
- K. Clothes Washer/Dryer Combinations
 1. Clothes Washer/Dryer Combination Complying with ASSE 1007.
 - a. Type: Freestanding washer/dryer unit with dual-drum design and electric dryer **OR** dual-drum design and gas dryer **OR** all-in-one, single-drum design, **as directed**; washer is top **OR** front loading, **as directed**.
 - b. Dimensions:
 - 1) Width: 23-1/2 inches (597 mm) **OR** 27 inches (686 mm), **as directed**.
 - 2) Depth: 25 inches (635 mm) **OR** 32 inches (813 mm), **as directed**.
 - 3) Height: 34-1/2 inches (876 mm) **OR** 71-1/2 inches (1816 mm), **as directed**.
 - c. Washer and Dryer Drums: Manufacturer's standard **OR** Perforated porcelain-enameled steel **OR** Perforated stainless steel, **as directed**.

- 1) Washer-Drum Capacity: 1.5 cu. ft. (0.04 cu. m) OR 2.0 cu. ft. (0.06 cu. m) OR 2.6 cu. ft. (0.07 cu. m), as directed.
 - 2) Dryer-Drum Capacity: 2.0 cu. ft. (0.06 cu. m) OR 3.4 cu. ft. (0.10 cu. m) OR 5.9 cu. ft. (0.17 cu. m), as directed.
 - d. Washer/Dryer Drum: Manufacturer's standard OR Perforated stainless steel, as directed.
 - 1) Drum Capacity: 2.3 cu. ft. (0.07 cu. m).
 2. Washer Controls: Touch-pad OR Rotary-dial controls for water-fill levels, as directed, wash/rinse water temperatures and variable-speed and fabric selectors.
 3. Dryer Controls: Touch-pad OR Rotary-dial controls for drying cycle, as directed, temperatures and fabric selectors.
 - a. Wash Cycles: Three wash cycles including regular, delicate, and permanent press.
 - b. Wash Temperatures: Three settings.
 - c. Speed Combinations: Two.
 4. Electric Washer/Dryer Power: 240 V, 60 Hz, 1 phase, 30 A OR 120 V, 60 Hz, 1 phase, 15 A, as directed.
 5. Gas Washer/Dryer Power: 120 V, 60 Hz, 1 phase, 15 A electric; 22,000-Btu/h (6400-W) gas.
 6. Motor: Manufacturer's standard with built-in overload protector.
 7. Washing Features:
 - a. Self-cleaning lint filter.
 - b. Unbalanced-load compensator.
 - c. Inlet Hoses: Minimum length 60 inches (1525 mm).
 - d. Drain Hoses: Minimum length 48 inches (1220 mm).
 - e. Self-leveling legs.
 - f. Automatic dispenser for bleach, fabric softener and OR detergent.
 - g. Spin-cycle safety switch.
 8. Drying Features:
 - a. Removable lint filter.
 - b. Electronic temperature and moisture level sensor control.
 - c. End-of-cycle signal.
 - d. Interior drum light.
 9. Energy Performance, ENERGY STAR: Provide appliances that qualify for the EPA/DOE ENERGY STAR product labeling program.
 10. Water-Efficient Clothes Washer: Provide clothes washer with modified energy factor greater than or equal to 2.0 and water factor less than 5.5.
 11. Appliance Finish: Porcelain enamel on top and lid; baked enamel on front and sides OR Stainless steel, as directed.
 - 1) Color: White OR Almond, as directed.
- L. Trash Compactors
- a. Type: Built in OR Convertible, as directed.
 - b. Width: 15 inches (381 mm) OR 18 inches (457 mm), as directed.
 - c. Capacity: 1.4 cu. ft. (0.04 cu. m) OR 1.7 cu. ft. (0.05 cu. m), as directed.
 - d. Features:
 - 1) Key-operated starting switch.
 - 2) Rear wheels.
 - 3) Removable bag carrier.
 - 4) Retainer for disposable bags.
 - 5) Odor-control mechanism.
 - 6) Foot-operated drawer operator.
 - e. Front Panel: Manufacturer's standard OR Wood panel to match kitchen cabinets OR Enameled steel OR Stainless steel OR Wood-panel insert specified in Division 06 Section "Interior Architectural Woodwork" to match kitchen cabinets OR Wood-panel insert specified in Division 12 Section "Residential Casework" to match kitchen cabinets, as directed.
 - a) Panel Color: White OR Black, as directed.

M. General Finish Requirements

1. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
2. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

1.3 EXECUTION

A. Examine

1. Examine substrates and conditions, with Installer present, for compliance with requirements for installation tolerances, power connections, and other conditions affecting installation and performance of residential appliances.
2. Examine roughing-in for piping systems to verify actual locations of piping connections before appliance installation.
3. Examine walls, ceilings, and roofs for suitable conditions where overhead exhaust hoods **OR** downdraft exhaust and microwave ovens with vented exhaust fans will be installed.
4. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.
5. Proceed with installation only after unsatisfactory conditions have been corrected.

B. Installation, General

1. General: Comply with manufacturer's written instructions.
2. Built-in Equipment: Securely anchor units to supporting cabinets or countertops with concealed fasteners. Verify that clearances are adequate for proper functioning and rough openings are completely concealed.
3. Freestanding Equipment: Place units in final locations after finishes have been completed in each area. Verify that clearances are adequate to properly operate equipment.
4. Range Anti-Tip Device: Install at each range according to manufacturer's written instructions
5. Utilities: Refer to Division 21 AND Division 26 for plumbing and electrical requirements.

C. Field Quality Control

1. Perform tests and inspections.
 - a. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.
2. Tests and Inspections:
 - a. Perform visual, mechanical, and electrical inspection and testing for each appliance according to manufacturers' written recommendations. Certify compliance with each manufacturer's appliance-performance parameters.
 - b. Leak Test: After installation, test for leaks. Repair leaks and retest until no leaks exist.
 - c. Operational Test: After installation, start units to confirm proper operation.
 - d. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and components.
3. An appliance will be considered defective if it does not pass tests and inspections.
4. Prepare test and inspection reports.

END OF SECTION 11 30 13 13

SECTION 11 30 13 13a - REFRIGERATORS

1.1 GENERAL

A. Summary

1. Section Includes:
 - a. Remove existing refrigerators.
 - b. Refrigerators supply and deliver only or supply and install as scheduled.
2. Related Requirements: Comply with requirements of following sections:
 - a. Contractor Use of Premises and Work Sequence
 - b. Section "Alteration Project Procedures."
3. Related Sections:
 - a. Kitchen Renovation Requirements; "Summary of Work"
 - b. Reference Standards: Section "References."

B. References

1. Reference Standards: See Section "References." Comply with following:
 - a. Association of Home Appliance Manufacturers (AHAM) HRF-1 - Standard for Household Refrigerators and Household Freezers, 1988.
 - 1) ASTM B 117 - Salt Spray (Fog) Testing.
 - b. ANSI/UL 250 - Household Refrigerators and Freezers, 1991.
 - c. Certification:
 - 1) ANSI Z34.2 - Certification, Self-Certification by Producer or Supplier, 1987.

C. Definitions

1. Configurations:
 - a. SD: Single Door.
 - b. TF: Top Freezer.
 - c. BF: Bottom Freezer.
 - d. SS: Side-by-Side.
2. Defrost System:
 - a. M: Manual Defrost: Defrost system in which defrosting action for refrigerated surfaces is initiated manually.
 - b. P: Partial Automatic: Defrost system in which defrosting action for refrigerated surfaces in refrigerator compartment is initiated and terminated automatically and defrosting action for refrigerated surfaces in freezer is initiated manually.
 - c. A: Automatic Defrost: Defrost system in which defrosting action for all refrigerated surfaces is initiated and terminated automatically.
3. Efficiency Standards:
 - a. Refrigerator: Cabinet designed for refrigerated storage of food at temperatures above 0 degrees C (32 degrees F) and may include compartment for freezing and storage of food at temperatures below 0 degrees C (32 degrees F), but does not provide separate low temperature compartment designed for freezing and storage of food at temperatures below minus 13 degrees C (8 degrees F).
 - b. Refrigerator-freezer: Cabinet with two or more compartments with at least one compartment designed for refrigerated storage of food at temperatures above 0 degrees C (32 degrees F) and with at least one compartment designed for freezing and storage of food at temperatures below minus 13 degrees C (8 degrees F).
 - c. AV: Adjusted Volume:
 - 1) Refrigerator: [1.44 x freezer volume (cubic feet)] + refrigerator volume (cubic feet).
 - 2) Refrigerator-freezer: [1.63 x freezer volume (cubic feet)] + refrigerator volume (cubic feet).
4. Supply and Delivery Only: Include supply and delivery to site(s) FOB destination freight prepaid. Unless otherwise specified or scheduled, unloading and handling at site is by PHA/IHA.



D. System Description

1. Performance Requirements: Comply with following:
 - a. Refrigerators: Capable of producing average cabinet air temperature in general food storage compartment of 2.2 degrees C (36 degrees F) in ambient of 21.1 degrees C (70 degrees F), and 3.3 degrees C (38 degrees F) in ambient of 43.3 degrees C (110 degrees F).
 - 1) Performance Test Procedures: As specified in AHAM HRF-1.
 - b. Plastic Compartment and Door Liners: Not show any cracks or crazing when tested under Environment Cracking Resistance Test specified in AHAM HRF-1.
 - 1) Single-Piece Liners Testing: As specified in AHAM HRF-1, paragraph 10.6.
2. Efficiency Standards: Provide refrigerators which do not exceed following annual energy consumption in kWh:
 - a. Refrigerators and Refrigerator-freezers with Manual Defrost: 13.5 AV plus 299.
 - b. Refrigerator-freezers with Partial Automatic Defrost: 10.4 AV plus 398.
 - c. Refrigerator-freezers with Automatic Defrost with Top Mounted Freezer without Through-the-door Ice Service: 16.0 AV plus 355.
 - d. Refrigerator-freezers with Automatic Defrost with Side Mounted Freezer without Through-the-door Ice Service: 11.8 AV plus 501.
 - e. Refrigerator-freezers with Automatic Defrost with Bottom Mounted Freezer without Through-the-door Ice Service: 16.5 AV plus 367.

E. Submittal

1. Product Data: Submit to Contracting Officer.
2. Samples:
 - a. Production Sample: When requested, provide sample refrigerator to Contracting Officer for examination as to compliance with specifications.
 - b. Color Samples: Submit samples of manufacturer's standard colors to Contracting Officer for selection.
3. Quality Assurance/Control Submittals: Submit following to Contracting Officer:
 - a. Certificates: Manufacturer's written self certification that refrigerators meet or exceed specified requirements.
 - b. Manufacturer's installation instructions.
4. Closeout Submittals: Submit following to Contracting Officer:
 - a. Operation and Maintenance: Provide use and care information with each refrigerator. Include parts manual with diagrams and part numbers.
 - b. Special warranty.

F. Quality Assurance

1. Qualifications: Manufacturer: Stock and sell parts for refrigerators supplied for five years from time of delivery.
2. Regulatory Requirements: Comply with following:
 - a. EPA regulations regarding refrigerant.
 - b. Accessibility:
 - 1) Architectural Barriers Act of 1968 as amended (42 USC 4151-4157) and HUD implementing regulations (24 CFR Part 40).
 - a) Uniform Federal Accessibility Standards (UFAS).
 - 2) Section 504 of the Rehabilitation Act of 1973 as amended (29 USC 794) and HUD implementing regulations 24 CFR Part 8.
 - 3) Fair Housing Accessibility Guidelines (24 CFR Chapter 1).
 - 4) Americans with Disabilities Act of 1990 (ADA) (42 USC §§ 12101, et seq.) and implementing regulations (28 CFR Part 35).
3. Appliances shall meet or exceed requirements established by the Energy Star program and bear the Energy Star logo. Visit www.energystar.gov for a listing of products that qualify. Energy Star® is a voluntary partnership that includes the U.S. Department of Energy, the U.S. Environmental Protection Agency, product manufacturers, local utilities, and retailers, helps

promote efficient products by labeling them with the Energy Star logo and educating consumers about the benefits of energy efficiency.

- G. Delivery, Storage, And Handling
 - 1. Packing, Shipping, Handling, and Unloading: In accordance with standard commercial practices.
 - 2. Acceptance at Site: Inspect refrigerators upon delivery. Replace damaged or defective appliances before installation.
- H. Scheduling
 - 1. Scheduling and Completion: Comply with requirements of Division 1.
- I. Warranty
 - 1. Special Warranties: Provide following written special warranties:
 - a. Plastic parts of cabinet for period of two years.
 - b. Sealed refrigerator cooling system for five years.
 - 1) Provide new or reconditioned cooling system units or components, replacing units and/or parts which become defective (excluding damage due to visible abuse) during five year period.
 - c. Entire refrigerator for one year.
 - 2. Special Warranty Periods: If refrigerator becomes inoperative, as defined in following paragraph, repair or replace and install any part (except enamel, porcelain or lacquer) necessary to make refrigerator operative within five working days of notification.
 - a. Inoperative Refrigerator: When interior cabinet temperature rises above 10.0 degrees C (50 degrees F) and remains at such temperature for six or more consecutive hours after usual normal adjustments have been made or other mechanical and electrical trouble affecting normal operations has been corrected.
 - 3. Special Warranties: Include labor, material and equipment to provide replacements and make repairs to refrigerators at no additional cost to PHA/IHA.
 - a. Defective Units and/or Parts: Become property of Contractor.
 - b. Submit name and address of local agent who will furnish service and replacement parts in connection with warranties to PHA/IHA.
 - 1) Charges by local service agent to PHA/IHA for services covered under special warranties not allowed.

1.2 PRODUCT

- A. Refrigerators - General Requirements
 - 1. Refrigerators: Household type, self-contained with electric-motor-driven condensing units and comply with Performance Requirements and Energy Standard Requirements.
 - 2. Types, Sizes and Grades: As specified and scheduled.
 - 3. Total Storage Volumes, Shelf Areas and Dimensions: In accordance with descriptions and computed in accordance with AHAM HRF-1.
- B. Refrigerators Cabinets
 - 1. Outer Shells (including Doors): Carbon-steel sheet finished in baked synthetic enamel.
 - a. Colors: As scheduled from manufacturer s standard colors.
 - 2. Exterior Doors: Provide with reversible hinges for right or left hand swing except on side-by-side (SS) configuration.
 - a. Construction of Freezer or Evaporator Door and Hinging: Door may be operated without breaking, cracking, or distorting when freezer or evaporator is free from or has maximum thickness of 6 mm (1/4 inch) of frost on outer surface of evaporator adjacent to door.
 - b. Exterior Doors: Equipped with magnetic gasket.
 - c. Doors: Contain shelves.
 - 3. Interior Liners of (including General and Low-Temperature) Storage Compartments and Doors: Porcelain enamel on carbon-steel or molded plastic.

- a. Carbon-Steel Sheet Inner Liners: Porcelain enamel or baked synthetic enamel finish.
 - b. Color of Plastic Inner Liners: White or pastel.
 - c. Plastic Liners in Conjunction with Foamed-In-Place Polyurethane Employing Fluorinated Hydrocarbons: Isolate liner material from polyurethane foam or fabricate of acrylonitrile butadiene styrene (ABS) or High Impact Polystyrene (HIPS).
 - d. Breaker Strips: ABS plastic, polypropylene, or HIPS when insulation is foamed-in-place polyurethane with fluorinated hydrocarbons.
 4. Drawers and Trays:
 - a. Vegetable Drawers or Crisper Trays: Provide one or more trays occupying full width of food compartment and readily removable.
 - b. Drawers or Trays: Constructed of steel finished with porcelain enamel, anodized aluminum, or durable plastic; durable glass; or non-corrosive metal.
 - c. Ice Cube Trays: Provide minimum of two standard size ice cube trays.
 - d. Defrosting or Chiller Tray: Made of material suitable for intended service and of adequate size to receive drip from cooling unit during defrosting.
 5. Hardware Components: Sturdy construction and made of material that are durable and structurally correct for application.
 - a. Hardware Attachment Devices (screws, bolts and nuts): Of material and finish consistent with material of components and parts which they are used.
 - b. Hardware Finish: Remain intact after being subjected to salt spray test for period of 25 hours in accordance with ASTM B 117.
 - 1) Center Section of Door Handle: Vinyl covered steel is acceptable.
 - c. Food Compartment Door Hinges: May be same finish as specified for outer panel of food compartment door.
 - d. Hardware: Securely attached in substantial manner and to extent that removal may not be accomplished without use of tools.
 6. Manual Defrost and Partial Defrost Refrigerators: Provide clear and legible caution similar to following: Do not use implements to defrost or to remove ice trays or other material from freezer section.
 - a. Location: Print or impress on freezer door or on name plate securely fastened in another prominent position easily read by user.
- C. Refrigerators Components
1. Electrical Components and Parts: Locate and mount controls, lamp socket, relay, switches, thermostat, wiring harness, cables and leads and their accessories in manner that their replacement may be readily accomplished.
 - a. Electrical Assemblies and Harness: Design and manufacture so that replacement of complete assembly or harness is not necessary when any component part of assembly becomes defective or inoperative.
 - b. Individual Components and Parts of Assemblies and Harness: Obtainable for relatively simple replacement purposes.
 2. Temperature Control: Equip refrigerators with off position and contact points or setting positions for wide range of degrees of temperature, which may be selected by readily accessible knob, properly marked with settings available, mounted on temperature control shaft.
 - a. Relay: Quality and rating which under normal operating conditions shall function properly for at least one year period and which is consistent with requirements specified and its companion components and parts in electrical circuit.
 3. Motor: For 115 volt, plus or minus 10 percent, 60 HZ, single phase, alternating current operation and capable of starting in ambient temperature of 37.8 degrees C (100 degrees F) on voltages between 90 percent and 100 percent of rated voltage.
 - a. Thermal Overload Protection: Automatic re-set type to prevent excess temperature rise of motor windings.
 - b. Three-Wire Cord with Three-Prong Attachment Plug: Provide grounding of refrigerator and extend five feet to nine feet beyond point at which it is attached to back of cabinet.

- c. Motor: Type, speed, load and horsepower ratings consistent with other requirements specified.
- 4. Refrigeration Unit: Compressor, motor and housing of hermetically sealed type with reciprocating or rotary-type compressor.
 - a. Compressor: Equipped with means of unloading, such as automatic unloader or capillary tube.
 - b. Sealed Refrigerating System: Serviceable by complete unit replacement or replacement of component parts such as motor compressor assembly, evaporator, condenser and heat exchanger.
 - c. Hermetic Compressor Unit: Quiet in operation, free from excessive vibration and entirely automatic in operation.
- D. Workmanship
 - 1. Welding and Brazing: Complete; uniform and properly fused; with no holes, slag inclusions, scale, or flux deposits; and not cracked, fractured or undercut.
 - 2. Soldering: Complete, clean, adherent and without pin-holes.
 - 3. Fasteners: Not be broken, fractured, stripped, or loose.
 - a. Structural Parts Subject to Vibration: Provide lock washers or self-locking washers.

1.3 EXECUTION

- A. Examination
 - 1. Site Verification of Conditions:
 - a. Utilities: Verify that required utilities are available, in proper locations, and ready for use.
- B. Preparation
 - 1. Existing Refrigerators: Remove existing refrigerators and debris from site.
- C. Installation
 - 1. General: Install refrigerators in accordance with manufacturer's recommendations.
 - a. Make adjustments to feet of refrigerators for a level installation.
 - b. Install in manner to ensure proper ventilation space is present.
- D. Cleaning
 - 1. Cleaning: Comply with requirements of Section 01120.
- E. Schedules
 - 1. Provide refrigerators as selected in following schedule:
 - _____ Remove existing refrigerators.
 - _____ Supply and Deliver Only to _____.
 - _____ Unloading and handling included.
 - _____ Supply and Install.

SELECTION SIZE

COLOR TYPE

_____ 0.28 cu m (10.0 CU FT) Minimum	_____ SD/M/S: Small, Single Door, Manual Defrost.
_____ 0.37 cu m (13.0 CU FT) Minimum	_____ SD/M/L: Large, Single Door, Manual Defrost.
_____ 0.28 - 0.34 cu m (10.0 - 11.9) CU FT	_____ TF/P/S: Small, Top Freezer, Partial Automatic Defrost.
_____ 0.34 - 0.39 cu m (12.0 - 13.9 CU FT)	_____ TF/P/M: Medium, Top Freezer, Partial Automatic Defrost.



_____ 0.40 cu m (14.0 CU FT) Minimum	_____ TF/P/L: Large, Top Freezer, Partial Automatic Defrost.
_____ 0.28 - 0.34 cu m (10.0 - 11.9 CU FT)	_____ TF/A/S: Small, Top Freezer, Automatic Defrost.
_____ 0.34 - 0.39 cu m (12.0 - 13.9 CU FT)	_____ TF/A/M: Medium, Top Freezer, Automatic Defrost.
_____ 0.40 - 0.45 cu m (14.0 - 15.9 CU FT)	_____ TF/A/ML: Medium/Large, Top Freezer, Automatic Defrost.
_____ 0.45 - 0.51 cu m (16.0 - 17.9 CU FT)	_____ TF/A/L: Large, Top Freezer, Automatic Defrost.
_____ 0.51 cu m (18.0 CU FT) Minimum	_____ TF/A/EL: Extra Large, Top Freezer, Automatic Defrost.
_____ 0.45 cu m (16.0 CU FT) Minimum	_____ BF/A for Accessible Units: Bottom Freezer, Automatic Defrost in accordance with UFAS requirements.
_____ 0.45 cu m (16.0 CU FT) Minimum	_____ SS/A for Accessible Units: Side-by-Side, Automatic Defrost in accordance with UFAS requirements.

END OF SECTION 11 30 13 13a

SECTION 11 30 13 13b - GAS RANGES

GENERAL

Summary

1. Section Includes:
 - a. Remove existing ranges.
 - b. Gas ranges, supply and deliver only or supply and install as scheduled.
2. Related Requirements: Comply with requirements of following sections:
 - a. Contractor Use of Premises and Work Sequence; "Summary of Work"
 - b. Section "Alteration Project Procedures."
3. Related Sections:
 - a. Kitchen Renovation Requirements: Section "Summary of Work"
 - b. Reference Standards: Section "References."
 - c. Electric Ranges: Section "Electric Ranges."
 - d. Gas Line Relocation: Section "Plumbing."

References

4. Reference Standards: See Section "References." Comply with following:
 - a. American National Standard Institute (ANSI) Z21.1 - Household Cooking Gas Appliances, 1990, including addenda Z21.1a, 1991.
 - 1) ANSI Z21.20 - Automatic Gas Ignition Systems and Components, 1989, including addenda Z21.20a, 1991, and Z21.20b, 1992.
 - b. Certification:
 - 1) ANSI Z34.1 - Certification, Third-Party Certification Program, 1987.
 - 2) ANSI Z34.2 - Certification, Self-Certification by Producer or Supplier, 1987.

Definitions

5. Types:
 - a. Type A: Economy or Builder's Model
 - b. Type C: Quality Model with hinged top.
6. Supply and Delivery Only: Include supply and delivery to site(s) FOB destination freight prepaid. Unless otherwise specified or scheduled, unloading and handling at site is by PHA/IHA.

Submittals

7. Product Data: Submit to the Owner.
8. Samples:
 - a. Production Sample: When requested, provide sample gas range to the Owner for examination as to compliance with specifications.
 - b. Color Samples: Submit samples of manufacturer's standard colors to the Owner for selection.
9. Quality Assurance/Control Submittals: Submit following to the Owner:
 - a. Certificates: Manufacturer's written certification that ranges have been tested and comply with ANSI Z21.1 for operation with natural or LP gas.
 - 1) Certification by American Gas Association (AGA) Laboratories, or Third Party Certifier in accordance with ANSI Z34.1.
 - 2) Acceptable Evidence of Meeting Applicable Requirements of Standard: Photostatic copy of American Gas Association (AGA) Laboratories Appliance Certificate or listing including igniter device in American Gas Association (AGA) Laboratories Directory of Certified Appliances and Accessories.
 - b. Manufacturer's installation instructions.
10. Closeout Submittals: Submit following to the Owner:

- a. Operation and Maintenance: Provide use and care information with each gas range. Include parts manual with diagrams and part numbers.
- b. Special warranty.

Quality Assurance

- 11. Qualifications: Manufacturer: Stock and sell parts for ranges supplied for five years from time of delivery.
- 12. Regulatory Requirements: Comply with and following:
 - a. Gas Connections: Comply with applicable codes and regulations.
 - b. Accessibility:
 - 1) Architectural Barriers Act of 1968 as amended (42 USC 4151-4157) and HUD implementing regulations (24 CFR Part 40).
 - a) Uniform Federal Accessibility Standards (UFAS).
 - 2) Section 504 of the Rehabilitation Act of 1973 as amended (29 USC 794) and HUD implementing regulations 24 CFR Part 8.
 - 3) Fair Housing Accessibility Guidelines (24 CFR Chapter 1).
 - 4) Americans with Disabilities Act of 1990 (ADA) (42 USC §§ 12101, et seq.) and implementing regulations (28 CFR Part 35).
- 13. Appliances shall meet or exceed requirements established by the Energy Star program and bear the Energy Star logo. Visit www.energystar.gov for a listing of products that qualify. Energy Star® is a voluntary partnership that includes the U.S. Department of Energy, the U.S. Environmental Protection Agency, product manufacturers, local utilities, and retailers, helps promote efficient products by labeling them with the Energy Star logo and educating consumers about the benefits of energy efficiency.

Delivery, Storage, And Handling

- 14. Packing, Shipping, Handling, and Unloading: In accordance with standard commercial practices.
- 15. Acceptance at Site: Inspect gas ranges upon delivery. Replace damaged or defective appliances before installation.

Scheduling

- 16. Scheduling and Completion: Comply with requirements of Division 1.

Warranty

- 17. Special Warranties: Provide following written special warranties:
 - a. Entire gas range for one year.
- 18. Special Warranties: Include labor, material and equipment to provide replacements and make repairs to gas ranges at no additional cost to PHA/IHA.
 - a. Defective Units and/or Parts: Become property of Contractor.
 - b. Submit name and address of local agent who will furnish service and replacement parts in connection with warranties to PHA/IHA.
 - 1) Charges by local service agent to PHA/IHA for services covered under special warranties not allowed.

PRODUCTS

Gas Ranges - General Requirements

- 19. Ranges: ANSI Z21.1, current standard models of manufacturer except for additional requirements specified.
 - a. Ranges: Floor mounted, free standing flush-to-wall, domestic gas ranges with open cooking top, oven and broiler below.
 - b. Ranges of Same Size: Identical, including parts and assemblies.
- 20. Gas Valves: Provide with either:
 - a. Convertible orifice set for gas specified on purchase order .

- b. Fixed orifice hood for use with gas specified on order.
- 21. Convertible Gas Pressure Regulators: Provide with each range.

Type A Ranges (Economy Or Builder S Model)

- 22. Burners: Provide cooking top with four burners.
 - a. Each Burner: Rated at no less than 2 650 W (9000 BTU/H) for natural gas and 2 350 W (8000 BTU/H) for LP.
- 23. Manual Gas Valves: Limited displacement type complying with ANSI Z21.1.
- 24. Grates: Provide each top burner with porcelain enameled cast iron or steel grate.
- 25. Ignition: One of following:
 - a. Automatic Ignition: Equip burners with means for automatic ignition of gas. Failure of oven burner pilot shall activate means for shutting off gas to oven burner.
 - b. 2. Intermittent Ignition: Equip burners with means for automatic electric ignition of gas complying with applicable requirements of ANSI Z21.20. Electric Ignition System: May be either spark, coil, glow bar, or combination of these.
- 26. Oven Thermostat Control: Provide oven thermostat control for controlling oven temperatures down to "hold warm temperature", approximately 77 degrees C (170 degrees F).
- 27. F. Insulation: Glass fiber blanket type, installed in manner to prevent sagging, and of sufficient thermal efficiency to meet surface and handle temperature tests specified in ANSI Z21.1.
- 28. Oven and Broiler Sections: Porcelain enamel-coated steel.
 - a. Broiling Section: Either drop door type, pull-out-type, or swing-door type with 3-position smokeless broiler pan and grill sliding on stationary runners.
 - b. Provide stops so that oven racks cannot be completely pulled out by accident.
- 29. Oven Vents: Provide ovens with vent designed to deflect moisture and fumes away from wall behind range.
- 30. Oven Doors: Drop-shelf type, counter-balanced and provided with device to hold door fully closed.
 - a. Hinges: Permit ready removal and replacement of hinge brackets and parts subject to wear.
 - b. Provide oven doors with means for adjusting misaligned door.
- 31. Burner Bowls (Aeration Bowls): Corrosion-resisting steel, plated steel, or steel coated with porcelain enamel.
 - a. Bowls: May be separate bowls or integral part of top.
- 32. Exterior Surfaces: Porcelain enamel, except body sides and front panels (including oven door) may be finished in synthetic baked-on enamel capable of withstanding 121 degrees C (250 degrees F).
 - a. Trim: In accordance with manufacturer's standard practice.
 - b. Backguard, Manifold Shield, Aeration Bowls, and Burners: May be porcelain enamel.
 - c. Range Body Back Panel, Legs, and/or Base: Porcelain enamel, baked-on enamel, galvanized, or aluminized steel.
 - d. Colors: As scheduled from manufacturer s standard colors.
- 33. Backguards: Equip each range with back guards not less than 100 mm (4 inches) higher than top cooking surface and extending full width of range top.
- 34. Equipment and Accessories: Provide accessories such as oven and broiler racks normally supplied with manufacturer's standard production for type range scheduled.
- 35. Name Plate: Permanent record of manufacturer's name and address, range model and serial number, and manufacturer's normal hourly W (BTU/H) input rating for oven, broiler and top burners.
 - a. Securely fasten nameplate to main part of each range in accessible place.

Type C Ranges (Quality Model)

- 36. General Requirements: Comply with requirements for Type A Ranges except as modified by following requirements.
- 37. B. Range Top: Hinged at back or lift off for easy cleaning and access to burners, valves, and pilots.



- a. Hinge Top: May have supporting rod to hold top in raised position or be removable. Design supporting rod, when in raised position, to prevent accidental closing of range top. Counterbalanced top is also acceptable.
- 38. Cooking Top Burners/Low Setting: Equip each range with burners with low settings not in excess of 400 W (1400 BTU/H).
- 39. Leg levelers: Equip each range with at least two leg levelers.
- 40. Manifold Shield: Provide recessed or slanted manifold shield to minimize burning of burner knobs from heat from open oven doors.
- 41. Oven Door: Provide 610 mm (24 inch), 760 mm (30 inch) and 910 mm (36 inch) ranges with removable oven door.

EXECUTION

Examination

- 42. Site Verification of Conditions:
 - a. Utilities: Verify that required utilities are available, in proper locations, and ready for use.

Preparation

- 43. Existing Ranges: Remove existing ranges and debris from site.

Installation

- 44. General: Install gas ranges in accordance with manufacturer's recommendations.
 - a. Make connection to gas line in accordance with applicable codes.
 - b. Make adjustments to feet of ranges for a level installation.

Cleaning

- 45. Cleaning: Comply with requirements of Division 1.

Schedules

- 46. Provide gas ranges as selected in following schedule:

- _____ Remove existing ranges.
- _____ Supply and Deliver Only to _____.
- _____ Unloading and handling included.
- _____ Supply and Install.

SELECTION	NUMBER OF	SIZE	COLOR	TYPE BURNERS
_____	4 Burner	510 mm (20 Inch)	_____	Type A Economy or Builders Model.
_____	4 Burner	610 mm (24 Inch)	_____	Type A Economy or Builders Model.
_____	4 Burner	760 mm (30 Inch)	_____	Type A Economy or Builders Model.
_____	4 Burner	910 mm (36 Inch)	_____	Type A Economy or Builders Model.
_____	4 Burner	510 mm (20 Inch)	_____	Type C Quality Model.
_____	4 Burner	610 mm (24 Inch)	_____	Type C Quality Model.
_____	4 Burner	760 mm (30 Inch)	_____	Type C Quality Model.
_____	4 Burner	910 mm (36 Inch)	_____	Type C Quality Model.

END OF SECTION 11 30 13 13b

SECTION 11 30 13 13c - ELECTRIC RANGES

GENERAL

Summary

1. Section Includes:
 - a. Remove existing ranges.
 - b. Electric ranges, supply and deliver only or supply and install as scheduled.
2. Related Requirements: Comply with requirements of following sections:
 - a. Contractor Use of Premises and Work Sequence: Section "Summary of Work."
 - b. Section "Alteration Project Procedures."
3. Related Sections:
 - a. Kitchen Renovation Requirements: Section "Summary of Work."
 - b. Reference Standards: Section "References."
 - c. Gas Ranges: Section "Gas Ranges."
 - d. Electrical Renovation: Section "Electrical Renovation."

References

4. Reference Standards: See Section "References." Comply with following:
 - a. Association of Home Appliance Manufacturers (AHAM) ER-1 - American National Standard Household Electric Ranges, 1992.
 - b. Federal Specification (FS): WR-101F dated March 13, 1970, and Interim Amendment 2 dated December 31, 1970.
 - c. Underwriter's Laboratories (UL): ANSI/UL 858 - Household Electric Ranges, 1986.
 - d. Certification:
 - 1) ANSI Z34.1 - Certification, Third-Party Certification Program, 1987.
 - 2) ANSI Z34.2 - Certification, Self-Certification by Producer or Supplier, 1987.

Definitions

5. Standard Ranges: Four Surface Cooking Units: Three - 150 mm (6 inch) and one - 200 mm (8 inch) with oven and broiler below.
 - a. Type, Style, and Sizes as defined in FS W-R-101F:
 - 1) Type I: Freestanding range.
 - 2) Type II: Build-in (slide-in) range.
 - 3) Style 1: Single oven.
 - 4) Style 2: Double oven 1 020 mm (40 inches) wide.
 - 5) Size 1: 1 020 mm (40 inches) wide.
 - 6) Size 2: 910 mm (36 inches) wide.
 - 7) Size 3: 760 mm (30 inches) wide.
 - 8) Size 4: 610 mm (24 inches) wide.
 - 9) Size 5: 510 mm (20 inches) wide.
6. Supply and Delivery Only: Include supply and delivery to site(s) FOB destination freight prepaid. Unless otherwise specified or scheduled, unloading and handling at site is by PHA/IHA.

Submittals

7. Product Data: Submit to the Owner.
8. Samples:
 - a. Production Sample: When requested, provide sample electric range to the Owner for examination as to compliance with specifications.
 - b. Color Samples: Submit samples of manufacturer's standard colors to the Owner for selection.
9. Quality Assurance/Control Submittals: Submit following to the Owner:
 - a. Certificates: Manufacturer's written certification that electric ranges meet or exceed specified requirements including UL requirements and requirements of FS WR-101F.



- b. Manufacturer's installation instructions.
- 10. Closeout Submittals: Submit following to the Owner:
 - a. Operation and Maintenance Instructions: Provide use and care information with each range. Include parts manual with diagrams and part numbers.
 - b. Special warranty.

Quality Assurance

- 11. Qualifications: Manufacturer: Stock and sell parts for ranges supplied for five years from time of delivery.
- 12. Regulatory Requirements: Comply with following:
 - a. Accessibility:
 - 1) Architectural Barriers Act of 1968 as amended (42 USC 4151-4157) and HUD implementing regulations (24 CFR Part 40).
 - a) Uniform Federal Accessibility Standards (UFAS).
 - 2) Section 504 of the Rehabilitation Act of 1973 as amended (29 USC 794) and HUD implementing regulations 24 CFR Part 8.
 - 3) Fair Housing Accessibility Guidelines (24 CFR Chapter 1).
 - 4) Americans with Disabilities Act of 1990 (ADA) (42 USC §§ 12101, et seq.) and implementing regulations (28 CFR Part 35).
- 13. Appliances shall meet or exceed requirements established by the Energy Star program and bear the Energy Star logo. Visit www.energystar.gov for a listing of products that qualify. Energy Star® is a voluntary partnership that includes the U.S. Department of Energy, the U.S. Environmental Protection Agency, product manufacturers, local utilities, and retailers, helps promote efficient products by labeling them with the Energy Star logo and educating consumers about the benefits of energy efficiency.

Delivery, Storage, And Handling

- 14. Packing, Shipping, Handling, and Unloading: In accordance with standard commercial practices.
- 15. Acceptance at Site: Inspect electric ranges upon delivery. Replace damaged or defective appliances before installation.

Scheduling

- 16. Scheduling and Completion: Comply with requirements of Division 1.

Warranty

- 17. Special Warranties: Provide following written special warranties:
 - a. Entire electric range for one year.
- 18. Special Warranties: Include labor, material and equipment to provide replacements and make repairs to electric ranges at no additional cost to PHA/IHA.
 - a. Defective Units and/or Parts: Become property of Contractor.
 - b. Submit name and address of local agent who will furnish service and replacement parts in connection with warranties to PHA/IHA.
 - 1) Charges by local service agent to PHA/IHA for services covered under special warranties not allowed.

PRODUCTS

Electric Ranges

- 19. Ranges: AHAM ER-1, ANSI/UL 858, and FS WR-101F, current standard models of manufacturer except for additional requirements specified.
 - a. Ranges: Floor mounted, free standing flush-to-wall, domestic electric ranges with open cooking top, oven and broiler below.
 - b. Ranges of Same Classification: Identical, including parts and assemblies.

- c. Ranges: UL listed and bear UL label.
- 20. Operating Service: 115/230 volts or 120/208 volts, 3-wire, single-phase, 60-HZ.
 - a. Type of Service: As scheduled.
- 21. Ranges:
 - a. Each Range: Equipped with at least two leg levelers.
 - b. Oven Door: Equip 610 mm (24 inch), 760 mm (30 inch), and 910 mm (36 inch) ranges with removable oven door.
 - c. Ranges without Storage Drawer: May be equipped with only one oven rack.

Ranges For Elderly Housing

- 22. Ranges for Elderly Housing: Same as above, Type I or II, Style 1, Sizes 4 and 5, standard electric ranges but, as minimum, include following additional items:
 - a. Location of Controls for Ranges and Cook-Tops: Not require reaching across burners.
 - b. Burner Indicator Lights: Provide light for each top burner and oven unit that will clearly indicate when burner is on.
 - 1) Indicator Light: Integral part of, or adjacent to, each control switch or adjacent to each top burner unit.
 - c. Oven Interior Light: Provide light in each oven that will clearly illuminate interior when oven door is open.

EXECUTION

Examination

- 23. Site Verification of Conditions:
 - a. Utilities: Verify that required utilities are available, in proper locations, and ready for use.

Preparation

- 24. Existing Ranges: Remove existing ranges and debris from site.

Installation

- 25. General: Install electric ranges in accordance with manufacturer's recommendations.
 - a. Make adjustments to feet of ranges for a level installation.
 - b. Electrical Renovation: See Section 16095.

Cleaning

- 26. Cleaning: Comply with requirements of Division 1.

Schedules

- 27. Provide electric ranges as selected in following schedule:

☐ Remove existing ranges.
☐ Supply and Deliver Only to _____
☐ Unloading and handling included.
☐ Supply and Install.

<u>SELECTION</u>	<u>NUMBER</u>	<u>ELECTRIC</u>	<u>COLOR</u>	<u>TYPE AND SIZE</u>
<u>BURNERS</u>		<u>SERVICE</u>		
<input type="checkbox"/>	4 Burner	<input type="checkbox"/>	<input type="checkbox"/>	Type I, Style I, Size 1, 1 020 mm (40 inches wide).
<input type="checkbox"/>	4 Burner	<input type="checkbox"/>	<input type="checkbox"/>	Type I, Style I, Size 2, 910 mm (36 inches) wide.
<input type="checkbox"/>	4 Burner	<input type="checkbox"/>	<input type="checkbox"/>	Type I, Style I, Size 3, 760 mm (30 inches) wide.
<input type="checkbox"/>	4 Burner	<input type="checkbox"/>	<input type="checkbox"/>	Type I, Style I, Size 4, 610 mm (24 inches) wide.
<input type="checkbox"/>	4 Burner	<input type="checkbox"/>	<input type="checkbox"/>	Type I, Style I, Size 5, 510 mm (20 inches) wide.



_____	4 Burner	_____	_____	Type I or II, Style I, Size 5, 510 mm (20 inches)
_____	4 Burner	_____	_____	wide with specified elderly housing requirements.
_____	4 Burner	_____	_____	Type I or II, Style I, Size 4, 610 mm (24 inches)
_____	4 Burner	_____	_____	wide with specified elderly housing requirements.

END OF SECTION11 30 13 13c

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SECTION 11 30 13 13d - RANGE HOODS

GENERAL

Summary

1. Section Includes:
 - a. Remove existing range hoods.
 - b. Range hoods, supply and deliver only or supply and install as scheduled.
2. Related Requirements: Comply with requirements of following sections:
 - a. Contractor Use of Premises and Work Sequence: Section "Summary of Work."
 - b. Section "Alteration Project Procedures."
3. Related Sections:
 - a. Kitchen Renovation Requirements: Section "Summary of Work."
 - b. Reference Standards: Section "References."
 - c. Gas Ranges: Section "Gas Ranges."
 - d. Electric Ranges: Section "Electric Ranges."
 - e. Residential Cabinets: Section "Residential Cabinets."
 - f. Electrical Hook-up: Section "Electrical Renovation."

References

4. Reference Standards: See Section "References." Comply with following:
 - a. National Fire Protection Association (NFPA): NFPA 70 - National Electrical Code (NEC).
 - b. Certification:
 - 1) ANSI Z34.1 - Certification, Third-Party Certification Program, 1987.
 - 2) ANSI Z34.2 - Certification, Self-Certification by Producer or Supplier, 1987.

Definitions

5. Supply and Delivery Only: Include supply and delivery to site(s) FOB destination freight prepaid. Unless otherwise specified or scheduled, unloading and handling at site is by PHA/IHA.

Submittals

6. Product Data: Submit to the Owner.
7. Samples: Submit to the Owner.

Production Sample: When requested, provide sample range hood to the Owner for examination as to compliance with specifications.

 - a. Color Samples: Samples of manufacturer's standard colors for selection.
8. Quality Assurance/Control Submittals: Submit following to the Owner:
 - a. Certificates: Manufacturer's written certification that range hoods meet or exceed specified requirements including UL requirements.
 - b. Manufacturer's installation instructions.
 - c. Appliances shall meet or exceed requirements established by the Energy Star program and bear the Energy Star logo. Visit www.energystar.gov for a listing of products that qualify. Energy Star® is a voluntary partnership that includes the U.S. Department of Energy, the U.S. Environmental Protection Agency, product manufacturers, local utilities, and retailers, helps promote efficient products by labeling them with the Energy Star logo and educating consumers about the benefits of energy efficiency.
 - d. Closeout Submittals: Submit following to the Owner:
 - 1) Operation and Maintenance Instructions: Provide use and care information with each range hood. Include parts manual with diagrams and part numbers.
 - e. Special warranty.

Quality Assurance



9. Qualifications: Manufacturer: Stock and sell parts for range hoods supplied for five years from time of delivery.
10. Regulatory Requirements: Comply with following:
 - a. Accessibility:
 - 1) Architectural Barriers Act of 1968 as amended (42 USC 4151-4157) and HUD implementing regulations (24 CFR Part 40).
 - a) Uniform Federal Accessibility Standards (UFAS).
 - 2) Section 504 of the Rehabilitation Act of 1973 as amended (29 USC 794) and HUD implementing regulations 24 CFR Part 8.
 - 3) Fair Housing Accessibility Guidelines (24 CFR Chapter 1).
 - 4) Americans with Disabilities Act of 1990 (ADA) (42 USC §§ 12101, et seq.) and implementing regulations (28 CFR Part 35).

Delivery, Storage, And Handling

11. Packing, Shipping, Handling, and Unloading: In accordance with standard commercial practices.
12. Acceptance at Site: Inspect range hoods upon delivery. Replace damaged or defective appliances before installation.

Scheduling

13. Scheduling and Completion: Comply with requirements of Division 1.

Warranty

14. Special Warranties: Provide following written special warranties:
 - a. Entire range hood for one year.
15. Special Warranties: Include labor, material and equipment to provide replacements and make repairs to range hoods at no additional cost to PHA/IHA.

PRODUCTS

Range Hoods

16. Range Hoods: Ductless type with fan.
 - a. Size: 610 mm (24 inches) or 760 mm (30 inches) wide as scheduled, by 150 mm (6 inches) high by 445 mm (17.5 inches) deep.
 - b. Hoods: UL listed and bear UL label.
 - c. Fan: 120 V, 60 HZ, two speed, 2.0 A fan.
 - d. Light: Enclosed 75 watt.
 - e. Filter: Washable filter.
 - f. Color: As selected from manufacturer s standard colors.
17. Range Hood Shell: Same as range hoods above without fan and without light.
 - a. Size: 610 mm (24 inches) or 760 mm (30 inches) wide as scheduled, by 150 mm (6 inches) high by 445 mm (17.5 inches) deep.
 - b. Color: As selected from manufacturer standard colors.

EXECUTION

Examination

18. Site Verification of Conditions:
 - a. Utilities: Verify that required utilities are available, in proper locations, and ready for use.
 - b. Cabinets: Verify that adjacent residential cabinets and range hood are coordinated.

Preparation

19. Existing Range Hoods: Remove existing range hoods and debris from site.

Installation

20. General: Install range hoods in accordance with manufacturer's recommendations.
a. Electrical Hook-up: See electrical specifications.

Cleaning

21. Cleaning: Comply with requirements of Division 1.

Schedules

22. Provide range hoods as selected in following schedule:

_____ Remove existing range hoods.

_____ Supply and Deliver Only to _____.

_____ Unloading and handling included.

_____ Supply and Install.

_____ Range Hood (with fan, filter, and light).

_____ 760 mm (30 inches) wide.

_____ 610 mm (24 inches) wide.

_____ Range Hood Shell.

_____ 760 mm (30 inches) wide.

_____ 610 mm (24 inches) wide.

END OF SECTION 11 30 13 13d

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Task	Specification	Specification Description
11 30 13 23	11 30 13 13	Residential Appliances
11 30 33 00	01 22 16 00	No Specification Required

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SECTION 11 32 13 00 - UNIT KITCHENS

1.1 GENERAL

A. Description Of Work

1. This specification covers the furnishing and installation of materials for unit kitchens. Products shall be as follows or as directed by the Owner. Installation procedures shall be in accordance with the product manufacturer's recommendations. Demolition and removal of materials shall be as required to support the work.

B. Summary

1. Section includes factory-fabricated and -assembled unit kitchens with metal, laminate-clad and wood cabinets, countertops, fixtures, appliances, and accessories.

C. Submittals

1. Product Data: Include construction details, material descriptions, dimensions of individual components and profiles, finishes, furnished specialties, and accessories. Include rated capacities, operating characteristics, and utility requirements of appliances.
2. LEED Submittals:
 - a. Product Data for Credit EQ 4.4: For composite wood products, documentation indicating that product contains no urea formaldehyde.
 - b. Certificates for Credit MR 7: Chain-of-custody certificates certifying that cabinets and countertops comply with forest certification requirements. Include evidence that manufacturer is certified for chain of custody by an FSC-accredited certification body. Include statement indicating costs for each certified wood product.
 - c. Product Data for Credit EA 1.4: For appliances, documentation indicating that products are ENERGY STAR rated.
3. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
 - a. Wiring Diagrams: For power, signal, and control wiring.
4. Samples: For each type of exposed finish required, prepared on Samples of size indicated below:
 - a. Metal finish for cabinets and countertops, **8 by 10 inches (200 by 250 mm)**.
 - b. Wood finish for cabinets, **8 by 10 inches (200 by 250 mm)**.
 - c. Plastic laminate for cabinets and countertops, **8 by 10 inches (200 by 250 mm)**.
 - d. Solid surfacing for countertops, **6 inches (150 mm) square**.
 - e. One full-size unit of each type of exposed hardware.
5. Product Certificates: For each type of unit kitchen, from manufacturer.
6. Manufacturer Certificate: Signed by manufacturer certifying that units comply with requirements.
7. Maintenance Data: For unit kitchen appliances to include in maintenance manuals.
8. Warranty: Sample of special warranty.

D. Quality Assurance

1. Manufacturer Qualifications: A qualified manufacturer that fabricates unit kitchens and their components.
2. Source Limitations: Obtain unit kitchens from single source from single manufacturer.
3. Regulatory Requirements: Where unit kitchens are indicated to comply with accessibility requirements, comply with the U.S. Architectural & Transportation Barriers Compliance Board's ADA-ABA Accessibility Guidelines, ICC/ANSI A117.1 and HUD's "Fair Housing Accessibility Guidelines".
4. Forest Certification: Provide cabinets and countertops made from wood obtained from forests certified by an FSC-accredited certification body to comply with FSC STD-01-001, "FSC Principles and Criteria for Forest Stewardship."
5. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

- a. Built-in Refrigerators: Listed and labeled for recessed installation. Mount label to be visible after installation of unit; include electrical rating, type of refrigerant, and minimum installation clearances.
 - b. Refrigerated Unit Kitchens and Wet Bars: Listed and labeled for entire unit as a single integrated system. Mount label to be visible after installation of unit; include electrical rating, type of refrigerant, and minimum installation clearances.
- 6. Wood and Laminate-Clad Cabinet Fabrication Standard:
 - a. KCMA A161.1. Provide cabinets with KCMA's "Certified Cabinet" seal affixed to a semiexposed location of each unit and showing compliance with standard.
 - b. AWI 400B, Custom grade.
 - c. Either fabrication standard above.
- 7. Appliance Standards:
 - a. Refrigerators and Freezers: UL 250 or AHAM ER-1.
 - b. Electric Ranges: UL 858 or AHAM HRF-1.
 - c. Microwave Ovens: UL 923.
 - d. Gas-Burning Appliances: ANSI Z21 Series, and certified by CSA International, UL, or another testing and inspecting agency acceptable to authorities having jurisdiction.
- 8. ENERGY STAR Rating: Provide appliances that qualify for the EPA/DOE ENERGY STAR product labeling program.

E. Delivery, Storage, And Handling

- 1. Deliver factory-assembled units, individually factory packaged and protected. Label with manufacturer's name, product name, and model number.

F. Project Conditions

- 1. Environmental Limitations: Do not deliver or install unit kitchens until spaces are enclosed and weathertight, wet work in spaces is complete and dry, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.
- 2. Field Measurements: Verify actual dimensions of construction contiguous with unit kitchens by field measurements before fabrication.

G. Coordination

- 1. Coordinate sizes and locations of framing, blocking, furring, reinforcements, and other related units of work specified in other Sections to ensure that unit kitchens can be supported and installed as indicated.
- 2. Coordinate wiring requirements and current characteristics of unit kitchens with building electrical system. See Division 22.
- 3. Coordinate layout and installation of plumbing, mechanical, and electrical services for unit kitchens.

H. Warranty

- 1. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace hermetically sealed refrigerator compressor system of unit kitchens that fail within specified warranty period.
 - a. Warranty Period: Five years from date of Final Completion.

1.2 PRODUCTS

A. Materials

- 1. Cold-Rolled Steel Sheet: ASTM A 1008/A 1008M, Commercial Steel (CS), Type B, suitable for exposed applications.

2. Porcelain-Enamel-Finished Steel Sheet: ASTM A 424, enameling-grade steel, uncoated thickness indicated; with exposed face and edges coated with primer, ground coat, and color cover coat; and concealed face coated with primer and ground coat; acid resistant.
3. Stainless-Steel Sheet: ASTM A 240/A 240M, Type 304.
4. Medium-Density Fiberboard: ANSI A208.2, Grade 130, made with binder containing no urea-formaldehyde resin.
5. Particleboard: ANSI A208.1, Grade M-2 **OR** Grade M-2-Exterior Glue **OR** Grade M-2, made with binder containing no urea-formaldehyde resin, **as directed**.
6. Veneer-Faced Panel Products (Hardwood Plywood): HPVA HP-1, Type I, made with adhesive containing no urea formaldehyde.
7. Solid Wood: Clear hardwood lumber of species indicated, free of defects, selected for compatible grain and color, and kiln dried to 7 percent moisture content.
8. High-Pressure Decorative Laminate: NEMA LD 3.
9. Solid-Surfacing Material: Homogenous solid sheets fabricated from reacted monomers and resins, mineral fillers, and pigments; in thickness indicated; complying with ISSFA-2.
10. Adhesives: Do not use adhesives that contain urea formaldehyde.

B. Metal Cabinets

1. Steel Base Cabinets: Fabricate frames and sides from **0.036-inch (0.91-mm) OR 0.030-inch (0.76-mm), as directed**, nominal-thickness, cold-rolled steel sheet; welded and reinforced with internal gussets and bracing; with baked-enamel finish.
 - a. Door and Drawer Fronts: **0.036-inch (0.91-mm) OR 0.030-inch (0.76-mm), as directed**, nominal-thickness, cold-rolled steel sheet, textured or smooth; welded, reinforced, and sound-deadened; with baked-enamel finish.
OR
Door and Drawer Fronts: **0.038-inch- (0.95-mm-)** thick, stainless-steel sheet; welded, reinforced, and sound deadened.
2. Stainless-Steel Base Cabinets: Fabricate frames and sides from **0.038-inch- (0.95-mm-)** thick, stainless-steel sheet; welded and reinforced with internal gussets and bracing.
 - a. Door and Drawer Fronts: **0.038-inch- (0.95-mm-)** thick, stainless-steel sheet; welded, reinforced, and sound deadened.
3. Undercounter Storage Cabinet: Same material and finish as base cabinets, with adjustable shelf and drawer or with two drawers.
4. Wall Cabinets: Same material and finish as base cabinets, with flush double bottoms and adjustable shelves.
 - a. Wall Shields: Fabricated from textured, cold-rolled steel sheet with baked-enamel finish, color to match cabinets **OR** textured, cold-rolled steel sheet with baked-enamel finish, color to match countertop **OR** stainless-steel sheet, **as directed**. Provide wall shields for back wall and side walls, **as directed**, between countertop splash and wall cabinets.
5. Shelves: Manufacturer's standard rolled-front shelves, fixed **OR** adjustable, **as directed**, of same material and finish as cabinets.
6. Wire Pulls: Brushed-chrome **OR** Polished-chrome **OR** Brushed-brass **OR** Polished-brass, **as directed**, finish.

C. Laminate-Clad Cabinets

1. Framed-Style Base Cabinets:
 - a. Face Frames: **3/4-inch- (19-mm-)** thick plywood or solid wood.
 - b. Back Panels: **3/8-inch- (10-mm-)** thick particleboard with melamine bonded to inside surface.
 - c. Top, Bottom, and End Panels: **3/8-inch- (10-mm-)** thick particleboard with melamine bonded to both sides.
 - d. Door and Drawer Fronts: **3/4-inch- (19-mm-)** thick, medium-density fiberboard with **16-mil- (0.4-mm-)** thick vinyl film (Thermofoil) bonded to exposed surfaces and melamine bonded to inside surfaces.
OR

- Door and Drawer Fronts: **5/8-inch- (16-mm-)** thick particleboard with melamine bonded to both sides.
- e. Drawers: Four sided, with **1/2-inch- (13-mm-)** thick particleboard fronts, backs, and sides, and **1/4-inch- (6-mm-)** thick particleboard bottom.
 - f. Shelves: **5/8-inch- (16-mm-)** thick particleboard with melamine bonded to both sides and PVC edges.
2. Frameless-Style Base Cabinets:
- a. Back Panels: **1/4-inch- (6-mm-)** thick plywood or particleboard with melamine bonded to inside surface.
 - b. Top and Bottom Panels: **3/4-inch- (19-mm-)** thick particleboard with melamine bonded to both sides.
 - c. End Panels: **5/8-inch- (16-mm-)** thick particleboard with melamine bonded to both sides.
 - d. Door and Drawer Fronts: **3/4-inch- (19-mm-)** thick plywood with Grade HGS high-pressure decorative laminate bonded to front and edges, and Grade CLS high-pressure decorative laminate bonded to inside surface.
- OR**
- Door and Drawer Fronts: **5/8-inch- (16-mm-)** thick particleboard with melamine bonded to both sides.
- OR**
- Door and Drawer Fronts: **5/8-inch- (16-mm-)** thick particleboard with melamine bonded to both sides. Provide continuous bevel edge at tops and bottoms of doors and bottom of drawer fronts in wood-grain laminate **OR** solid wood, **as directed**.
- e. Drawers: Four sided, with **1/2-inch- (13-mm-)** thick particleboard fronts, backs, and sides, and **1/4-inch- (6-mm-)** thick particleboard bottom.
 - f. Shelves: **3/4-inch- (19-mm-)** thick particleboard with melamine bonded to both sides and PVC edges.
3. Wall Cabinets: Same material and finish as base cabinets, with adjustable shelves.
- a. Wall Shields: Fabricated from high-pressure decorative laminate of grade and color to match cabinets **OR** high-pressure decorative laminate of grade and color to match countertop **OR** stainless-steel sheet, **as directed**. Provide wall shields for back wall and side walls, **as directed**, between countertop splash and wall cabinets.
4. Scribe Strips for Recessed Cabinets: Same material, finish, and color as cabinet.
5. Wire Pulls: Brushed-chrome **OR** Polished-chrome **OR** Brushed-brass **OR** Polished-brass, **as directed**, finish.

D. Wood Cabinets

1. Base Cabinets: Birch **OR** Maple **OR** Oak **OR** Cherry **OR** Ash, **as directed**.
 - a. Face Frames: **3/4-inch- (19-mm-)** thick, hardwood-veneer plywood or solid wood.
 - b. Back Panels: **3/8-inch- (10-mm-)** thick particleboard with melamine bonded to inside surface.
 - c. Top, Bottom, and End Panels: **3/8-inch- (10-mm-)** thick particleboard with melamine bonded to both sides.
 - d. Shelves: **5/8-inch- (16-mm-)** thick particleboard with melamine bonded to both sides and PVC edges.
 - e. Door and Drawer Fronts: **5/8-inch- (16-mm-)** thick, hardwood-veneer plywood with matching hardwood edges.

OR

Door and Drawer Fronts: **3/4-inch- (19-mm-)** thick, solid wood stiles and rails, with solid wood center panels.
2. Wall Cabinets: Same material and finish as base cabinets, with adjustable shelves.
 - a. Wall Shields: Fabricated from high-pressure decorative laminate of grade and color to match countertop **OR** stainless-steel sheet, **as directed**. Provide wall shields for back wall and side walls, **as directed**, between countertop splash and wall cabinets.
3. Scribe Strips for Recessed Cabinets: Same material, finish, and color as cabinet.

4. Wire Pulls: Brushed-chrome **OR** Polished-chrome **OR** Brushed-brass **OR** Polished-brass, **as directed**, finish.
- E. Countertops
1. Countertop and Integral Sink: Seamless, one-piece countertop and sink with integral embossed drainboard and backsplash and side splashes, **as directed**.
 - a. Stainless Steel: **0.038-inch- (0.95-mm-)** thick sheet bonded to **3/4-inch (19-mm)** plywood.
 - b. Porcelain-Enamel-Finished Steel: **0.0677 inch (1.7 mm)** thick.
 - c. Solid-Surfacing Material: Minimum **1/2 inch (13 mm)** thick.
 2. Countertop **OR** Countertop for Drop-in Sink, **as directed**: Seamless, one-piece countertop with integral backsplash and side splashes, **as directed**.
 - a. Stainless Steel: **0.038-inch- (0.95-mm-)** thick sheet bonded to **3/4-inch (19-mm)** plywood.
 - b. High-Pressure Decorative Laminate: Grade HGS, bonded to **3/4-inch (19-mm)** plywood.
OR
High-Pressure Decorative Laminate: Grade HGP, post formed, bonded to **3/4-inch (19-mm)** particleboard with Grade BKL unfinished backing sheet bonded to reverse side.
 3. Countertop **OR** Countertop for Undercounter-Mounted Sink, **as directed**: Seamless, one-piece countertop with integral backsplash and side splashes, **as directed**; fabricated from **1/2-inch- (13-mm-)** thick, solid-surfacing material.
- F. Fixtures
1. Stainless-Steel Drop-in Sinks: **0.050 inch (1.27 mm)** **OR** **0.038 inch (0.95 mm)**, **as directed**, thick; seamless; single compartment.
 2. Porcelain-Enamel-Finished Steel Drop-in Sinks: **0.043 inch (1.09 mm)** thick; seamless; single compartment.
 3. Undercounter-Mounted Sinks: Solid-surfacing material; seamless; single compartment.
 4. Supplies: **NPS 3/8 (DN 12)** **OR** **NPS 1/2 (DN 15)**, **as directed**, chrome-plated copper with stops.
 5. Sink Faucet: Single-lever control; polished chrome-plated mixing **OR** European-style, pull-out spray, **as directed**, faucet with limited-swing spout and aerator.
OR
Sink Faucet: Separate hot and cold controls with wrist-blade handles, **as directed**; polished chrome-plated mixing faucet with limited-swing spout **OR** gooseneck spout, **as directed**, and aerator.
 6. Sink Outlet with Disposer: **3-1/2-inch- (89-mm-)** diameter outlet.
 7. Sink Outlet without Disposer: **3-1/2-inch- (89-mm-)** diameter outlet with stainless-steel cup strainer and **1-1/2-inch- (38-mm-)** diameter tailpiece.
 8. Drain Piping: **NPS 1-1/2 (DN 40)** chrome-plated cast-brass trap, tubular brass waste to wall, and wall escutcheon.
 9. Bar Sink Outlet: **2-inch- (51-mm-)** diameter outlet with stainless-steel grid strainer.
 10. Disposers: Continuous-feed, household, food-waste disposers. Include 115-V ac, 1725-rpm, 1/2-hp motor with overload protection and reset button; three-conductor, grounded power cord; wall switch; corrosion-resistant chamber with jam-resistant, cutlery- or stainless-steel grinder or shredder; **NPS 1-1/2 (DN 40)** outlet; quick-mounting, stainless-steel sink flange; antisplash guard; and combination cover/stopper.
 11. Hot-Water Dispensers: Household type with instant on-off control; insulated, corrosion-resistant metal storage tank that is open to atmosphere; electric, 115-V ac, heating element; three-conductor, grounded power cord; chrome-plated faucet or spout; removable strainer; thermostat control for water temperature up to **190 deg F (88 deg C)**; thermal-overload protection; and minimum **1/2-gal. (1.9-L)** tank capacity dispensing approximately **60 cups (240 mL)** of water per hour.
- G. Appliances
1. Built-in Refrigerators: Fabricated with one-piece seamless steel or ABS plastic inner liner; refrigerator compartment with slide-out or removable shelves and meat tray; adjustable automatic temperature control; door with magnetic gaskets and storage shelves; interior light; closed

- compartment for **25-lb (11-kg)** minimum storage of prefrozen food and two ice cube trays; 115-V ac.
- a. Minimum Capacity: **3.2 cu. ft. (0.091 cu. m) OR 5.5 cu. ft. (0.156 cu. m) OR 6.0 cu. ft. (0.169 cu. m), as directed.**
 - b. Defrost System: Automatic defrost timer **OR** Push button or manual, **as directed.**
 - c. Compressor: Cushion-mounted, self-oiling, and hermetically sealed compressor; fan or gravity cooled.
 - d. Finish Panel: Manufacturer's standard door trim kit with filler panel or integral finish panel; match material and finish of base cabinets.
2. Freestanding, Upright Refrigerator-Freezers: Two-door combination unit with one-piece seamless steel or ABS plastic inner liner; automatic defrost; closed freezer compartment with two adjustable shelves and two ice cube trays, **as directed**; full-width vegetable crisper; dairy compartment; interior light; adjustable automatic temperature control; door with magnetic gaskets and storage shelves; 115-V ac, with three-conductor, grounded power cord.
 - a. Minimum Capacity: **12-cu. ft. (0.340-cu. m)** refrigerator capacity with **100-lb (45-kg)** freezer capacity **OR 14-cu. ft. (0.396-cu. m)** refrigerator capacity with **125-lb (57-kg)** freezer capacity, **as directed.**
 - b. Ice maker: Built-in automatic unit, **as directed.**
 - c. Finish Panel: Manufacturer's standard door trim kit with filler panel or integral finish panel; match material and finish of base cabinets.
 3. Automatic Ice makers: Built-in undercounter unit; capable of producing **22 lb (10 kg)** of ice per day; with **12-lb (5.4-kg) OR 35 lb (15.9 kg)** of ice per day; with **26-lb (11.8-kg) OR 50 lb (22.6 kg)** of ice per day; with **35-lb (15.9-kg), as directed**, storage bin; 115-V ac, with three-conductor, grounded power cord; with plumbed water supply.
 4. Electric Cooktops: Porcelain-enamel-finished steel; coil-element burners with removable rings and reflector bowls, infinitely adjustable heating controls, and individual signal lights; with wiring terminated at factory-installed junction box.
 - a. Cooktop Burner: One element rated at 900 W; 115 **OR** 1250 W; 208/240, **as directed**, -V ac.
OR
Cooktop Burners: One element rated at 550 W and one element rated at 950 W; 115-V ac.
OR
Cooktop Burners: Two elements, each rated at 1250 W; 115 **OR** 208/240, **as directed**, -V ac.
OR
Cooktop Burners: Two elements rated at 1250 W and one element rated at 2100 W; 208/240-V ac.
 5. Built-in Electric Ovens: Porcelain-enamel-finished steel exterior surfaces; coil-element burners with removable rings and reflector bowls, infinitely adjustable heating controls, and individual signal lights. Oven interior fabricated from one-piece porcelain-enamel-finished steel with rounded corners, with "Bake" and "Broil" oven elements, automatic heat control, signal light, and removable wire oven rack; textured baked-enamel- or porcelain-enamel-finished steel oven door; 208/240-V ac, with wiring terminated at factory-installed junction box.
 - a. Cooktop Burners: Three elements, each rated at 1250 W.
 - b. Oven Elements: 1500 W bake; 2000 W broil **OR** Manufacturer's standard, **as directed.**
 6. Freestanding Electric Ranges: Porcelain-enamel-finished steel exterior surfaces; coil-element burners with removable rings and reflector bowls, infinitely adjustable heating controls, and individual signal lights; anti-tip anchors. Oven interior fabricated from one-piece porcelain-enamel-finished steel with rounded corners, with "Bake" and "Broil" oven elements, automatic heat control, signal light, two removable wire oven racks, and porcelain-on-steel broiler pan; textured baked-enamel- or porcelain-enamel-finished steel oven door; 208/240-V ac, with wiring terminated at factory-installed junction box.
 - a. Cooktop Burners: Three elements, each rated at 1250 W, and one element rated at 2100 W.
 - b. Oven Elements: Manufacturer's standard.

7. Gas Cooktops: Porcelain-enamel-finished steel; surface burners with removable cast-iron grates, lift-out burner bowls, and 115-V ac electronic ignition; with wiring terminated at factory-installed junction box, and burner control panel mounted at front of unit.
 - a. Cooktop Burners: Two elements, each rated at 8000 Btu/h (8440 kJ) OR 10,000 Btu/h (10 550 kJ), as directed, for natural gas.
8. Built-in Gas Ovens: Stainless-steel OR Porcelain-enamel-finished steel, as directed, exterior surfaces; surface burners with removable cast-iron grates, lift-out burner bowls, and 115-V ac electronic ignition; with wiring terminated at factory-installed junction box. Oven interior fabricated from porcelain-enamel-finished steel with rounded corners; removable wire oven rack, automatic heat control, and combination surface burner and oven control panel mounted above oven door at front of unit.
 - a. Cooktop Burners: Three elements, each rated at 5000 Btu/h (5275 kJ) for natural gas.
OR
Cooktop Burners: Four elements, each rated at 9000 Btu/h (9495 kJ) for natural gas.
 - b. Oven Burner: Rated at 9000 Btu/h (9495 kJ) OR 18,000 Btu/h (18 990 kJ), as directed, for natural gas.
9. Freestanding Gas Ranges: Porcelain-enamel-finished steel exterior surfaces; surface burners with removable grates, lift-out burner bowls, and 115-V ac electronic ignition; with three-conductor, grounded power cord; anti-tip anchors. Oven interior fabricated from porcelain-enamel-finished steel with rounded corners; two removable wire oven racks, porcelain-on-steel broiler pan, automatic heat control, and combination surface burner and oven control panel mounted above oven door at front of unit.
 - a. Cooktop Burners: Four elements, each rated at 9000 Btu/h (9495 kJ) for natural gas.
 - b. Oven Burner: Rated at 18,000 Btu/h (18 990 kJ) for natural gas.
10. Freestanding Microwave Ovens: 0.7-cu. ft. (0.020-cu. m) capacity with 600 W OR 0.8-cu. ft. (0.023-cu. m) capacity with 700 W, as directed, cooking power; electronic touch controls, variable power control, digital clock timer, interior light, turntable, and tempered glass door; 115-V ac, with three-conductor, grounded power cord.
11. Built-in Microwave Ovens with Exhaust Hood: Undercabinet mounted, minimum 1.0-cu. ft. (0.028-cu. m) capacity with 800-W cooking power; electronic touch controls, variable power control, digital clock timer, interior light, turntable, tempered glass door, and exhaust hood with integral light and two-speed fan control; 115-V ac, with three-conductor, grounded power cord.
 - a. Exhaust Hood: Recirculating, nonventing type, with replaceable charcoal filter.
OR
Exhaust Hood: Ventilating type, with permanent washable filter. Provide exhaust duct and wall OR roof, as directed, cap and shutter. See Division 23 Section "Metal Ducts".
12. Built-in Microwave/Convection Ovens with Exhaust Hood: Undercabinet mounted, minimum 1.0-cu. ft. (0.028-cu. m) capacity with 800-W cooking power; electronic touch controls, variable power control, digital clock timer, interior light, turntable, convection rack, tempered glass door, and exhaust hood with integral light and two-speed fan control; 115-V ac, with three-conductor, grounded power cord.
 - a. Exhaust Hood: Recirculating, nonventing type, with replaceable charcoal filter.
 - b. Exhaust Hood: Ventilating type, with permanent washable filter. Provide exhaust duct and wall OR roof, as directed, cap and shutter. See Division 23 Section "Metal Ducts".
13. Ventilating Exhaust Hoods: Undercabinet mounted, 24 inches (610 mm) wide, stainless OR baked-enamel, as directed, steel; two-speed fan control, permanent washable filter, and built-in lighting; 115-V ac, with wiring terminated at factory-installed junction box.
 - a. Provide exhaust duct and wall OR roof, as directed, cap and shutter. See Division 23 Section "Metal Ducts".
14. Recirculating, Nonventilating Exhaust Hoods: Undercabinet mounted, 24 inches (610 mm) wide, stainless OR baked-enamel, as directed, steel; two-speed fan control, replaceable charcoal filter, and built-in lighting; 115-V ac, with wiring terminated at factory-installed junction box.
15. Dishwashers: Built-in undercounter unit, 18 inches (457 mm) wide OR 24 inches (610 mm) wide OR width as indicated, as directed; multiple wash cycles, coated roll-out racks, detergent dispenser, and insulated cavity walls and door; 115-V ac, with wiring terminated at factory-installed junction box.

16. Automatic Coffeemakers: Stainless steel, with capacity for three pots of coffee; automatic brewing, nonstick warmer plates, and lighted on-off switch; 115-V ac, with three-conductor, grounded power cord; designed for permanent installation in countertop, with plumbed water supply. Provide glass coffee decanters in number to match capacity.

H. Accessories

1. Locks: Brass-cylinder type; furnish two keys per lock. Provide where indicated **OR** on base cabinet doors **OR** on refrigerator, **as directed**.
2. Fluorescent Light Fixtures: Surface mounted to underside of overhead cabinet; with 15-W lamp, on-off switch, grounded convenience receptacle, and translucent plastic lens.
3. Cutlery Drawers: Concealed drawer in undercounter storage compartment with pull-out divided tray.
4. Cutting Boards: Pull-out hardwood board.
5. Heat Shields: Minimum **12 inches high by 24 inches (305 mm high by 610 mm)** wide, **0.025-inch- (0.64-mm-)** thick stainless steel over **1/4-inch- (6-mm-)** thick board insulation.

I. Fabrication

1. General: Factory fabricate and assemble unit kitchens, with base cabinets, sink **OR** refrigerator, **as directed**, and countertop shipping as a one-piece assembly. Securely fasten components, fixtures, and appliances together.
 - a. Provide manufacturer's standard hardware including concealed, adjustable plated-steel hinges; steel drawer slides with nylon rollers; and catches and rubber bumpers on doors and drawers. Unless otherwise indicated, provide chromium-plated metal or satin-finished stainless steel for exposed hardware.
2. Accessible Units: Fabricate unit kitchens to comply with accessibility regulations as follows:
 - a. Standard, Accessible Countertops: Fabricate unit kitchens with one-piece countertop located at height of **34 inches (864 mm)** above floor.
OR
Adjustable, Accessible Countertops: Fabricate unit kitchens with two-piece countertop that allows countertop over sink, including backsplash, side splashes, and sink assembly, to be adjusted between **29 and 36 inches (735 and 915 mm)** above finished floor.
 - b. Removable, Accessible Cabinets: Fabricate cabinet under sink to allow removal for future accessibility conversion. Fabricate cabinet to allow access to plumbing and electrical connections after conversion.
 - c. Knee and Toe Clearance: Provide minimum **30-inch- (760-mm-)** wide open space beneath countertop with a minimum clear height of **27 inches (685 mm)** above floor for first **8 inches (205 mm)** of depth, then reduce clearance at a rate of **1 inch (25 mm)** in depth for each **6 inches (150 mm)** in height, to a minimum clear height of **9 inches (230 mm)** above floor at a depth of **11 inches (280 mm)**.
 - d. Pipe Enclosure Panels: Provide manufacturer's standard panels to enclose plumbing under countertop, of same material and finish as cabinets. Install panel to prevent exposure of sharp or abrasive surfaces under countertop.
 - e. Operable Parts: Locate operable parts no higher than **48 inches (1219 mm)** and no lower than **15 inches (380 mm)** above floor. Provide operable parts that do not require tight grasping, pinching, or twisting of the wrist and that operate with a force of not more than **5 lbf (22.2 N)**.
 - f. Range or Cooktop: Provide top surface **34 inches (865 mm)** above floor, with controls that do not require reaching across burners. Provide knee and toe clearance beneath range or cooktop; insulate underside of cooktop to prevent burns, shocks, or abrasions.
 - g. Refrigerator/Freezer: Provide 50 percent of freezer space no higher than **54 inches (1370 mm)** off floor.
 - h. Oven: Provide work surface adjacent to one side of bottom-hinged doors. Locate controls on front panel.

J. General Finish Requirements

1. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

K. Finishes

1. Stainless-Steel Finishes: Remove tool and die marks and stretch lines, or blend into finish. Grind and polish surfaces to produce uniform, directionally textured, polished finish indicated, free of cross scratches. Run grain with long dimension of each piece. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
 - a. Bright, Directional Polish: No. 4 finish.
2. Wood Finishes: Factory finished with manufacturer's standard stain, sealer, and clear finish coat. Defer only final touchup until after installation.

1.3 EXECUTION

A. Examination

1. Examine walls and floors, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
2. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.
3. Examine walls and partitions for proper backing for unit kitchens.
4. Examine roughing-in for electrical power plumbing and mechanical system(s) to verify actual locations of connections before installation of unit kitchens.
5. Proceed with installation only after unsatisfactory conditions have been corrected.

B. Installation

1. General: Install level, plumb, and true; shim as required, using concealed shims. Provide fasteners, clips, backing materials, brackets, anchors, fillers, scribes, trim, and accessories necessary for complete installation.
 - a. Anchor unit kitchens at ends and at intervals recommended by manufacturer, but not more than 36 inches (910 mm) o.c. Install anchors through backup reinforcing plates, channels, or blocking as required to prevent material distortion; use concealed fasteners.
 - b. Freestanding Ranges: Install anti-tip anchors at locations recommended by manufacturer.
2. Comply with requirements specified in Division 14 AND Division 21 for connecting unit kitchens to plumbing and mechanical system(s).
3. Comply with requirements specified in Division 22 for connecting unit kitchens to electrical power system.

C. Adjusting And Cleaning

1. Test, adjust, and verify operation of each appliance, plumbing fixture, and component of unit kitchens. Repair or replace items found to be defective or operating below rated capacity.
2. Verify that operating parts work freely and fit neatly and that clearances are adequate to properly and freely operate appliances.
3. Clean, lubricate, and adjust hardware. Adjust doors and latches to operate easily without binding. Verify that locking devices operate properly.
4. After completing unit kitchen installation, remove protective coverings if any.
5. Repair or replace damaged parts, dents, buckles, abrasions, and other defects affecting appearance or serviceability. Touch up factory-applied finishes to restore damaged or soiled areas.

END OF SECTION 11 32 13 00

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Task	Specification	Specification Description
11 41 13 00	11 21 63 00	Food Service Equipment
11 41 23 00	11 21 63 00	Food Service Equipment
11 41 31 00	11 21 63 00	Food Service Equipment

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SECTION 11 41 33 00 - RESIDENTIAL CASEWORK

1.1 GENERAL

A. Description Of Work

1. This specification covers the furnishing and installation of materials for residential casework. Products shall be as follows or as directed by the Owner. Installation procedures shall be in accordance with the product manufacturer's recommendations. Demolition and removal of materials shall be as required to support the work.

B. Summary

1. This Section includes the following:
 - a. Kitchen cabinets.
 - b. Vanity cabinets.
 - c. Plastic-laminate countertops and backsplashes.
 - d. Solid-surfacing-material countertops and backsplashes.

C. Definitions

1. Exposed Surfaces of Cabinets: Surfaces visible when doors and drawers are closed, including visible surfaces in open cabinets or behind glass doors.
2. Semiexposed Surfaces of Cabinets: Surfaces behind opaque doors or drawer fronts, including interior faces of doors and interiors and sides of drawers. Bottoms of wall cabinets are defined as "semiexposed."
3. Concealed Surfaces of Cabinets: Surfaces not usually visible after installation, including sleepers, web frames, dust panels, bottoms of drawers, and ends of cabinets installed directly against and completely concealed by walls or other cabinets. Tops of wall cabinets and utility cabinets are defined as "concealed."

D. Submittals

1. Product Data: For cabinets, countertop material, and cabinet hardware.
2. Shop Drawings: For cabinets and countertops. Include plans, elevations, details, and attachments to other work. Show materials, finishes, filler panels, hardware, edge and backsplash profiles, methods of joining countertops, and cutouts for plumbing fixtures.
3. Samples: For each type of material exposed to view.
4. LEED Submittals:
 - a. Product Data for Credit EQ 4.4: For adhesives and composite wood products, documentation indicating that product contains no urea formaldehyde.
 - b. Product Data for Credit MR 4.1 and MR 4.2, **as directed**: For products having recycled content, documentation indicating percentages by weight of postconsumer and preconsumer recycled content.
 - 1) Include statement indicating costs for each product having recycled content.
 - c. Certificates for Credit MR 7: Chain-of-custody certificates certifying that wood used to produce cabinets and countertops complies with forest certification requirements. Include evidence that manufacturer is certified for chain of custody by an FSC-accredited certification body.
 - 1) Include statement indicating costs for each certified wood product.

E. Quality Assurance

1. Manufacturer Qualifications: A qualified manufacturer that is certified for chain of custody by an FSC-accredited certification body.
2. Quality Standards: Unless otherwise indicated, comply with the following standards:
 - a. Cabinets: KCMA A161.1.

- 1) KCMA Certification: Provide cabinets with KCMA's "Certified Cabinet" seal affixed in a semiexposed location of each unit and showing compliance with the above standard.
- b. Plastic-Laminate Countertops: KCMA A161.2.

1.2 PRODUCTS

A. Cabinet Materials

1. General:

- a. Certified Wood Materials: Fabricate cabinets with wood and wood-based products produced from wood obtained from forests certified by an FSC-accredited certification body to comply with FSC STD-01-001, "FSC Principles and Criteria for Forest Stewardship."
- b. Adhesives: Do not use adhesives that contain urea formaldehyde.
- c. Hardwood Lumber: Kiln dried to 7 percent moisture content.
- d. Softwood Lumber: Kiln dried to 10 percent moisture content.
- e. Hardwood Plywood: HPVA HP-1, made with adhesive containing no urea formaldehyde.
- f. Particleboard: ANSI A208.1, Grade M-2, made with binder containing no urea formaldehyde.

OR

Particleboard: Straw-based particleboard complying with requirements of ANSI A208.1, Grade M-2, except for density.

- g. Medium-Density Fiberboard: ANSI A208.2, Grade MD, made with binder containing no urea formaldehyde.
 - h. Hardboard: AHA A135.4, Class 1 Tempered.
- #### 2. Exposed Materials:
- a. Exposed Wood Species: Oak **OR** Maple **OR** Alder **OR** Birch **OR** Hickory **OR** Cherry **OR** Manufacturer's standard domestic hardwood species, **as directed**.
 - 1) Select materials for compatible color and grain. Do not use two adjacent exposed surfaces that are noticeably dissimilar in color, grain, figure, or natural character markings.
 - 2) Staining and Finish: As selected from manufacturer's full range.
 - b. Solid Wood: Clear hardwood lumber of species indicated, free of defects.
 - c. Plywood: Hardwood plywood with face veneer of species indicated, with Grade A faces and Grade C backs of same species as faces.
 - 1) Edge band exposed edges with minimum **1/8-inch- (3-mm-)** thick, solid-wood edging of same species as face veneer.
 - d. Plastic Laminate: Particleboard faced with high-pressure decorative laminate complying with NEMA LD 3, Grade VGS **OR** HGL, **as directed**.
 - 1) Where edges of solid-color plastic-laminate sheets will be visible after fabrication, provide through-color plastic laminate.
 - 2) For doors and drawer fronts faced with plastic laminate, provide plastic-laminate edges of same grade, pattern, color, and texture of plastic laminate as for faces.
 - 3) Colors, Textures, and Patterns: As selected from cabinet manufacturer's full range.
 - e. Thermoset Decorative Panels: Particleboard or medium-density fiberboard finished with thermally fused, melamine-impregnated decorative paper complying with LMA SAT-1.
 - 1) Provide material finished on both sides for doors and drawer fronts.
 - 2) Provide PVC or polyester edge banding complying with LMA EDG-1 on components with exposed or semiexposed edges.
 - 3) Colors: As selected from cabinet manufacturer's full range.
 - f. Thermoformed Vinyl-Faced Panels: Medium-density fiberboard, milled to required shapes, with a thermoformed vinyl overlay applied in a vacuum or membrane press.
 - 1) Color: As selected from cabinet manufacturer's full range.
 - g. PVC Edge Molding: Rigid PVC extrusions, through color with satin finish, 3 mm thick at doors and drawer fronts, and 1 mm thick elsewhere.

- 1) Color: As selected from cabinet manufacturer's full range.
 3. Semiexposed Materials: Unless otherwise indicated, provide the following:
 - a. Solid Wood: Sound hardwood lumber, selected to eliminate appearance defects. Same species as exposed surfaces or stained to be compatible with exposed surfaces.
 - b. Plywood: Hardwood plywood with Grade C faces and not less than Grade 3 backs of same species as faces. Face veneers of same species as exposed surfaces or stained to be compatible with exposed surfaces.
 - c. Plastic Laminate: Particleboard faced with high-pressure decorative laminate complying with NEMA LD 3, Grade VGS **OR** CLS, **as directed**.
 - 1) For backs of doors and drawer fronts faced with plastic laminate, provide same grade, pattern, color, and texture of plastic laminate as for faces.
 - 2) For face frames faced with plastic laminate, provide plastic-laminate edges of same grade, pattern, color, and texture of plastic laminate as for faces.
 - 3) Colors, Textures, and Patterns: As selected from cabinet manufacturer's full range.
 - d. Thermoset Decorative Panels: Particleboard or medium-density fiberboard finished with thermally fused, melamine-impregnated decorative paper complying with LMA SAT-1.
 - 1) Provide material finished on both sides for shelves, dividers, drawer bodies, and other components with two semiexposed surfaces.
 - 2) Provide PVC or polyester edge banding complying with LMA EDG-1 on components with semiexposed edges.
 - 3) Colors: As selected from cabinet manufacturer's full range.
 - e. Vinyl-Faced Particleboard: Medium-density particleboard with embossed, wood-grain-patterned, **as directed**, vinyl film adhesively bonded to particleboard.
 - 1) Provide vinyl film on both sides of shelves, dividers, drawer bodies, and other components with two semiexposed surfaces and on semiexposed edges.
 - 2) Colors, Textures, and Patterns: As selected from cabinet manufacturer's full range.
 4. Concealed Materials: Solid wood or plywood, of any hardwood or softwood species, with no defects affecting strength or utility; particleboard; medium-density fiberboard; or hardboard.
- B. Cabinet Hardware
1. General: Manufacturer's standard units complying with BHMA A156.9, of type, size, style, material, and finish as selected from manufacturer's full range.
 2. Pulls: Surface-mounted decorative pulls **OR** Back-mounted decorative pulls **OR** Back-mounted decorative pulls with backing plates **OR** Wire pulls **OR** Back-mounted Knobs **OR** Surface-mounted porcelain knobs, **as directed**.
 3. Hinges: Decorative full-surface hinges **OR** Concealed butt hinges **OR** Semiconcealed (wraparound) butt hinges for overlay doors **OR** Pivot (knife) hinges **OR** Concealed European-style self-closing hinges, **as directed**.
 4. Drawer Guides: Epoxy-coated-metal, self-closing drawer guides; designed to prevent rebound when drawers are closed; with nylon-tired, ball-bearing rollers; and complying with BHMA A156.9, Type B05011 or B05091.
- C. Countertop Materials
1. Plastic Laminate: High-pressure decorative laminate complying with NEMA LD 3.
 - a. Grade: HGS **OR** HGL **OR** HGP, **as directed**.
 - b. Provide through-color plastic laminate.
 - c. Grade for Backer Sheet: BKL.
 - d. Colors, Textures, and Patterns: As selected from countertop manufacturer's full range.
 2. Certified Wood Materials: Fabricate countertops with wood and wood-based products produced from wood obtained from forests certified by an FSC-accredited certification body to comply with FSC STD-01-001, "FSC Principles and Criteria for Forest Stewardship."
 3. Particleboard: ANSI A208.1, Grade M-2 **OR** M-2-Exterior Glue, **as directed**.
OR
Particleboard: Straw-based particleboard complying with requirements of ANSI A208.1, Grade M-2, except for density.

4. Plywood: Exterior softwood plywood complying with DOC PS 1, Grade C-C Plugged, touch sanded.
5. Adhesives: Do not use adhesives that contain urea formaldehyde.
6. Solid-Surfacing Material: Homogeneous solid sheets of filled plastic resin complying with ISSFA-2.
 - a. Type: Provide Standard Type or Veneer Type made from material complying with requirements for Standard Type, as indicated, unless Special Purpose Type is indicated.
 - b. Integral Sink Bowls: Comply with ISSFA-2 and ANSI Z124.3, Type 5 or Type 6, without a precoated finish.
 - c. Colors and Patterns: As selected from manufacturer's full range.
7. Solid Wood Edges and Trim: Clear red oak **OR** white oak **OR** hard maple **OR** cherry, **as directed**, lumber, free of defects, selected for compatible grain and color, and kiln dried to 7 percent moisture content.

D. Cabinets

1. Face Style: Flush overlay; door and drawer faces cover cabinet fronts with only enough space between faces for operating clearance.
OR
Face Style: Reveal overlay; door and drawer faces partially cover cabinet fronts.
OR
Face Style: Lipped overlay; door and drawer faces are rabbeted and partially inset within cabinet fronts with the lip of the rabbet overlapping cabinet body members or face frames.
OR
Face Style: Flush inset; door and drawer faces are set within cabinet fronts, flush with face.
2. Cabinet Style: Face Frame **OR** Frameless, **as directed**.
3. Door and Drawer Fronts: Solid-wood stiles and rails, **5/8 inch (16 mm)** thick, with **3/4-inch- (19-mm-)** thick, solid-wood center panels.
OR
Door and Drawer Fronts: Solid-wood stiles and rails, **3/4 inch (19 mm)** thick, with **1/4-inch- (6.4-mm-)** thick, veneer-faced plywood center panels.
OR
Door and Drawer Fronts: **1/2-inch- (12.7-mm-)** thick, veneer-faced plywood.

OR Door and Drawer Fronts: **1/2-inch- (12.7-mm-)** thick plastic-laminate-faced particleboard, with continuous solid-wood pulls on one edge, **as directed**, with PVC edge banding, **as directed**.
OR
Door and Drawer Fronts: **1/2-inch- (12.7-mm-)** thick thermoset decorative panels, with continuous solid-wood pulls on one edge, **as directed**.
OR
Door and Drawer Fronts: **1/2-inch- (12.7-mm-)** thick, thermoformed-vinyl-faced panels with vinyl overlay on faces and edges and with thermoset decorative panel backs **OR** faces, backs, and edges, **as directed**.
4. Face Frames: **3/4-by-1-5/8-inch (19-by-41-mm)** solid wood with glued mortise and tenon or doweled joints, **as directed**.
OR
Face Frames: **5/8-inch- (16-mm-)** thick particleboard with plastic laminate on exposed and semiexposed surfaces.
OR
Face Frames: **5/8-inch- (16-mm-)** thick thermoset-decorative-panel material.
OR
Face Frames: **1/2-inch- (12.7-mm-)** thick, thermoformed-vinyl-faced panels with vinyl overlay on exposed and semiexposed surfaces.
5. Exposed Cabinet End Finish: Wood veneer **OR** Plastic laminate **OR** Thermoset decorative panels **OR** Thermoformed vinyl-faced panels, **as directed**.

6. Cabinet End Construction: **5/8-inch- (16-mm-)** OR **1/2-inch- (12.7-mm-)**, **as directed**, thick particleboard or **1/2-inch- (12.7-mm-)** OR **3/8-inch- (9.5-mm-)**, **as directed**, thick plywood.
 7. Cabinet Tops and Bottoms: **5/8-inch- (16-mm-)** thick particleboard or **1/2-inch- (12.7-mm-)** thick plywood, fully supported by and secured in rabbets in end panels, front frame (if any), and back rail.
OR
Cabinet Tops and Bottoms: **1/2-inch- (12.7-mm-)** thick particleboard or **3/8-inch- (9.5-mm-)** thick plywood, fully supported by and secured in rabbets in end panels, front frame, and back rail.
 8. Back, Top, and Bottom Rails: **3/4-by-2-1/2-inch (19-by-63-mm)** solid wood, interlocking with end panels and rabbeted to receive top and bottom panels. Back rails secured under pressure with glue and with mechanical fasteners.
 9. Wall-Hung-Unit Back Panels: **3/16-inch- (4.8-mm-)** thick plywood fastened to rear edge of end panels and to top and bottom rails.
 10. Base-Unit Back Panels: **3/16-inch- (4.8-mm-)** thick plywood fastened to rear edge of end panels and to top and bottom rails.
 11. Base-Unit Back Panels: **1/8-inch- (3.2-mm-)** thick hardboard fastened to rear edge of end panels and to top and bottom rails.
 12. Front Frame Drawer Rails: **3/4-by-1-1/4-inch (19-by-32-mm)** solid wood mortised and fastened into face frame.
 13. Drawers: Fabricate with exposed fronts fastened to subfront with mounting screws from interior of body.
 - a. Join subfronts, backs, and sides with glued rabbeted joints supplemented by mechanical fasteners **OR** glued dovetail joints, **as directed**.
 - b. Subfronts, Backs, and Sides: **3/4-inch- (19-mm-)** OR **1/2-inch- (12.7-mm-)**, **as directed**, thick solid wood.
OR
Subfronts, Backs, and Sides: **1/2-inch- (12.7-mm-)** thick solid wood or **3/8-inch- (9.5-mm-)** thick plywood.
OR
Subfronts, Backs, and Sides: **3/8-inch- (9.5-mm-)** thick particleboard.
 - c. Bottoms: **1/4-inch- (6.4-mm-)** OR **3/16-inch- (4.8-mm-)**, **as directed**, thick plywood.
OR
Bottoms: **1/4-inch- (6.4-mm-)** thick hardboard **OR** particleboard, **as directed**.
 14. Shelves: **3/4-inch- (19-mm-)** thick particleboard or **5/8-inch- (16-mm-)** thick plywood.
OR
Shelves: **5/8-inch- (16-mm-)** thick particleboard or **1/2-inch- (12.7-mm-)** thick plywood.
 15. Joinery: Rabbet backs flush into end panels and secure with concealed mechanical fasteners. Connect tops and bottoms of wall cabinets and bottoms and stretchers of base cabinets to ends and dividers with mechanical fasteners. Rabbet tops, bottoms, and backs into end panels.
 16. Factory Finishing: Finish cabinets at factory. Defer only final touchup until after installation.
- E. Plastic-Laminate Countertops
1. Configuration: Provide countertops with the following front, cove (intersection of top with backsplash), backsplash, and endsplash style:
 - a. Front: No drip (raised marine edge with rolled front) **OR** Rolled **OR** Bevel **OR** Self-edge **OR** Wood-trimmed edge as indicated, **as directed**.
 - b. Cove: Cove molding (one-piece postformed laminate supported at junction of top and backsplash by wood cove molding) **OR** Applied (backsplash rests on top forming seam at inside corner), **as directed**.
 - c. Backsplash: Curved or waterfall shape with scribe **OR** Square edge without scribe **OR** Sloped top edge without scribe **OR** Square edge with scribe, **as directed**.
 - d. Endsplash: None **OR** Square edge without scribe **OR** Sloped top edge without scribe **OR** Square edge with scribe, **as directed**.
 2. Plastic-Laminate Substrate: Particleboard not less than **3/4 inch (19 mm)** thick.
 - a. For countertops at sinks and lavatories, use Grade M-2-Exterior-Glue particleboard or exterior-grade plywood.

- b. Build up countertop thickness to **1-1/2 inches (38 mm)** at front, back, and ends with additional layers of particleboard laminated to top.
3. Backer Sheet: Provide plastic-laminate backer sheet on underside of countertop substrate.
4. Paper Backing: Provide paper backing on underside of countertop substrate.

F. Solid-Surfacing-Material Countertops

1. Configuration: Provide countertops with the following front and backsplash style:
 - a. Front: Straight, slightly eased at top **OR** Bevel **OR** **3/4-inch (19-mm)** bullnose **OR** Radius edge with apron, **2 inches (50 mm)** high with **3/8-inch (9.5-mm)** radius **OR** **1-1/2-inch (38-mm)** laminated bullnose **OR** **1-inch (25-mm)** laminated bullnose **OR** Wood-trimmed edge as indicated, **as directed**.
 - b. Backsplash: Straight, slightly eased at corner **OR** Bevel **OR** Radius edge with **3/8-inch (9.5-mm)** radius, **as directed**.
 - c. Endsplash: Matching backsplash **OR** None, **as directed**.
2. Countertops: **1/2-inch- (12.7-mm-) OR 3/4-inch- (19-mm-), as directed**, thick, solid-surfacing material with wood-trimmed edges, **as directed**.
OR
 Countertops: **1/2-inch- (12.7-mm-) OR 3/4-inch- (19-mm-), as directed**, thick, solid-surfacing material with front edge built up with same material.
OR
 Countertops: **1/4-inch- (6.4-mm-)** thick, solid-surfacing material laminated to **3/4-inch- (19-mm-)** thick particleboard with wood-trimmed edges.
OR
 Countertops: **1/4-inch- (6.4-mm-)** thick, solid-surfacing material laminated to **3/4-inch- (19-mm-)** thick particleboard with front edge built up with **3/4-inch- (19-mm-)** thick, solid-surfacing material.
3. Backsplashes: **1/2-inch- (12.7-mm-) OR 3/4-inch- (19-mm-), as directed**, thick, solid-surfacing material with wood-trimmed edges, **as directed**.
4. Fabrication: Fabricate tops in one piece with shop-applied edges and backsplashes, **as directed**, unless otherwise indicated. Comply with solid-surfacing-material manufacturer's written instructions for adhesives, sealers, fabrication, and finishing.
 - a. Fabricate with loose backsplashes for field assembly.
 - b. Install integral sink bowls in countertops in the shop.

1.3 EXECUTION

A. Installation

1. Install cabinets with no variations in flushness of adjoining surfaces; use concealed shims. Where cabinets abut other finished work, scribe and cut for accurate fit. Provide filler strips, scribe strips, and moldings in finish to match cabinet face.
2. Install cabinets without distortion so doors and drawers fit openings and are aligned. Complete installation of hardware and accessories as indicated.
3. Install cabinets and countertop level and plumb to a tolerance of **1/8 inch in 8 feet (3 mm in 2.4 m)**.
4. Fasten cabinets to adjacent units and to backing.
 - a. Fasten wall cabinets through back, near top and bottom, at ends and not less than **24 inches (600 mm)** o.c. with No. 10 wafer-head screws sized for **1-inch (25-mm)** penetration into wood framing, blocking, or hanging strips.
 - b. Fasten wall cabinets through back, near top and bottom, at ends and not less than **24 inches (600 mm)** o.c., with toggle bolts through metal backing behind gypsum board.
5. Fasten plastic-laminate countertops by screwing through corner blocks of base units into underside of countertop. Form seams using splines to align adjacent surfaces, and secure with glue and concealed clamping devices designed for this purpose.
 - a. Provide cutouts for sinks and lavatories, including holes for faucets and accessories.
 - b. Seal edges of cutouts by saturating with varnish.

6. Fasten solid-surfacing-material countertops by screwing through corner blocks of base units into underside of countertop. Align adjacent surfaces, and form seams to comply with manufacturer's written instructions using adhesive in color to match countertop. Carefully dress joints smooth, remove surface scratches, and clean entire surface.
 - a. Install backsplashes and endsplashes to comply with solid-surfacing-material manufacturer's written instructions for adhesives, sealers, fabrication, and finishing.
 - b. Seal edges of cutouts by saturating with varnish.
- B. Adjusting And Cleaning
 1. Adjust cabinets and hardware so doors and drawers are centered in openings and operate smoothly without warp or bind. Lubricate operating hardware as recommended by manufacturer.
 2. Clean casework on exposed and semiexposed surfaces. Touch up factory-applied finishes to restore damaged or soiled areas.

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Task	Specification	Specification Description
11 41 33 00	11 21 63 00	Food Service Equipment
11 42 13 00	11 21 63 00	Food Service Equipment
11 42 16 00	11 21 63 00	Food Service Equipment
11 44 13 00	11 21 63 00	Food Service Equipment
11 44 16 00	11 21 63 00	Food Service Equipment
11 44 19 00	11 21 63 00	Food Service Equipment
11 46 13 00	11 21 63 00	Food Service Equipment
11 46 16 00	11 21 63 00	Food Service Equipment
11 46 19 00	11 21 63 00	Food Service Equipment
11 46 83 00	11 21 63 00	Food Service Equipment
11 48 13 00	11 21 63 00	Food Service Equipment
11 48 16 00	11 21 63 00	Food Service Equipment

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SECTION 11 52 13 13 - PROJECTION SCREENS

1.1 GENERAL

A. Description Of Work

1. This specification covers the furnishing and installation of materials for projection screens. Products shall be as follows or as directed by the Owner. Installation procedures shall be in accordance with the product manufacturer's recommendations. Demolition and removal of materials shall be as required to support the work.

B. Summary

1. Section Includes:
 - a. Manually operated projection screens.
 - b. Electrically operated projection screens and controls.
 - c. Rigid rear-projection screens.

C. Definitions

1. Gain of Front-Projection Screens: Ratio of light reflected from screen material to that reflected perpendicularly from a magnesium carbonate surface as determined per SMPTE RP 94.
2. Gain of Rear-Projection Screens: Ratio of light refracted by screen material to that reflected perpendicularly from a magnesium carbonate surface as determined per SMPTE RP 94, except that for measuring luminance of test screen, projection lamp shall be placed behind screen same distance as it was placed in front of magnesium carbonate surface for measuring luminance of reference standard.
3. Half-Gain Angle: The angle, measured from the axis of the screen surface to the most central position on a perpendicular plane through the horizontal centerline of the screen where the gain is half of the peak gain.

D. Submittals

1. Product Data: For each type of product indicated.
2. Shop Drawings: For projection screens. Show layouts and types of projection screens. Include the following:
 - a. For manually operated projection screens:
 - 1) Drop lengths.
 - 2) Anchorage details.
 - 3) Accessories.
 - b. For electrically operated projection screens and controls:
 - 1) Location of screen centerline relative to ends of screen case.
 - 2) Location of wiring connections for electrically operated units.
 - 3) Location of seams in viewing surfaces.
 - 4) Drop lengths.
 - 5) Anchorage details, including connection to supporting structure for suspended units.
 - 6) Details of juncture of exposed surfaces with adjacent finishes.
 - 7) Accessories.
 - 8) Wiring diagrams.
 - c. For rigid rear-projection screens:
 - 1) Frame details.
 - 2) Anchorage details.
 - 3) Details of juncture of exposed surfaces with adjacent finishes.
 - 4) Accessories.
3. Maintenance Data: For projection screens to include in maintenance manuals.

E. Quality Assurance

1. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

F. Delivery, Storage, And Handling

1. Environmental Limitations: Do not deliver or install projection screens until spaces are enclosed and weathertight, wet work in spaces is complete and dry, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.
2. Store rear-projection screens in manufacturer's protective packaging and according to manufacturer's written instructions.

1.2 PRODUCTS

A. Manually Operated Projection Screens

1. General: Manufacturer's standard spring-roller-operated units, consisting of case, screen, mounting accessories, and other components necessary for a complete installation.
 - a. Screen Mounting: Top edge securely anchored to a **3-inch- (75-mm-)** diameter, rigid steel roller; bottom edge formed into a pocket holding a tubular metal slat, with ends of slat protected by plastic caps, and with a saddle and pull attached to slat by screws.
 - b. Tab Tensioning: Provide units that have a durable low-stretch cord, such as braided polyester, on each side of screen connected to edge of screen by tabs to pull screen flat horizontally. In lieu of tab tensioning, screens may be constructed from vinyl-coated screen cloth that contains horizontal stiffening monofilaments to resist edge curling, **as directed**.
2. Bracket-Mounted or Ceiling-Suspended, Metal-Encased, Manually Operated Screens: Units designed and fabricated for suspending from wall brackets or ceiling, fabricated from formed-steel sheet not less than **0.027 inch (0.7 mm)** thick or from aluminum extrusions; with vinyl covering or baked-enamel finish and matching end caps. Provide mounting brackets unless otherwise indicated.
3. Surface-Mounted, Metal-Encased, Manually Operated Screens: Units designed and fabricated for surface mounting on wall or ceiling, fabricated from formed-steel sheet not less than **0.027 inch (0.7 mm)** thick or from aluminum extrusions; with flat back design and vinyl covering or baked-enamel finish. Provide units with matching end caps and concealed mounting.
4. Surface-Mounted, Wood-Finished, Manually Operated Screens: Units designed and fabricated for surface mounting on wall or ceiling; with flat back design, hardwood finish, and concealed mounting brackets.
 - a. Hardwood: Oak **OR** Walnut **OR** Cherry **OR** As selected from manufacturer's full range of species, **as directed**.
 - b. Finish: As selected from manufacturer's full range.

B. Electrically Operated Projection Screens

1. General: Manufacturer's standard units consisting of case, screen, motor, controls, mounting accessories, and other components necessary for a complete installation. Provide units that are listed and labeled as an assembly by UL or another testing and inspecting agency acceptable to authorities having jurisdiction, **as directed**.
 - a. Controls: Remote, key-operated, **as directed**, three-position control switch installed in recessed device box with flush cover plate matching other electrical device cover plates in room where switch is installed.
 - 1) Provide two **OR** three, **as directed**, control switches for each screen.
 - 2) Provide number of control switches indicated for each screen.
 - 3) Provide power supply for low-voltage systems if required.
 - 4) Provide locking cover plates for switches.
 - 5) Provide key-operated, power-supply switch.

- 6) Provide infrared **OR** radio-frequency, **as directed**, remote control consisting of battery-powered transmitter and receiver.
- 7) Provide video interface control for connecting to projector. Projector provides signal to raise or lower screen.
- b. Motor in Roller: Instant-reversing motor of size and capacity recommended by screen manufacturer; with permanently lubricated ball bearings, automatic thermal-overload protection, preset limit switches to automatically stop screen in up and down positions, and positive-stop action to prevent coasting. Mount motor inside roller with vibration isolators to reduce noise transmission.
- c. End-Mounted Motor: Instant-reversing, gear-drive motor of size and capacity recommended by screen manufacturer; with permanently lubricated ball bearings, automatic thermal-overload protection, preset limit switches to automatically stop screen in up and down positions, and positive-stop action to prevent coasting. Locate motor in its own compartment on right end of screen unless otherwise indicated **OR** on left end of screen unless otherwise indicated **OR** on end of screen indicated, **as directed**.
- d. Screen Mounting: Top edge securely anchored to rigid metal roller and bottom edge formed into a pocket holding a **3/8-inch- (9.5-mm-)** diameter metal rod with ends of rod protected by plastic caps.
 - 1) Roller for end-mounted motor supported by self-aligning bearings in brackets.
 - 2) Roller for motor in roller supported by vibration- and noise-absorbing supports.
- e. Tab Tensioning: Provide units that have a durable low-stretch cord, such as braided polyester, on each side of screen connected to edge of screen by tabs to pull screen flat horizontally. In lieu of tab tensioning, screens may be constructed from vinyl-coated screen cloth that contains horizontal stiffening monofilaments to resist edge curling.
2. Surface-Mounted, Metal-Encased, Electrically Operated Screens: Motor-in-roller **OR** End-mounted motor, **as directed**, units designed and fabricated for surface mounting on wall or ceiling, fabricated from formed-steel sheet not less than **0.027 inch (0.7 mm)** thick or from aluminum extrusions; with flat back design and vinyl covering or baked-enamel finish. Provide with matching end caps and concealed mounting.
3. Surface-Mounted, Wood-Finished, Electrically Operated Screens: Motor in roller units designed and fabricated for surface mounting on wall or ceiling; with flat back design, hardwood finish, and concealed mounting brackets.
 - a. Hardwood: Oak **OR** Walnut **OR** Cherry **OR** As selected from manufacturer's full range of species, **as directed**.
 - b. Finish: As selected from manufacturer's full range.
4. Suspended, Electrically Operated Screens without Ceiling Closure: Motor-in-roller **OR** End-mounted motor, **as directed**, units designed and fabricated for suspended mounting, with bottom of case entirely or partially open under screen compartment.
 - a. Provide metal or metal-lined motor enclosure on units with end-mounted motor.
 - b. Provide metal or metal-lined wiring compartment on units with motor in roller.
 - c. Screen Case: Made from metal **OR** metal and fire-retardant materials **OR** metal, wood, wood products, and fire-retardant materials, **as directed**.
 - d. Provide screen case with trim flange to receive ceiling finish **OR** constructed to be installed with underside flush with ceiling **OR** constructed to be installed with ceiling finish applied to underside, **as directed**.
 - e. Finish on Exposed Surfaces: Prime painted **OR** Vinyl covering or baked enamel, **as directed**.
5. Suspended, Electrically Operated Screens with Automatic Ceiling Closure: Motor-in-roller **OR** End-mounted motor, **as directed**, units designed and fabricated for suspended mounting; with bottom of case composed of two panels, fully enclosing screen, motor, and wiring; one panel hinged and designed to open and close automatically when screen is lowered and fully raised, the other removable or openable for access to interior of case.
 - a. Provide metal or metal-lined motor enclosure on units with end-mounted motor.
 - b. Provide metal or metal-lined wiring compartment on units with motor in roller.
 - c. Screen Case: Made from metal **OR** metal and fire-retardant materials **OR** metal, wood, wood products, and fire-retardant materials, **as directed**.

- d. Provide screen case with trim flange to receive ceiling finish **OR** constructed to be installed with underside flush with ceiling **OR** constructed to be installed with ceiling finish applied to underside, **as directed**.
- e. Finish on Exposed Surfaces: Prime painted **OR** Vinyl covering or baked enamel, **as directed**.

C. Front-Projection Screen Material

1. Matte-White Viewing Surface: Peak gain not less than 0.9, and gain not less than 0.8 at an angle of 50 degrees from the axis of the screen surface.
2. Matte-Gray Viewing Surface: Peak gain not less than 0.8, and half-gain angle of not less than 50 degrees from the axis of the screen surface.
3. Glass-Beaded Viewing Surface: Peak gain not less than 2.0, and half-gain angle of at least 15 degrees from the axis of the screen surface.
4. Matte Reflective Viewing Surface: Peak gain not less than 1.3, and half-gain angle of at least 40 degrees from the axis of the screen surface.
5. Wide-Angle Reflective Viewing Surface: Peak gain not less than 1.5, and half-gain angle of at least 35 degrees from the axis of the screen surface.
6. Multipurpose Reflective Viewing Surface: Peak gain not less than 1.8, and half-gain angle of at least 25 degrees from the axis of the screen surface.
7. High-Gain Reflective Viewing Surface: Peak gain not less than 2.5, and half-gain angle of at least 20 degrees from the axis of the screen surface.
8. Material: Vinyl-coated, glass-fiber fabric or vinyl sheet.
9. Mildew-Resistance Rating: 0 or 1 when tested according to ASTM G 21.
10. Flame Resistance: Passes NFPA 701.
11. Flame-Spread Index: Not greater than 75 when tested according to ASTM E 84.
12. Seams: Where length of screen indicated exceeds maximum length produced without seams in material specified, provide screen with horizontal seam placed as follows:
 - a. At top **OR** bottom, **as directed**, of screen at juncture between extra drop length and viewing surface.
 - b. In location indicated.
13. Seamless Construction: Provide screens, in sizes indicated, without seams.
14. Edge Treatment: Black **OR** Without black, **as directed**, masking borders.
15. Size of Viewing Surface: **50 by 50 inches (1270 by 1270 mm) OR 60 by 60 inches (1524 by 1524 mm) OR 70 by 70 inches (1778 by 1778 mm) OR 84 by 84 inches (2133 by 2133 mm) OR 48 by 65 inches (1219 by 1651 mm) OR 54 by 72 inches (1371 by 1828 mm) OR 58 by 79 inches (1473 by 2006 mm) OR 72 by 96 inches (1828 by 2438 mm), as directed.**
16. Provide extra drop length of dimensions and at locations indicated.
 - a. Color: Same as viewing surface **OR** Black, **as directed**.

D. Flexible Rear-Projection Screen Material

1. Wide-Angle Screens: Peak gain not less than 1.0, and half-gain angle of at least 35 degrees from the axis of the screen surface.
2. Moderate-Gain Screens: Peak gain not less than 1.3, and half-gain angle of at least 30 degrees from the axis of the screen surface.
3. High-Gain Screens: Peak gain not less than 1.8, and half-gain angle of at least 15 degrees from the axis of the screen surface.
4. Material: Coated vinyl sheet.
5. Mildew-Resistance Rating: 0 or 1 when tested according to ASTM G 21.
6. Flame Resistance: Passes NFPA 701.
7. Flame-Spread Index: Not greater than 75 when tested according to ASTM E 84.
8. Seamless Construction: Provide screens, in sizes indicated, without seams.
9. Size of Viewing Surface: **50 by 50 inches (1270 by 1270 mm) OR 60 by 60 inches (1524 by 1524 mm) OR 70 by 70 inches (1778 by 1778 mm) OR 84 by 84 inches (2133 by 2133 mm) OR 48 by 65 inches (1219 by 1651 mm) OR 54 by 72 inches (1371 by 1828 mm) OR 58 by 79 inches (1473 by 2006 mm) OR 72 by 96 inches (1828 by 2438 mm), as directed.**

10. Provide extra drop length of dimensions and at locations indicated.
 - a. Color: Same as viewing surface **OR** Black, **as directed**.
- E. Optically Coated Rigid Rear-Projection Screens
 1. Screen Substrate: Optically clear substrate complying with the following requirements:
 - a. Clear float glass complying with ASTM C 1036 for Type I (transparent glass, flat), Class 1 (clear), and Quality q3 (glazing select), 6.0 mm thick **OR** 10.0 mm thick **OR** 12.0 mm thick **OR** thickness as indicated, **as directed**.
 - b. Colorless, transparent, cast-acrylic sheet with a luminous transmittance of 92 percent per ASTM D 1003 and complying with ASTM D 4802, Category A-1 (cell cast), Finish 1 (smooth or polished), **1/4 inch (6.4 mm) thick OR 3/8 inch (9.5 mm) thick OR 1/2 inch (12.7 mm) thick OR** thickness as indicated, **as directed**.
 - c. Fresnel lens cast from colorless, transparent, acrylic with a luminous transmittance of 92 percent per ASTM D 1003 and complying with ASTM D 4802, Category A-1 (cell cast), Finish 1 (smooth or polished) on one side and Finish 2 (patterned) on other side, **1/4 inch (6.4 mm) thick OR 3/8 inch (9.5 mm) thick OR 1/2 inch (12.7 mm) thick OR** thickness as indicated, **as directed**.
 2. Optical Coating: Durable, washable coating bonded to one side of substrate.
 3. Wide-Angle Screens: Peak gain not less than 1.0, and half-gain angle of at least 35 degrees from the axis of the screen surface.
 4. Moderate-Gain Screens: Peak gain not less than 1.3, and half-gain angle of at least 30 degrees from the axis of the screen surface.
 5. General-Purpose Screens: Peak gain of not less than 1.8, and half-gain angle of at least 28 degrees from the axis of the screen surface.
 6. High-Gain Screens: Peak gain not less than 2.0, and half-gain angle of at least 20 degrees from the axis of the screen surface.
 7. Optical Tint: High-contrast dark gray **OR** Medium neutral gray **OR** Neutral white **OR** Manufacturer's standard, **as directed**.
 8. Protective Coating: Provide formulation designed by screen manufacturer as a permanent topcoat over optical coatings to protect against normal abrasion before, during, and after installation.
 9. Writing-Surface Coating: Provide screen manufacturer's protective coating, designed as a writing surface for dry-erase markers, on front of screen.
 10. Size of Viewing Surface: **40 by 54 inches (1016 by 1371 mm) OR 43 by 57 inches (1092 by 1447 mm) OR 50 by 67 inches (1270 by 1701 mm) OR 54 by 72 inches (1371 by 1828 mm) OR 60 by 80 inches (1524 by 2032 mm) OR 72 by 96 inches (1828 by 2438 mm), as directed.**
- F. High-Performance Rigid Rear-Projection Screens
 1. High-Performance Screens, General: Acrylic screen with Fresnel lens on rear surface and linear lenses on front surface.
 - a. Screen Substrate: Optically clear acrylic with a luminous transmittance of 92 percent per ASTM D 1003 and complying with ASTM D 4802, Category A-1 (cell cast), Finish 2 (patterned), **1/4 inch (6.4 mm) thick OR 3/8 inch (9.5 mm) thick OR 1/2 inch (12.7 mm) thick OR** thickness as indicated, **as directed**.
 2. Performance:
 - a. Peak gain not less than 3.0 **OR** 4.0, **as directed**, and horizontal half-gain angle of at least 50 degrees from the axis of the screen surface.
 - b. Peak gain of 3.5 **OR** 4.0, **as directed**, and horizontal half-gain angle of at least 30 degrees from the axis of the screen surface.
 - c. Performance: Peak gain of 5.0, and horizontal half-gain angle of at least 25 degrees from the axis of the screen surface.
 - d. Performance: Peak gain not less than 1.5 **OR** 3.0, **as directed**, and horizontal half-gain angle of at least 20 degrees from the axis of the screen surface.
 3. Size of Viewing Surface: **40 by 54 inches (1016 by 1371 mm) OR 43 by 57 inches (1092 by 1447 mm) OR 50 by 67 inches (1270 by 1701 mm) OR 54 by 72 inches (1371 by 1828 mm) OR 60 by 80 inches (1524 by 2032 mm) OR 72 by 96 inches (1828 by 2438 mm), as directed.**

G. Rigid Rear-Projection Screen Accessories

1. Factory Frames: Screen manufacturer's standard frames of profile indicated, fabricated to sizes required to fit screens from aluminum extrusions complying with **ASTM B 221** (**ASTM B 221M**) for 6063-T5 alloy and temper.
 - a. Class II, Clear Anodic Finish: AA-M12C22A41 (Mechanical Finish: nonspecular as fabricated; Chemical Finish: etched, medium matte; Anodic Coating: Architectural Class II, clear coating 0.010 mm or thicker) complying with AAMA 611.
 - b. Class II, Color Anodic Finish: AA-M12C22A42/A44 (Mechanical Finish: nonspecular as fabricated; Chemical Finish: etched, medium matte; Anodic Coating: Architectural Class II, integrally colored or electrolytically deposited color coating 0.010 mm or thicker) complying with AAMA 611.
 - 1) Color: Black **OR** Dark bronze **OR** Either black or dark bronze, as standard with manufacturer, **as directed**.
2. Glazing Accessories for Factory Frames: Provide gaskets and setting blocks with proven record of compatibility with screen and frame surfaces, of sizes and shapes to accommodate thickness of screen indicated and to fit glazing channel provided.
3. Glazing Accessories for Field-Framed Screens: Provide materials compatible with screen and frame surfaces while complying with applicable requirements in Division 08 Section "Glazing".

1.3 EXECUTION

A. Front-Projection Screen Installation

1. Install front-projection screens at locations indicated to comply with screen manufacturer's written instructions.
2. Install front-projection screens with screen cases in position and in relation to adjoining construction indicated. Securely anchor to supporting substrate in a manner that produces a smoothly operating screen with vertical edges plumb and viewing surface flat when screen is lowered.
 - a. Install low-voltage controls according to NFPA 70 and complying with manufacturer's written instructions.
 - 1) Wiring Method: Install wiring in raceway except in accessible ceiling spaces and in gypsum board partitions where unenclosed wiring method may be used. Use UL-listed plenum cable in environmental air spaces, including plenum ceilings. Conceal raceway and cables except in unfinished spaces.
 - b. Test electrically operated units to verify that screen controls, limit switches, closures, and other operating components are in optimum functioning condition.
 - c. Test manually operated units to verify that screen-operating components are in optimum functioning condition.

B. Rigid Rear-Projection Screen Installation

1. Install rear-projection screens at locations indicated to comply with screen manufacturer's written instructions. Handle screens carefully during installation using procedures and tools recommended by screen manufacturer; do not abrade screen surfaces.
2. Install optically coated rear-projection screens with optical coating toward projector **OR** audience, **as directed**.
3. Install high-performance, rear-projection screens with orientation as indicated in manufacturer's written instructions.
4. Install factory-framed, rear-projection screens in prepared wall openings. Securely anchor frames to surrounding construction so frames are plumb and level and screen surfaces are flat.
5. Install rear-projection screens with glass substrates, in frames specified in other Sections, to comply with applicable requirements in Division 08 Section "Glazing" and with screen manufacturer's written instructions. Set projection screen with surfaces flat and edges plumb and level.

6. Install rear-projection screens with plastic substrates, in frames specified in other Sections, to comply with screen manufacturer's written instructions. Clamp units only at top edge and allow for expansion and contraction of plastic glazing material by providing frame with adequate bite and edge clearances.
- C. Protecting And Cleaning Rigid Rear-Projection Screens
1. Provide temporary covering of rear-projection screens until time of Final Completion. Use type of covering approved by screen manufacturer that will effectively protect screen from abrasion, breakage, or other damage.
 2. Clean rear-projection screens on both faces immediately before date scheduled for inspection intended to establish date of Final Completion. Use methods and cleaning materials recommended by screen manufacturer, taking care not to scratch or damage optical coatings or screen substrates.
- D. Projection Screen Schedule
1. Manually Operated, Front-Projection Screen Type: Surface mounted, metal encased **OR** Surface mounted, wood finished, **as directed**.
 - a. Screen Surface: Matte white **OR** Matte gray **OR** Glass beaded **OR** Matte reflective **OR** Wide-angle reflective **OR** Multipurpose reflective **OR** High-gain reflective, **as directed**.
 - b. Viewing Surface Size: 50 by 50 inches (1270 by 1270 mm) **OR** 60 by 60 inches (1524 by 1524 mm) **OR** 70 by 70 inches (1778 by 1778 mm) **OR** 84 by 84 inches (2133 by 2133 mm) **OR** 48 by 65 inches (1219 by 1651 mm) **OR** 54 by 72 inches (1371 by 1828 mm) **OR** 58 by 79 inches (1473 by 2006 mm) **OR** 72 by 96 inches (1828 by 2438 mm), **as directed**.
 - c. Extra Drop Length: As needed at top of screen for bottom of screen to be 36 inches (900 mm) above floor and 36 inches (900 mm) at bottom of screen, **as directed**.
 2. Electrically Operated, Front-Projection Screen Type: Surface mounted, metal encased **OR** Surface mounted, wood finished **OR** Suspended, without ceiling closure **OR** Suspended, with automatic ceiling closure, **as directed**.
 - a. Motor Configuration: Motor in roller **OR** End-mounted motor on right end of screen **OR** End-mounted motor on left end of screen **OR** End-mounted motor on end of screen indicated, **as directed**.
 - b. Screen Surface: Matte white **OR** Matte gray **OR** Glass beaded **OR** Matte reflective **OR** Wide-angle reflective **OR** Multipurpose reflective **OR** High-gain reflective, **as directed**.
 - c. Viewing Surface Size: 50 by 50 inches (1270 by 1270 mm) **OR** 60 by 60 inches (1524 by 1524 mm) **OR** 70 by 70 inches (1778 by 1778 mm) **OR** 84 by 84 inches (2133 by 2133 mm) **OR** 48 by 65 inches (1219 by 1651 mm) **OR** 54 by 72 inches (1371 by 1828 mm) **OR** 58 by 79 inches (1473 by 2006 mm) **OR** 72 by 96 inches (1828 by 2438 mm), **as directed**.
 - d. Extra Drop Length: As needed at top of screen for bottom of screen to be 36 inches (900 mm) above floor and 36 inches (900 mm) at bottom of screen, **as directed**.
 3. Manually Operated, Rear-Projection Screen Type: Surface mounted, metal encased **OR** Surface mounted, wood finished, **as directed**.
 - a. Screen Type: Wide angle **OR** Moderate gain **OR** High gain, **as directed**.
 - b. Viewing Surface Size: 50 by 50 inches (1270 by 1270 mm) **OR** 60 by 60 inches (1524 by 1524 mm) **OR** 70 by 70 inches (1778 by 1778 mm) **OR** 84 by 84 inches (2133 by 2133 mm) **OR** 48 by 65 inches (1219 by 1651 mm) **OR** 54 by 72 inches (1371 by 1828 mm) **OR** 58 by 79 inches (1473 by 2006 mm) **OR** 72 by 96 inches (1828 by 2438 mm), **as directed**.
 - c. Extra Drop Length: As needed at top of screen for bottom of screen to be 36 inches (900 mm) above floor and 36 inches (900 mm) at bottom of screen, **as directed**.
 4. Electrically Operated, Rear-Projection Screen Type: Surface mounted, metal encased **OR** Surface mounted, wood finished **OR** Suspended, without ceiling closure **OR** Suspended, with automatic ceiling closure, **as directed**.
 - a. Motor Configuration: Motor in roller **OR** End-mounted motor on right end of screen **OR** End-mounted motor on left end of screen **OR** End-mounted motor on end of screen indicated, **as directed**.
 - b. Screen Type: Wide angle **OR** Moderate gain **OR** High gain, **as directed**.

- c. Viewing Surface Size: **50 by 50 inches** (1270 by 1270 mm) **OR** **60 by 60 inches** (1524 by 1524 mm) **OR** **70 by 70 inches** (1778 by 1778 mm) **OR** **84 by 84 inches** (2133 by 2133 mm) **OR** **48 by 65 inches** (1219 by 1651 mm) **OR** **54 by 72 inches** (1371 by 1828 mm) **OR** **58 by 79 inches** (1473 by 2006 mm) **OR** **72 by 96 inches** (1828 by 2438 mm), **as directed**.
- d. Extra Drop Length: As needed at top of screen for bottom of screen to be **36 inches** (900 mm) above floor and **36 inches** (900 mm) at bottom of screen, **as directed**.
- 5. Rigid Rear-Projection Screen Type: Optically coated screen.
 - a. Screen Substrate: Glass **OR** Acrylic, **as directed**.
 - b. Screen Type: Wide angle **OR** Moderate gain **OR** General purpose **OR** High gain, **as directed**.
 - c. Optical Tint: High-contrast dark gray **OR** Medium neutral gray **OR** Neutral white, **as directed**.
 - d. Size of Viewing Surface: **40 by 54 inches** (1016 by 1371 mm) **OR** **43 by 57 inches** (1092 by 1447 mm) **OR** **50 by 67 inches** (1270 by 1701 mm) **OR** **54 by 72 inches** (1371 by 1828 mm) **OR** **60 by 80 inches** (1524 by 2032 mm) **OR** **72 by 96 inches** (1828 by 2438 mm), **as directed**.
 - e. Additional Features: Protective coating **OR** Writing surface coating **OR** Factory frame, **as directed**.
- 6. Rigid Rear-Projection Screen Type: High-performance screen.
 - a. Gain: Not less than 1.5 **OR** 3 **OR** 3.5 **OR** 4 **OR** 5, **as directed**.
 - b. Horizontal Half-Gain Angle: At least 20 **OR** 25 **OR** 30 **OR** 50, **as directed**, degrees from screen axis.
 - c. Size of Viewing Surface: **40 by 54 inches** (1016 by 1371 mm) **OR** **43 by 57 inches** (1092 by 1447 mm) **OR** **50 by 67 inches** (1270 by 1701 mm) **OR** **54 by 72 inches** (1371 by 1828 mm) **OR** **60 by 80 inches** (1524 by 2032 mm) **OR** **72 by 96 inches** (1828 by 2438 mm), **as directed**.
 - d. Additional Features: Factory frame.

END OF SECTION 11 52 13 13



Task	Specification	Specification Description
11 52 13 13	01 22 16 00	No Specification Required
11 52 16 26	01 22 16 00	No Specification Required

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SECTION 11 66 13 00 - PLAYGROUND EQUIPMENT AND STRUCTURES

1.1 GENERAL

A. Description Of Work

1. This specification covers the furnishing and installation of materials for playground equipment and structures. Products shall be as follows or as directed by the Owner. Installation procedures shall be in accordance with the product manufacturer's recommendations. Demolition and removal of materials shall be as required to support the work.

B. Summary

1. This Section includes the following:
 - a. Freestanding playground equipment and structures.
 - b. Composite playground equipment and structures.

C. Definitions

1. Fall Height: According to ASTM F 1487, "the vertical distance between a designated play surface and the protective surfacing beneath it."
2. HDPE: High-density polyethylene.
3. IPEMA: International Play Equipment Manufacturers Association.
4. LLDPE: Linear low-density polyethylene.
5. MDPE: Medium-density polyethylene.
6. Use Zone: According to ASTM F 1487, "the area beneath and immediately adjacent to a play structure that is designated for unrestricted circulation around the equipment and on whose surface it is predicted that a user would land when falling from or exiting the equipment."

D. Submittals

1. Product Data: For each type of product indicated.
2. Shop Drawings: Show fabrication and installation details for playground equipment and structures.
3. Coordination Drawings: Plans, drawn to scale, on which the following items are shown and coordinated with each other, based on input from installers of the items involved:
 - a. Extent of surface systems and use zones for equipment.
 - b. Critical heights for playground surface, or fall heights for equipment.
4. Samples: For each type of exposed finish.
5. LEED Submittals:
 - a. Product Data for Credit MR 4.1 and MR 4.2, **as directed**: For products having recycled content, documentation indicating percentages by weight of postconsumer and preconsumer recycled content.
 - 1) Include statement indicating costs for each product having recycled content.
 - b. Certificates for Credit MR 7: Chain-of-custody certificates certifying that products specified to be made from certified wood comply with forest certification requirements. Include evidence that manufacturer is certified for chain of custody by an FSC-accredited certification body.
 - 1) Include statement indicating costs for each certified wood product.
6. Product Certificates: For each type of playground equipment, signed by product manufacturer.
7. Material Certificates: For the following items, signed by manufacturers:
 - a. Shop finishes.
 - b. Wood Preservative Treatment: Include certification by treating plant that states type of preservative solution and pressure process used, net amount of preservative retained, and compliance with applicable standards.
 - c. Recycled plastic.
8. Field quality-control test reports.

9. Product Test Reports: Based on evaluation of comprehensive tests performed by manufacturer and witnessed by a qualified testing agency, for playground equipment.
10. Maintenance Data: For playground equipment and finishes to include in maintenance manuals.
11. Warranty: Special warranty specified in this Section.

E. Quality Assurance

1. Installer Qualifications: An employer of workers trained and approved by manufacturer.
2. Manufacturer Qualifications: A firm whose playground equipment components have been certified by IPEMA's third-party product certification service.
3. Forest Certification: Fabricate designated playground equipment with wood components produced from wood obtained from forests certified by an FSC-accredited certification body to comply with FSC STD-01-001, "FSC Principles and Criteria for Forest Stewardship."
4. Safety Standards: Provide playground equipment complying with or exceeding requirements in the following:
 - a. ASTM F 1487.
 - b. CPSC No. 325.
5. Preinstallation Conference: Conduct conference at Project site.

F. Warranty

1. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of playground equipment that fail in materials or workmanship within specified warranty period.
 - a. Failures include, but are not limited to, the following:
 - 1) Structural failures.
 - 2) Deterioration of metals, metal finishes, and other materials beyond normal weathering.
 - b. Warranty Period: Two **OR** Five, **as directed**, years from date of Final Completion.

1.2 PRODUCTS

A. Materials

1. Aluminum: Alloy and temper recommended by manufacturer for type of use and finish indicated.
 - a. Extruded Bars, Profiles, and Tubes: **ASTM B 221 (ASTM B 221M)**.
 - b. Cast Aluminum: ASTM B 179.
 - c. Flat Sheet: **ASTM B 209 (ASTM B 209M)**.
2. Steel: Comply with the following:
 - a. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M, hot-dip galvanized.
 - b. Steel Pipe: ASTM A 53/A 53M or ASTM A 135/A 135M standard-weight, hot-dip galvanized.
 - c. Steel Tubing: ASTM A 513, cold formed, hot-dip galvanized.
 - d. Steel Sheet: ASTM A 1011/A 1011M, hot-dip galvanized not less than **G60 (Z180)** coating designation.
 - e. Perforated Metal: Steel sheet not less than **0.075-inch (1.9-mm) OR 0.090-inch (2.3-mm) OR 0.120-inch (3.0-mm)** uncoated thickness; hot-dip galvanized; manufacturer's standard perforation pattern.
 - f. Expanded Metal: Manufacturer's standard carbon-steel sheets complying with ASTM F 1267, Type II (expanded and flattened); deburred after expansion.
 - g. Woven Wire Mesh: Manufacturer's standard, with wire complying with **ASTM A 510 (ASTM A 510M)**.
3. Stainless-Steel Sheet: ASTM A 240/A 240M or ASTM A 666; Type 304, finished on exposed faces with No. 2B finish.
4. Wood: Surfaced smooth on all sides and all edges rounded, Douglas fir, preservative treated after fabrication **OR** Pine, preservative treated after fabrication **OR** [Western red cedar, as directed.

5. Softwood Plywood: DOC PS 1, Exterior; smooth surfaced with rounded edges; preservative treated after fabrication.
 6. Opaque Plastic: Color impregnated, UV stabilized, and mold resistant.
 - a. Polyethylene: Fabricated from virgin **OR** 96 percent recycled, purified, fractional-melt plastic resin; rotationally molded HDPE, LLDPE, or MDPE with not less than **1/4-inch (6-mm)** wall thickness.
 7. Transparent Plastic: Abrasion-resistant, UV-stabilized monolithic polycarbonate sheet; clear, colorless; not less than **3/16 inch (5 mm)** thick.
 8. Chain and Fittings: ASTM A 467/A 467M, Class CS, 4/0 or 5/0, welded-straight-link coil chain; hot-dip galvanized **OR** zinc plated **OR** PVC coated, **as directed**. With commercial-quality, hot-dip galvanized **OR** zinc-plated, **as directed**, steel connectors and swing or ring hangers.
 9. Castings and Hangers: Malleable iron, ASTM A 47/A 47M, Grade 32510, hot-dip galvanized.
 10. Post Caps: Cast aluminum **OR** color-impregnated, UV-stabilized, mold-resistant polyethylene or polypropylene, **as directed**; color to match posts.
 11. Platform Clamps and Hangers: Cast aluminum **OR** zinc-plated steel, not less than **0.105-inch-(2.7-mm-)** nominal thickness, **as directed**.
 12. Hardware: Manufacturer's standard; commercial-quality; corrosion-resistant; hot-dip galvanized steel and iron, stainless steel, or aluminum; of a secure and vandal-resistant design.
 13. Fasteners: Manufacturer's standard; corrosion-resistant; hot-dip galvanized or plated steel and iron, or stainless steel; permanently capped, and theft resistant.
- B. Wood-Preservative-Treated Materials
1. Preservative Treatment: Pressure-treat wood according to AWPA C2 (lumber) and AWPA C9 (plywood).
 - a. Use preservative chemicals acceptable to authorities having jurisdiction and containing no arsenic or chromium. Use chemical formulations that do not bleed through or otherwise adversely affect finishes. Do not use colorants to distinguish treated materials from untreated materials.
 - b. Kiln-dry lumber and plywood after treatment to a maximum moisture content, respectively, of 19 and 15 percent. Do not use materials that are warped or do not comply with requirements for untreated materials.
- C. Playground Equipment Fabrication
1. General: Provide sizes, strengths, thicknesses, wall thickness, and weights of components as indicated but not less than required to comply with structural performance and other requirements in ASTM F 1487. Factory drill components for field assembly. Unnecessary holes in components, not required for field assembly, are not permitted. Provide complete play structure, including supporting members and connections, means of access and egress, designated play surfaces, barriers, guardrails, handrails, handholds, and other components indicated or required to comply with referenced standards for equipment indicated.
 - a. Composite Play Structure: Provide complete play structure, designed to be modular, linked, and expandable, forming one integral unit for more than one play activity.
 2. Metal Frame: Fabricate main-frame upright support posts from metal pipe or tubing with cross-section profile and dimensions as indicated. Unless otherwise indicated, provide each pipe or tubing main-frame member with manufacturer's standard drainable bottom plate or support flange. Fabricate secondary frame members, bracing, and connections from either steel or aluminum.
 3. Wood Frame: Fabricate main-frame upright support posts from wood species and with profile and dimensions as indicated. Fabricate secondary frame members, bracing, and connections from wood, steel, or aluminum.
 4. Composite Frame: Fabricate main-frame upright support posts from metal and plastic with profile and dimensions as indicated. Fabricate secondary frame members, bracing, and connections from either steel or aluminum.
 5. Play Surfaces: Provide manufacturer's standard elevated drainable decks, platforms, landings, walkways, ramps, and similar transitional play surfaces, designed to withstand loads; fabricated from perforated or expanded metal **OR** molded plastic **OR** plastic panel or plank **OR** recycled

polyethylene panel or plank **OR** wood plank, **as directed**, made into floor units with slip-slip-resistant foot surfaces. Fabricate units in manufacturer's standard modular sizes and shapes to form assembled play surfaces indicated.

- a. Elevated Play Surfaces: Provide protective devices, completely surrounding play surface except for access openings, if play-surface heights above protective surfacing exceed requirements in ASTM F 1487 **OR** CPSC No. 325, **as directed**.
- b. Stepped Play Surfaces: Provide protective infill between stepped platforms.
6. Protective Barriers: Fabricated such that openings within the barrier and between the barrier and the play surface preclude passage of the torso probe according to ASTM F 1487 **OR** CPSC No. 325, **as directed**. Provide barriers designed to minimize the possibility of climbing, free of hand- and footholds, and configured to completely surround the protected area except for access openings. Extend barriers above the protected elevated surface for use by age group indicated. Fabricate from the following:
 - a. Welded metal pipe or tubing with vertical bars.
 - b. Steel sheet with openings for vision and ventilation.
 - c. Metal-pipe or -tubing frame with wire mesh infill panels.
 - d. Opaque **OR** Transparent as directed, solid plastic panels with openings.
 - e. Vertical wood balusters with metal pipe or tubing or wood frame.
 - f. Wood panels with openings for vision and ventilation.
7. Guardrails: Provide guardrails configured to completely surround the protected area except for access openings. Fabricate from welded metal pipe or tubing **OR** metal pipe or tubing, and wood, as directed. Extend guardrails to comply with requirements for use by age group indicated.
8. Handrails: Welded metal pipe or tubing, OD between **0.095 to 1.55 inches (24.1 to 39.4 mm) OR 0.125 inch (3.2 mm)**.
 - a. Provide handrails at heights to comply with requirements for use by age group indicated according to ASTM F 1487 **OR** CPSC No. 325.
9. Roofs and Canopies: Manufacturer's standard, designed to be positioned overhead and to discourage and minimize climbing by users.
 - a. Fabricated from metal **OR** metal-pipe or -tubing-framed, welded wire **OR** opaque plastic **OR** clear polycarbonate plastic **OR** recycled polyethylene **OR** wood, as directed.
10. Signs: Manufacturer's standard sign panels, fabricated from opaque plastic with graphics molded in **OR** wood with painted graphics, as directed, attached to upright support posts.
 - a. Text: As directed.
 - b. Colors: As directed.

D. Freestanding Playground Equipment And Structures

1. Swings, Single **OR** Multiple, **as directed**, Axis:
 - a. Frame: Galvanized steel **OR** Aluminum pipe or tubing connected frame sections.
 - 1) Leg Upright(s): Not less than **1-7/8-inch (48-mm) OR 2-3/8-inch (60-mm) OR 3-1/2-inch (89-mm) OR 4-1/2-inch (114-mm) OR 5-inch (127-mm)**, as directed
 - 2) Overhead Beam: Match leg upright **OR** Not less than **2-3/8-inch (60-mm) OR** Not less than **3-1/2-inch (89-mm)**, as directed.
 - 3) Color: As selected from manufacturer's full range].
 - b. Frame: Wood connected frame sections with leg upright(s) and overhead beam not less than **4 inches (100 mm) square OR 6 inches (152 mm) square OR 6 inches (152 mm) round**, as directed, for legs.
 - c. Overhead Beam Height: **96 inches (2440 mm) OR 10 feet (3 m) OR** Height as indicated on Drawings, **as directed**, from pivot point above protective surfacing.
 - d. Chain: Standard link **OR** Short link not permitting finger penetration **OR** Manufacturer's standard, **as directed**.
 - 1) Color: As indicated by manufacturer's designations **OR** Match the Owner's sample **OR** As selected by the Owner from manufacturer's full range, **as directed**.
 - e. Swing Connector: S-hook **OR** Double clevis and bolt link, **as directed**.
 - f. Swing Hanger: Galvanized stamped steel clamp and ductile-iron pivot **OR** heavy-duty ductile iron **OR** manufacturer's standard, **as directed**.

- g. Swing Seats: Enclosed, full-bucket infant/tot **OR** Half-bucket **OR** U-shaped flexible belt **OR** Rigid rectangular **OR** Rigid disk **OR** Tire seat made from rubber **OR** plastic, as directed.
- h. Swing Seats: EPDM rubber **OR** Injection molded plastic, **as directed**, enclosed infant seat **OR** flexible seat **OR** tire, **as directed**.
 - 1) Color: As indicated by manufacturer's designations **OR** Match the Owner's sample **OR** As selected by the Owner from manufacturer's full range, **as directed**.
- i. Age Appropriateness: Two through five years **OR** 5 through 12 years, **as directed**.
- 2. Slides: Fabricated from stainless steel **OR** opaque plastic **OR** aluminum, **as directed**.
 - a. Configuration: Straight-aligned **OR** Quarter-turn **OR** Half-turn **OR** Three-quarter-turn **OR** Full-turn spiral **OR** S-shaped **OR** Squiggle-shaped descending chute(s), **as directed**.
 - b. Access: Stair or step ladder with handrails **OR** Vertical ladder **OR** Vertical ladder with side handrails, **as directed**.
 - c. Sit-Down Entrance: With protective barriers **OR** opaque plastic panel barriers **OR** canopy or hood enclosure, **as directed** and overhead handhold and side handholds.
 - d. Frame: Manufacturer's standard galvanized-steel pipe or tubing **OR** aluminum pipe or tubing **OR** wood, **as directed**.
 - e. Sliding Surface: Inclined **OR** Wavy **OR** Washboard rollers, **as directed**.
 - f. Sliding Surface Construction: Flat, continuous stainless-steel sheet with integral, full-length side rails **OR** U-shaped, continuous stainless-steel sheet with integral, full-length side rails **OR** [One-piece plastic with integral, full-length side rails **OR** Plastic tube, ID not less than **24 inches (610 mm)** **OR** [Plastic tube, ID not less than **30 inches (760 mm)**, **as directed**.
 - g. Colors: As selected from manufacturer's full range.
 - h. Age Appropriateness: Two through five years **OR** 5 through 12 years, **as directed**.
 - 1) Color: As indicated by manufacturer's designations **OR** Match the Owner's sample **OR** As selected by the Owner from manufacturer's full range, **as directed**.
 - i. Tube, round, not less than **24-inch (610-mm)** **OR** **30-inch (760-mm)**, **as directed**, diameter.
- 3. Merry-Go-Rounds: Rotating platform **OR** seating, **as directed**, around a vertical axis.
 - a. Rotating Mechanism: Permanently sealed and lubricated ball bearings with hydraulic-speed **OR** mechanical-speed, **as directed**, limiting device.
 - b. Platform: Round, dish-shaped **OR** flat **OR** flat, dimpled, **as directed**, steel sheet, not less than **0.1196-inch- (3.038-mm-)** nominal thickness, with slip-resistant footing.
 - 1) Color: As indicated by manufacturer's designations **OR** Match the Owner's sample **OR** As selected by the Owner from manufacturer's full range, **as directed**.
 - c. Handholds and Handrails: Metal pipe or tubing.
 - 1) Color: As indicated by manufacturer's designations **OR** Match the Owner's sample **OR** As selected by the Owner from manufacturer's full range, **as directed**.
 - d. Capacity: Single user **OR** Two users **OR** Five users, **as directed**.
- 4. Tunnels (Crawl Tubes): Fabricated from stainless steel **OR** opaque plastic, **as directed**.
 - a. Shape: Straight **OR** Curved, quarter turn, **as directed**.
 - b. Tube, round, not less than **24-inch (610-mm)** **OR** **30-inch (760-mm)**, **as directed**, diameter.
 - 1) Color: As indicated by manufacturer's designations **OR** Match the Owner's sample **OR** As selected by the Owner from manufacturer's full range, **as directed**.
- 5. Climbers: Fabricated from steel with galvanized **OR** PVC-plastisol, **as directed**, finish.
 - a. Horizontal ladder with hand rings, **as directed**.
 - b. Vertical fence.
 - c. Chain or cable ladder **OR** walks, **as directed**.
 - 1) Color: As indicated by manufacturer's designations **OR** Match the Owner's sample **OR** As selected by the Owner from manufacturer's full range, **as directed**.
- 6. Spring Rocking-Rider **OR** Seesaw, **as directed**:
 - a. Seat: Cast aluminum **OR** Molded HDPE or other plastic **OR** Wood, **as directed**; with handholds **OR** handholds and footrests, **as directed**.
 - 1) Seat Style: as directed by the Owner.
 - 2) Color: As indicated by manufacturer's designations **OR** Match the Owner's sample **OR** As selected by the Owner from manufacturer's full range, **as directed**.
 - b. Base: One **OR** Two, **as directed**, coil spring(s) with steel base plate.

- c. Capacity: Single user **OR** Two users, **as directed**.

E. Composite Playground Equipment And Structures

1. Composite Structure: Fabricated from steel **OR** wood **OR** opaque plastic, **as directed**.
 - a. Frame: Galvanized steel pipe or tubing frame sections connected with bolts **OR** clamps, **as directed**.
 - 1) Pipe or Tubing: Not less than **4-inch (102-mm)** **OR** **5-inch (127-mm)**, **as directed**, OD legs.
 - 2) Color: As indicated by manufacturer's designations **OR** Match the Owner's sample **OR** As selected by the Owner from manufacturer's full range, **as directed**.
 - b. Frame: Wood frame sections connected with bolts.
 - 1) Wood not less than **4 inches (102 mm)** square **OR** **6 inches (152 mm)** round, **as directed**, for legs.
 - c. Horizontal Ladder Beam Height: **60 inches (1524 mm)** **OR** **84 inches (2130 mm)** **OR** Height as indicated on Drawings, **as directed**, above protective surfacing.
 - 1) Steel overhead beam, **2-3/8-inch (60-mm)** OD.
 - 2) Wood overhead beam, **6 inches (152 mm)** square.
 - d. Platforms: Perforated metal **OR** Wood **OR** Manufacturer's standard, **as directed**.
 - 1) Color: As indicated by manufacturer's designations **OR** Match the Owner's sample **OR** As selected by the Owner from manufacturer's full range, **as directed**.
 - e. Roofs: Perforated metal **OR** Wood **OR** Manufacturer's standard, **as directed**.
 - 1) Color: As indicated by manufacturer's designations **OR** Match the Owner's sample **OR** As selected by the Owner from manufacturer's full range, **as directed**.
 - f. Equipment: Include the following play event components:
 - 1) Slide.
 - 2) Crawl tube with spy holes, **as directed**.
 - 3) Horizontal ladder.
 - 4) Log roll.
 - 5) Color: As indicated by manufacturer's designations **OR** Match the Owner's sample **OR** As selected by the Owner from manufacturer's full range, **as directed**.
 - g. Accessories: as directed by the Owner.
 - h. Arrangement: As indicated **OR** Manufacturer's standard, **as directed**.
 - i. Capacity: **10** **OR** **20**, **as directed**, users.
 - j. Age Appropriateness: 2 through 5 years **OR** 5 through 12 years, **as directed**.

F. Cast-In-Place Concrete

1. Concrete Materials and Properties: Comply with requirements in Division 03 Section "Cast-in-place Concrete" **OR** ACI 301, **as directed**, to produce normal-weight, air-entrained, **as directed**, concrete with a minimum 28-day compressive strength of **3000 psi (20.7 MPa)**, **3-inch (75-mm)** slump, and **1-inch- (25-mm-)** maximum-size aggregate.
2. Concrete Materials and Properties: Dry-packaged concrete mix complying with ASTM C 387 and mixed at site with potable water, according to manufacturer's written instructions, to produce normal-weight concrete with a minimum 28-day compressive strength of **3000 psi (20.7 MPa)**, **3-inch (75-mm)** slump, and **1-inch- (25-mm-)** maximum-size aggregate.

G. Aluminum Finishes

1. Baked-Enamel Finish: Prepare, treat, and coat metal to comply with paint manufacturer's written instructions and as follows:
 - a. Thermosetting, modified-acrylic enamel primer/topcoat system complying with AAMA 2603 except with a minimum dry film thickness not less than **1.5 mils (0.04 mm)** **OR** **3 to 5 mils (0.076 to 0.127 mm)**, **as directed**, medium gloss.
2. PVC Finish: Manufacturer's standard, UV-stabilized, mold-resistant, slip-resistant, matte-textured, dipped or sprayed-on, PVC-plastisol finish, with flame retardant added, complying with coating manufacturer's written instructions for pretreatment, application, and minimum dry film thickness of **80 mils (2 mm)** **OR** **100 mils (2.5 mm)**, **as directed**.

3. Color: As indicated by manufacturer's designations **OR** Match the Owner's sample **OR** As selected by the Owner from manufacturer's full range, **as directed**.

H. Iron And Steel Finishes

1. Galvanizing: Hot-dip galvanize products made from rolled-, pressed-, and forged-steel shapes, castings, plates, bars, and strips indicated to be galvanized to comply with ASTM A 123/A 123M.
 - a. Hot-dip galvanize steel and iron hardware indicated to be galvanized to comply with ASTM A 153/A 153M.
 - b. Galvanized Steel Sheet: Commercial steel sheet, hot-dip galvanized, complying with ASTM A 653/A 653M for not less than **G60 (Z180)** coating designation, mill phosphatized.
2. Powder-Coat Finish: Prepare, treat, and coat ferrous metal to comply with resin manufacturer's written instructions and as follows:
 - a. Apply thermosetting polyester or acrylic urethane powder coating with cured-film thickness not less than **1.5 mils (0.04 mm)**.
3. Baked-Enamel Finish: Immediately after cleaning and pretreating, apply manufacturer's standard two-coat, baked-enamel finish consisting of prime coat and thermosetting topcoat. Comply with paint manufacturer's written instructions for applying and baking to achieve a minimum dry film thickness of **2 mils (0.05 mm)**.
4. PVC Finish: Manufacturer's standard, UV-stabilized, mold-resistant, slip-resistant, matte-textured, dipped or sprayed-on, PVC-plastisol finish, with flame retardant added, complying with coating manufacturer's written instructions for pretreatment, application, and minimum dry film thickness of **80 mils (2 mm) OR 100 mils (2.5 mm)**, **as directed**.
5. Color: As indicated by manufacturer's designations **OR** Match the Owner's sample **OR** As selected by the Owner from manufacturer's full range, **as directed**.

I. Stainless-Steel Finishes

1. Remove tool and die marks and stretch lines or blend into finish.
2. Bright, Cold-Rolled, Unpolished Finish: No. 2B finish on exposed faces.

1.3 EXECUTION

A. Installation, General

1. General: Comply with manufacturer's written installation instructions, unless more stringent requirements are indicated. Anchor playground equipment securely, positioned at locations and elevations indicated.
 - a. Maximum Equipment Height: Coordinate installed heights of equipment and components with finished elevations of protective surfacing. Set equipment so fall heights and elevation requirements for age group use and accessibility are within required limits. Verify that playground equipment elevations comply with requirements for each type and component of equipment.
2. Post and Footing Excavation: Excavate holes for posts and footings as indicated in firm, undisturbed or compacted subgrade soil.
3. Post Set on Subgrade: Level bearing surfaces with drainage fill to required elevation.
4. Post Set with Concrete Footing: Comply with ACI 301 for measuring, batching, mixing, transporting, forming, and placing concrete.
 - a. Set equipment posts in **OR** on, **as directed**, concrete footing. Protect portion of posts above footing from concrete splatter. Verify that posts are set plumb or at the correct angle, alignment, height, and spacing.
 - 1) Place concrete around posts and vibrate or tamp for consolidation. Hold posts in position during placement and finishing operations until concrete is sufficiently cured.
 - b. Embedded Items: Use setting drawings and manufacturer's written instructions to ensure correct installation of anchorages for equipment.
 - c. Concrete Footings: Smooth top, and shape to shed water.



B. Field Quality Control

1. Testing Agency: Engage a qualified independent testing and inspecting agency to perform field tests and inspections and prepare test reports.
2. Arrange for playground equipment manufacturer's technical personnel to inspect playground and playground equipment and components during installation and, **as directed**, at final completion and to certify compliance with the following:
 - a. ASTM F 1487.
 - b. CPSC No. 325.
3. Notify the Owner 48 hours in advance of date and time of final inspection.

END OF SECTION 11 66 13 00

NOT FOR BID

SECTION 11 68 13 00 - RECREATIONAL FACILITIES

1.1 GENERAL

A. Description Of Work

1. This specification covers the furnishing and installation of recreational facilities. Products shall match existing materials and/or shall be as follows or as directed by the Owner. Installation procedures shall be in accordance with the product manufacturer's recommendations. Demolition and removal of materials shall be as required to support the work.

B. Submittals

1. Shop Drawings and/or Catalogue Cuts shall be submitted for approval prior to any installation.

1.2 PRODUCTS

A. Materials shall be resistant to corrosion and degradation by ultraviolet rays. Hardware and fittings shall be at least as corrosion-resistant as the materials fastened.

1. Steel Plates, Pipe, Tubing, Sheets, Wire Ropes, Chains, and Miscellaneous Shapes shall be stainless steel or galvanized steel, even if painted or coated with vinyl or other protective finish. All open pipe and tube ends shall have rain caps.
2. Wood shall be all-heart cedar, cypress, or redwood or shall be treated with a non-toxic preservative. Wood shall not be used where it will be in direct contact with the ground, unless approved by the Owner.
3. Fiberglass shall be smooth fiberglass-reinforced polyester with gelcoat coating and shall meet the following minimum physical properties: 22,000 psi (1,550 kg/sq cm) flexural strength, 15,000 psi (1,055 kg/sq cm) tensile strength, and 20,000 psi (1,410 kg sq cm) compressive strength.
4. Aluminum shall be anodized.
5. Foundations shall be 3,200 psi (225 kg/sq cm) compressive strength concrete, enforced as required. Provide embedded anchorage items as required,

B. Playground Equipment, including see-saws, slides, swings, whirlers, and monkey bars, shall be prefabricated and designed to withstand the anticipated structural loads.

1. Exposed Surfaces shall be smooth (except where required to be nonslip) seamless, and nonsplintering.
2. Steps, Platforms, and Other Flat Surfaces Subject to Foot Traffic shall be non-slip, but not abrasive and shall be formed to exclude or drain away water.
3. Fastening shall be flush, concealed, or otherwise formed or located to prevent injury to children playing on the equipment.
4. Slides shall have stainless steel sliding surfaces.

C. Bike Racks shall be mounted, and sections (if rack is sectional) shall be attached with tamper-proof fasteners.

D. Fiberglass Shelters shall be reinforced with steel, aluminum, or wood framework as required. Shelter roof shall be sloped to drain. Fiberglass edges shall be returned so that they are not exposed, Shelters shall be prefabricated and designed to withstand the anticipated live, dead, and wind loads.

1.3 EXECUTION

- #### A.
- Recreational facilities shall be installed plumb, aligned, and securely anchored to the ground. Adjust equipment with moving parts until operation is smooth and easy.

END OF SECTION 11 68 13 00

NOT FOR BID



Task	Specification	Specification Description
11 68 13 00	11 66 13 00	Playground Equipment And Structures

NOT FOR BID

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SECTION 11 68 23 13 - PLAYING FIELDS

1.1 GENERAL

A. Description Of Work

1. This specification covers the furnishing and installation of materials for repair and maintenance of playing fields. Products shall match existing materials and/or shall be as follows or as directed by the Owner. Installation procedures shall be in accordance with the product manufacturer's recommendations. Demolition and removal of materials shall be as required to support the work.

B. Submittals

1. Product Data: For each type of product/material indicated.
2. Shop drawings shall be submitted for approval.

1.2 PRODUCTS

- A. Fills required to bring the subgrade of playing surfaces up to required elevation shall be placed in horizontal layers of not more than **8 in. (200 mm)** in loose thickness. The top layer of all fills and excavated areas under the playing surfaces shall be compacted to 95 percent maximum density in accordance with ASTM D 698.

- B. Sand-Clay Playing Surfaces shall consist of a stone foundation course, a clay foundation course, a wearing course and, where equipped, a drainage filter course, constructed on the prepared subgrade.

1. Stone Foundation Course: A layer at least **3 in. (75 mm)** thick of **3/4- to 1-1/2 in. (19 to 38 mm)** crushed stone shall be spread over the subgrade or over the drainage filter course constructed thereon and shall be given preliminary compaction by rolling, followed by a filler consisting of **1/4- to 1/2-in. (6 to 13 mm)** crushed stone to fill voids in the underlying stone. The stone foundation course shall be compacted to a minimum of 95 percent maximum density in accordance with ASTM D 698.
2. Clay Foundation Course: Selected inorganic fat clay (CH) shall be evenly spread on the stone foundation course to produce a compacted layer not less than **3 in. (75 mm)** thick. The clay layer shall be compacted to a minimum of 90 percent of CE 55 maximum density in accordance with ASTM D 698.
3. Wearing Course: The approved inorganic clay-silt mixture of approximately 50 percent each of clay and silt shall be screened through a **1/4-in. (6 mm)** mesh screen. The wearing course shall be mixed in proportions of 1 part sand to 2 parts clay-silt by volume. The wearing course shall be compacted to at least 95 percent maximum density in accordance with ASTM D 698 and shall range from **1 to 1-1/2 in. (25 to 38 mm)** in thickness.
4. Drainage Filter Course: The drainage filter course shall consist of a well-graded aggregate course encased in a geotextile material and laid in such a manner to allow water to freely drain from the playing surfaces. The geotextile material shall be a woven or non-woven filter material with a minimum permeability of **0.008 in./sec (0.02 cm/sec)**. The material shall be resistant to mildew, ratting, insects, rodents, and chemicals normally encountered in a subsurface drainage system.

- C. Bituminous Concrete Playing Surfaces shall consist of a base course, prime coat, bituminous leveling course, tack coat, surface course, color coating and, where required, a drainage filter course, all constructed on a prepared subgrade. The stabilized-aggregate base course shall be compacted at optimum moisture to at least 95 percent maximum density in accordance with ASTM D 698. Marshall stability shall not be less than **500 pounds (190 kg)** and the flow shall not be greater than **20/100 in. (12.7 mm)**. The bituminous mixture shall be compacted until the voids in the total mix are reduced to less than 4.0 percent by volume.

1. Thickness of Courses: Base course shall be 4 in. (400 mm) thick after compaction. Leveling course shall be 1-1/2 in. (38 mm) thick after compaction unless directed otherwise. Surface course shall be 1 in. (100 mm) thick after Compaction.
 2. Color Coating and Marking Paint: After curing of the bituminous surface course, the entire playing surface shall be covered with a color coat as required.
- D. Portland Cement Concrete Playing Surfaces:
1. Aggregate: The nominal aggregate size shall be 1-1/2 in. (38 mm) to No. 4 sieve size and shall conform to ASTM C 33.
 2. Portland Cement: The cement shall conform to ASTM C 150, Type IA or IIA; or ASTM C 595, Type IP-A.
 3. Thickness: Horizontal Portland cement concrete playing surfaces shall consist of concrete slabs 4 inches thick.
- E. Maintenance of Sand-Clay Surfaces: Prior to final acceptance, the Contractor shall make one application of 3/4 lb/sq yd (0.4 kg/sq m) of calcium chloride to the sand-clay surface of the entire playing area.
- F. Portable Outdoor Bleachers:
1. Bleachers shall be designed to support a uniformly distributed live load of 100 lb/sq ft (490 kg/sq m) of gross horizontal projection and a horizontal wind load of 30 lbs/sq ft (150 kg/sq ft) of gross vertical projection. All seat and foot plank members shall be designed to support not less than 120 lb/lin ft (150 kg/m).
 2. Wood Seating and Walk Boards shall be preservative-treated and painted.
- G. Steel Basketball Poles: Minimum diameter 3-1/2 in. (88 mm); galvanized pipe.
- H. Running Track: Gravel and cinders over stone base; compaction to 95 percent of maximum density in accordance with ASTM D 698. One hundred percent by weight of the gravel and cinders shall pass the 3/4-in. (19 mm) screen, and 90 percent of the gravel and cinders shall be retained on the No. 4 screen.
- 1.3 EXECUTION (Not Used)

END OF SECTION 11 68 23 13

SECTION 11 82 19 00 - PACKAGED INCINERATORS

1.1 GENERAL

A. Description Of Work

1. This specification covers the furnishing and installation of packaged incinerators. Products shall match existing materials and/or shall be as follows or as directed by the Owner. Installation procedures shall be in accordance with the product manufacturer's recommendations. Demolition and removal of materials shall be as required to support the work.

B. Definitions

1. Waste Type

- a. Type 0, Trash: A mixture of highly combustible waste such as paper, cardboard cartons, wood boxes, and floor sweepings from commercial and industrial activities. The mixture consists of up to 10 percent by weight plastic bags, coated paper, laminated paper, treated corrugated cardboard, oily rags, and plastic or rubber scraps. This type of waste contains up to 10 percent moisture and not more than 5 percent non-combustible solids, and has a heating value of **8,500 BTU per pound (19,805 kJ/kg)** as fired.
- b. Type 1, Rubbish: A mixture of combustible waste such as paper, cardboard cartons, wood scraps, foliage, and floor sweepings from domestic, commercial, and industrial activities. The mixture consists of up to 20 percent by weight restaurant waste, but contains little or no treated paper, plastic, or rubber wastes. This type of waste contains up to 25 percent moisture and not more than 10 percent incombustible solids, and has a heating value of **6,500 BTU per pound (15,145 kJ/kg)** as fired.
- c. Type 2, Refuse: An approximately even mixture of rubbish and garbage by weight. This type of waste, common to apartment and residential occupancy, consists of up to 50 percent moisture and not more than 7 percent incombustible solids, and has a heating value of **4,300 BTU per pound (10,019 kJ/kg)** as fired.
- d. Type 3, Garbage: Garbage such as animal and vegetable wastes from restaurants, hotels, hospitals, markets, and similar installations. This type of waste contains up to 70 percent moisture and up to not more than 5 percent incombustible solids, and has a heating value of **2,500 BTU per pound (5825 kJ/kg)** as fired.
- e. Type 4, Pathological: Human and animal remains, such as organs, animal carcasses, and solid organic wastes from hospitals, laboratories, slaughterhouses, animal pounds, and similar sources. This type of waste contains up to 85 percent moisture and not more than 5 percent incombustible solids, and has a heating value as low as **1,000 BTU per pound (2330 kJ/kg)** as fired.
- f. Type 5, Classified: A mixture of highly combustible waste such as paper, plastics, or other items that have been used for intelligence purposes, or deemed sensitive to completing a sensitive mission on behalf of our National security. This mixture consists of up to 10 percent by weight plastic bags, coated paper, laminated paper, and plastic products. This type waste has approximately zero percent moisture content and non-combustible solids, and has a heating value of **7,000 to 10,000 BTU per pound (16,310 to 23,300 kJ/kg)** as fired.

C. Submittals:

1. Shop Drawings: Equipment installation.
2. Product Data:
 - a. Incinerator
 - b. Controls and instruments
3. Test Reports:
 - a. Instrument readings
 - b. Computations
 - c. Methods

- d. Performance
- 4. Certificates: Incinerator
- 5. Operation and Maintenance Data: Incinerator

D. Special Tools

- 1. Equipment specified under this section requiring special tools for assembly, adjustment, setting, or maintenance thereof shall be furnished as standard accessories.

1.2 PRODUCTS

- A. Incinerator (Manufactured Units): Provide packaged type controlled-air incinerator capable of burning Type as required to meet project requirements waste suitable for indoor installation. As required to meet project requirements, outdoor installation including totally enclosed electric motors, and corrosion and moisture protection, and equipped for manual **OR** mechanical, **as directed**, loading and operation.
- B. Capacity: Burn rate shall be as required to meet project requirements. Ash removal shall be an entire clean-out. Incinerator shall require no more than three ash clean-outs per week. Burnout and cool-down for ash removal shall be accomplished in not more than 72 hours after first ignition and in not more than 20 hours after final load addition during the weekly time period specified herein.
- C. Incineration of Classified Material: Incinerator shall reduce paper content to ash. Oxidize or melt other materials containing classified information, to prevent recovery of information for intelligence purposes. Screening ash, manual stoking, manual agitation, or opening of incinerator doors will not be allowed.
- D. Stack Emissions: The incinerator shall conform to all Federal, State and local Environmental Protection Agency (EPA) requirements and regulations.
- E. Noise Level: Noise level at one foot from each incinerator component shall not exceed 84 decibels, A scale.
- F. Electromagnetic Interference Control: Equipment shall conform to Class IIIC electromagnetic interference control and test limit requirements specified in MIL-STD-461.
- G. Primary and Secondary Chambers: Incinerator shall consist of a primary combustion chamber for partial burning and conversion of combustible material to gas and a secondary combustion chamber that shall consume combustible gases and entrained combustible particles. Preassemble and mount incinerator in accordance with the manufacturer's instructions. Packaged unit shall include a combustion air fan, primary and secondary burners, air distribution controls, and burner controls. Unit shall be ready for immediate mounting and ready for attachment of fuel, electrical, and vent and water supply connections. Provide lifting eyes.
 - 1. Primary Chamber: Construct primary chamber casing of steel supported by a steel frame and provided with insulation and refractory. Casing shall be not less than **3/16 inch (4.76 mm)** sheet steel conforming to ASTM A 569/A 569M and reinforced to withstand internal pressures without deflection or damage to refractory or other components. Construct frame and reinforcing members of steel conforming to ASTM A 36/A 36M. Frame shall be free standing and support the weight of incinerator components, including doors, burners, breeching, stack connections, and appurtenant assemblies without binding or warping. Provide access doors and ports with seals to prevent emission of smoke or admission of significant amounts of air during incinerator operation. Primary chamber shall have no grates, ash clean-out doors, or other openings which would permit leakage of waste fluids.
 - a. Insulation:
 - 1) The values for minimum thickness of insulation are in the following table:

INSULATION THICKNESS VS. CAPACITY

Capacity (pounds/hour)	(grams/second)	Min. Insulation Thickness (inches)	(mm)
For Walls	For Walls		
Up to 500	Up to 63	2	50.80
500 to 2,000	63 to 252	2 1/2	63.50
For Hearths			
Indoors			
Up to 500	Up to 63	2 1/2	63.50
500 to 2,000	63 to 252	4	101.60
Outdoors		1 1/2	38.10

- 2) Class 5 block conforming to ASTM C 612, containing no asbestos material, and of such thickness to prevent damage to the foundation due to excessive heat. Insulating cement shall conform to ASTM C 195 or ASTM C 196.

b. Refractory:

- 1) Values for minimum thickness of refractory:

REFRACTORY THICKNESS VS. CAPACITY

<u>Capacity</u> <u>(pounds/hour)</u>	<u>(grams/second)</u>	<u>Min. Insulation Thickness</u>	
		<u>(inches)</u>	<u>(mm)</u>
For Walls	For Walls		
Up to 500	Up to 63	4 1/4	108
500 to 2,000	63 to 252	4 1/4	108
For Hearths			
Indoors			
Up to 500	Up to 63	4 1/2	114
500 to 2,000	63 to 252	4 1/2	114
Outdoors		2 1/2	63.50

- 2) Heat-resistant non-asbestos containing clay, plastic or castable type. Attach refractory walls to casing with alloy steel or refractory anchors to form a monolithic structure which will resist heat and support walls with a safety factor of 4.
- c. Doors: Provide doors for stoking, clean-out, and charging areas of the incinerator. Construct doors and door frames of cast iron conforming to ASTM A 319 or steel conforming to ASTM A 569/A 569M or ASTM A 36/A 36M. Line doors exposed to flame or direct heat of combustion gases with the same type and thickness of refractory and insulation used in the combustion chamber. Attach refractory to doors to prevent sagging. Refractory shall have tapered edges to clear door frames during movement of swinging doors. Weld alloy steel hooked bars to the door cover to anchor the refractory. Doors shall be safely operable by one person. Temperature of door handles shall permit operation of door without gloves or other protective devices. Interlock charging doors with burners and air supply so that burners and blowers disconnect when door opens. Door closure gasket shall be non-asbestos high-temperature resistant material capable of withstanding expected temperatures. Vertically operated doors shall be counterweighted to require a manual operating force of **30 pounds (134 N)** maximum. Guillotine type doors shall lift completely off the seals prior to movement. Provide full swing type doors with an integral smaller feed door having a minimum rectangular clear opening of **24 by 24 inches (610 by 610 mm)** or a minimum circular clear opening of **30 inches (762 mm)** diameter. Provide doors with hasps or brackets to permit locking. Furnish a lock and two keys for each door on classified waste incinerators.
- 1) Manual Charging Doors: Provide full swing type doors for batch feeding; guillotine type doors for continuous feeding. Minimum door size of **24 by 24 inches (610 by 610 mm)**.
 - 2) Mechanical Charging Doors: Guillotine type or sweep type. Provide an inner and outer door. The inner or charging door shall open with operation of the charger. Interlock the inner and outer doors to prevent simultaneous opening during operation of incinerator. Insulate door to combustion chamber of incinerator. Line door with refractory material and anchor as specified herein for refractory. Construct outer door of same materials as exterior casing of incinerator. Provide doors with means for manual operation.
 - 3) Clean-out Doors: Clean-out doors shall provide access for total clean-out and visual inspection of the entire interior of the incinerator and shall not permit leakage of waste fluids.
- d. Observation Ports: Provide two observation ports in the primary combustion chamber. Furnish ports with a heat-resistant glass cover or angular steel frame and closure plate with handle for operation without gloves or other protective devices. Ports shall extend from casing exterior to not less than one-half the thickness of the refractory lining. Observation ports shall be gas tight.

- e. Test Holes: Fit test holes with standard weight, **2 inch (50 mm) OR 4 inch (100 mm)**, as **directed**, diameter, black steel pipe sleeve welded to casing. Extend sleeve from casing exterior to not less than one-half the thickness of the refractory lining. Form refractory opening from the pipe sleeve end to the interior wall surface to shield the sleeve end from reflected heat. Fit sleeve with a brass screw cap.
 - f. Solid Hearth: Construct of non-asbestos heat-resistant clay, plastic or castable type. Provide solid hearth for incinerators burning pathological wastes. Provide refractory of sufficient thickness and strength to prevent heat transfer to casing or foundation, not less than **4 1/2 inches (114 mm)** in thickness and able to withstand temperatures of **3000 degrees F (1649 degrees C)**. Hearth shall support not less than twice the hourly burn rate load and shall not permit leakage of waste fluids.
 - g. Draft Equipment: Capability of providing the correct amount of air to permit controlled combustion through operating range. Equipment shall include forced draft fans, draft gages, dampers, damper actuators, and linkage.
 - 1) Air Ducts: Introduce air for combustion to the primary chamber below the waste material through perforated under-fire air pipes or ducts. Over-fire air shall be controlled with automatic modulating air intake ports for completing combustion of combustible materials in gases, or for reducing operating temperatures. Ducts shall be constructed of sheet steel conforming to ASTM A 569/A 569M. Seams shall be air tight.
 - 2) Fan: Forced draft, multi-blade, forward curved, centrifugal type conforming to CID A-A-59222. Fan shall comply with standards of AMCA 99, applicable to centrifugal furnace fans, and rated for flow rate, pressure, power, speed of rotation, and efficiency in accordance with ANSI/AMCA 210.
 - 3) Damper: Controller-actuated to regulate air to the fan. Construct of wrought sheet steel conforming to ASTM A 569/A 569M, and no less than **1/16 inch (1.59 mm)** thick. Damper shall operate without noise or flutter. Actuators shall be electric motor operated, 115 volts ac.
 2. Secondary Chamber: Provide with an exterior casing not less than **3/16 inch (4.76 mm steel)** conforming to ASTM A 569/A 569M. Refractory lining shall be same type and thickness required for primary chamber walls. Insulation shall be of the same class and thickness used in the primary chamber. Minimum retention time of one second shall be allowed for conditions within normal operating limits.
- H. Burners
1. Insert appropriate fuel oil or gas specification section(s) associated with this project. Only allow direct electric spark ignition for burners up to **2,500,000 BTU/hour (732,500 watt)**. Values of minimum burner input capacity:

**SIZE OF BURNERS, (x1000) Watts
Primary Burners**

Capacity of Incinerator, (grams/sec)	2490 Min. kJ/kg Refuse	1905 Min. kJ/kg Refuse	1260 Min. kJ/kg Refuse	733 Min. kJ/kg Refuse	293 Min. kJ/kg Refuse	Secondary Burners All Refuse
6.30	350	350	582	815	990	466
12.60	466	466	1282	1631	1980	699
18.90	582	559	1514	2330	3262	932
31.50	699	699	1748	2680	3728	1514
63.00	1282	1282	2563	3845	5126	2330
94.50	1748	1748	3495	5242	6990	3029
126.00	2097	2047	3961	5592	7223	3961
189.00	2563	2563	5126	7689	10252	4893
252.00	3728	3728	7689	11650	15378	6291

**SIZE OF BURNERS, (x1000) BTU/Hr
Primary Burners**

Capacity of Incinerator, (lb/hr)	8500 Min. BTU/lb Refuse	6500 Min. BTU/lb Refuse	4300 Min. BTU/lb Refuse	2500 Min. BTU/lb Refuse	1000 Min. BTU/lb Refuse	Secondary Burners All Refuse
50	150	150	250	350	425	200
100	200	200	550	700	850	300
150	250	240	650	1,000	1,400	400
250	300	300	750	1,150	1,600	650
500	550	550	1,100	1,650	2,200	1,000
750	750	750	1,500	2,250	3,000	1,300
1,000	900	900	1,700	2,400	3,100	1,700
1,500	1,100	1,100	2,200	3,300	4,400	2,100
2,000	1,600	1,600	3,300	5,000	6,600	2,700

- Provide gas **OR** oil **OR** combination gas and oil, **as directed**, burners for the primary and secondary combustion chambers. Design burners for natural type gas or No. 2 fuel oil conforming to ASTM D 396. Fuel oil **OR** Gas, **as directed**, piping is covered in Division 23 Section(s) "Facility Fuel-oil Piping" OR "Facility Natural-gas Piping" OR "Facility Liquefied-petroleum Gas Piping", **as directed**. Each burner shall be a complete burner assembly including fuel, control systems, and accessories. Secondary burner shall be capable of maintaining a minimum continuous temperature in the secondary chamber of **1,600 degrees F (871 degrees C)**. Minimum continuous temperature of **1,400 degrees F (760 degrees C)** shall be maintained at the roof near the exit of the primary chamber. Burners shall be interrupted type with gas-electric or electrically spark-ignited and regulated by a variable set point indicator-controller adjustable from zero to **3000 degrees F (1649 degrees C)** to operate within temperature limits recommended by the manufacturer. Controllers shall be actuated by a thermocouple. Mounting, flame shape, and characteristics of each burner shall be suitable for the incinerator chamber in which the burner is installed. Flame impingement on the incinerator wall will not be permitted. Each burner shall be Factory Mutual listed in FM P7825 and furnished with flame failure protection. Flame safeguard sensor shall be sighted to detect only the burner flame for which it is designed. Furnish burners with manufacturer recommended appurtenances, for a complete installation. Burners shall be removable for inspection, cleaning, adjustment, and maintenance. Locate thermocouples in the

primary and secondary chambers capable of operating at a maximum temperature of **3000 degrees F (1649 degrees C)**.

- I. Controls And Instruments: Control equipment and instruments shall include burners and fan controls, time clocks, relays, operating switches, indicating lights, gages, motor starters, fuses, alarms, circuit elements of control system, and other instruments required for operation. Mount controls and instruments on a single control panel. Control system shall provide on-off control or proportioning control of the primary air supply and fuel supply to the secondary burner. Temperature indicator shall provide a visual indication for safe loading of the incinerator and excessive high temperature conditions which may require control by the operator. Interlock control circuit systems to prevent hazardous conditions, air pollution, and made fail safe.
 1. Control Panel: Sheet steel, weather tight, conforming to UL 50. Flush mount controls, instruments, and other equipment at the factory and test the assembly prior to shipment. Furnish a lock and two keys. Identify controls and instruments with nameplates conforming to MIL-DTL-15024. Provide a heater to prevent condensation.
 2. Draft Gages: ANSI/ASME B40.1, diaphragm or bellows actuating system and circular scale. The gages shall have a zero adjustment screw. Provide shut-off cocks.
 3. Pressure Gages: ANSI/ASME B40.1, single Bourdon tube style, suitable for measuring air pressure.
 4. Thermocouples: Provide to measure gas passage temperatures and control burner operation. Provide thermocouples which operation up to **3000 degrees F (1649 degrees C)**, and accurate within one-half percent of the operating and indicating temperature range.
 5. Emissions Monitoring Instrumentation: Provide incinerator and stack monitoring instrumentation for acceptance tests, emissions tests, and monitoring.
- J. Stack: Stack shall meet local building and fire protection codes, including local, state, and federal regulations conforming to NFPA 211. Attach a corrosion-resistant steel spark arrestor not less than No. 18 gage, and with **1/2 inch (15 mm)** mesh wire screen extending to top of stack and a corrosion-resistant steel weather cap. Provide tests ports for acceptance testing and/or emissions testing and monitoring.
- K. Connectors: Provide to connect the incinerator to the stack in accordance with NFPA 211. Locate the connector at a minimum clear vertical distance of **eight feet (2.45 mm)** above the floor **OR** ground, **as directed**.
- L. Charging Method:
 1. Manual: Incinerators having a capacity of less than **300 pounds per hour (38 grams per second)** should be manually charged. Manual charger shall include a front loading door with minimum dimensions of **24 by 24 inches (610 by 610 mm)**. Combustion chamber shall operate at negative air pressure when the loading door is open to prevent injury to the operator and the escape of smoke and gases. Provide an interlock to prevent operation of the charger when a predetermined safe operating temperature is exceeded. Locate the charger on the end **OR** side **OR** top, **as directed**, of the incinerator.
 2. Mechanical: Incinerators having a capacity of **300 pounds per hour (38 grams per second)** or more should be mechanically charged. Provide an automatic mechanical loading device compatible with the incinerator. Flange loader to incinerator. Construct loading device of plate steel conforming to ASTM A 36/A 36M. The loader shall include a single **OR** dual, **as directed**, hydraulic power pack driven by an electric motor conforming to NEMA MG 1. Loader shall include a guillotine type fire door lined with the same thickness refractory as the combustion chamber. The charging chamber shall have a capacity of not less than **one cubic yard (0.76 cubic meter)**. Locate charging chamber access door on top of the loader and hinged. Provide a temperature actuated automatic sprinkler device located inside the loader. Integrate operation of the automatic loader with the control system. An indicating light shall indicate when the incinerator can be charged. Mount light on control box, visible to the operator. When charging chamber door is closed and light on; indicating the incinerator can be charged, the following sequence shall take place when the loader is actuated in the charge mode: (1) fire door opens,

(2) ram pushes material into the incinerator, (3) ram retracts, (4) fire door closes, (5) indicator light signals the loader is ready to be charged. When loader is in the automatic mode of operation, fire door and charging chamber door shall not be allowed to open at the same time. Provide a manual override system so that ram, fire door, or charging chamber door can be operated independently.

3. Firing Tools: Provide firing tools, including shovel, hoe, rake, slice bar, used for firing the incinerator, and firing tool rack. Locate as indicated. Rack shall be steel and include hooks or other means for storing tools.

1.3 EXECUTION

- A. Equipment Installation: NFPA 82, as applicable. Combustion air supply and ventilation shall be in accordance with NFPA 54 **OR** NFPA 31, **as directed**.
- B. Utility Services Connections: Connect to utility services as directed.
- C. Foundation: Foundation shall be of size and strength to support incinerator and extend not less than **3 feet (one meter)** beyond incinerator sides, and not less than **8 feet (2.45 meters)** on front or side where ashes are removed.
- D. Fuel Supply: Install gas appliances and piping in accordance with NFPA 54, as applicable. Install oil burning equipment to conform to the applicable requirements of NFPA 31.
- E. Stack Support: Stack support shall be in accordance with paragraph entitled "Stack" of this section, NFPA 82 and NFPA 211, as applicable. Adequate vertical and lateral supports for exterior chimneys shall withstand wind forces of **106 miles per hour (171 km per hour)**, **unless directed otherwise**.
- F. Lubrication: Provide lubrication means for parts of equipment normally requiring lubrication. Where use of high pressure will damage grease seals or other parts, provide pressure release fittings.
- G. Treatment And Painting: Provide manufacturer's standard factory applied finish suitable for exterior service.
- H. Identification: Fasten an aluminum, brass, or corrosion-resistant steel nameplate to the equipment in a visible location by means of rivets or sheet metal screws. The nameplate shall contain data such as the manufacturer's name, model, or series number; electrical requirements; and serial number. The information shall be indented or embossed in the metal. The nameplate shall not be painted over.
- I. Field Quality Control
 1. General: Upon delivery to the job site, equipment and materials shall receive a preliminary inspection by the the Owner. Inspection will be continued during installation, after installation, and during tests. Inspections shall be made to assure equipment and installation comply with local, state, federal, and utility requirements for equipment, air pollution, and safety. Furnish labor, equipment, apparatus, and materials for testing, except waste materials used for testing. the Owner will supply waste material, fuel oil, gas, water, and electricity. Rectify defects disclosed by tests, and repeat tests. Two instruction manuals shall be available during tests. Perform tests under direct supervision of the start-up engineer employed by the Contractor. The the Owner shall be present for tests. Reports certifying instrument readings indicated are actual, computations required for testing are accurate, acceptable methods were used, and units satisfactory performed in accordance with requirements shall be furnished.
 2. Tests
 - a. Fuel Systems: Remove gages and apparatus that may be damaged by test pressure from the system prior to testing. Maintain required test pressure for not less than two hours to provide sufficient time for inspection of joints and connections. Correct defects which

develop during testing and retest piping system until system shows no defects or weakness.

- 1) Oil: Test oil piping systems with a hydrostatic pressure of one and one-half times the maximum working pressure.
 - 2) Gas: Pneumatically test gas piping systems tested at operating pressure. Use the soap bubble method to verify the tightness of the system.
- b. Performance: Preheat incinerator for four hours to reach the firing temperature of **1800 degrees F (982 degrees C)**. Weight the waste charges and provide a record of the total charge weight. Charge incinerator with the Owner provided waste at rated capacity in **lb/hr (kg/sec)** for a period of four hours. Operate incinerator in accordance with manufacturer's written instructions. Waste shall be reduced to a fine ash residual. Follow normal burnout procedure. Weigh residue after incinerator has cooled. Weight of residue shall not exceed 5.0 percent charge weight.
- 1) Clean-out: Residue from burning classified material shall be hand sorted or screened into three categories; totally oxidized white or off-white ash, unburned materials, and blackened or partially burned paper fragments. Clean-out and sorting shall be witnessed by the the Owner. Inspect materials to verify that the requirements in paragraph entitled "Incineration" of Classified Materials, are met. After clean-out, inspect incinerator for deterioration such as slagged or spalling refractory, warping of parts, and discolored exterior paint. Unit will be rejected until these conditions are repaired and do not recur in retesting. Such procedures that may create respirable dust shall require use of a OSHA certified dust respirator.
- c. Control: Test incinerator under actual firing conditions. Test shall verify controls function within maximum and minimum limits for temperature or timing. Simulate actual unsafe conditions such as high temperatures and flame failure by reducing settings for the activation of limit and safety controls.
- d. Shell Temperature: Operate incinerator under normal load conditions for not less than four hours. Record temperature readings of the outer shell at not less than five random locations of the secondary chamber. Shield incinerators installed outdoors from direct rays of the sun.

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SECTION 11 82 26 00 - WASTE COMPACTORS

1.1 GENERAL

A. Description Of Work

1. This specification covers the furnishing and installation of materials for waste compactors. Products shall be as follows or as directed by the Owner. Installation procedures shall be in accordance with the product manufacturer's recommendations. Demolition and removal of materials shall be as required to support the work.

B. Summary

1. This Section includes waste compactors and diverters.

C. Definitions

1. WASTEC Rating: The volume of waste material in the charging chamber moved by the ram within the compactor in a single stroke.

D. Submittals

1. Product Data: For each type of product indicated. Include rated capacities, operating characteristics, furnished specialties and accessories, and finishes.
2. Shop Drawings: For each installation and for special components not dimensioned or detailed in manufacturer's product data. Include plans, elevations, sections, details, and attachments to other work.
 - a. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
 - b. Dimensions locating chutes that interface with waste compactors.
 - c. Location and installation details of automatic sprinkler in hopper of each chute-fed compactor.
 - d. Equipment access points and required space for equipment service and operation.
 - e. Setting drawings, templates, and instructions for installing anchor bolts and other anchorages.
 - f. Wiring Diagrams: For power, signal, and control wiring.
3. Qualification Data: For qualified Installer.
4. Product Certificates: For each type of waste compactor, from manufacturer.
5. Field quality-control reports.
6. Operation and Maintenance Data: For waste compactors to include in operation and maintenance manuals.

E. Quality Assurance

1. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction.
2. Waste Compactor Standards: Comply with ANSI Z245.2 and with NFPA 82.
3. Waste Bin and Hopper Standard: Comply with ANSI Z245.30.

F. Maintenance Service

1. Initial Maintenance Service: Beginning at Final Completion, provide 12 months' full maintenance by skilled employees of waste compactor Installer. Include monthly preventive maintenance, repair, or replacement of worn or defective components, lubrication, cleaning, and adjusting as required for proper waste-compactor operation at rated speed and capacity. Provide parts and supplies the same as those used in the manufacture and installation of original equipment.
2. Continuing Maintenance Proposal: From Installer to the Owner, in the form of a standard yearly (or other period) maintenance agreement, starting on date initial maintenance service is concluded. State services, obligations, conditions, and terms for agreement period and for future renewal options.

1.2 PRODUCTS

A. Waste Compactors

1. Waste Compactors: Manufacturer's standard vertical **OR** stationary horizontal **OR** self-contained horizontal **OR** combination-container **OR** vertical **OR** pivoting-ram type, **as directed**, packaged units with components, options, and accessories needed to comply with requirements and provide complete functional systems.
 - a. WASTEC Rating Size (Volume): Minimum: 0.14 cu. yd. (0.11 cu. m) **OR** 1.00 cu. yd. (0.77 cu. m) **OR** 1.50 cu. yd. (1.15 cu. m) **OR** 2.00 cu. yd. (1.53 cu. m) **OR** 3.50 cu. yd. (2.68 cu. m) **OR** 5.00 cu. yd. (3.82 cu. m) **OR** 7.50 cu. yd. (5.73 cu. m) **OR** 10.00 cu. yd. (7.65 cu. m), **as directed**.
 - b. Clear Top Opening (Length by Width) Minimum: 20 by 28 inches (508 by 711 mm) **OR** 24 by 36 inches (610 by 914 mm) **OR** 30 by 48 inches (762 by 1219 mm) **OR** 60 by 48 inches (1524 by 1219 mm) **OR** 108 by 72 inches (2743 by 1829 mm), **as directed**.
 - c. Cycle Time: Maximum 30 **OR** 40 **OR** 50 **OR** 60 **OR** 70 seconds, **as directed**.
 - d. Discharge Opening (Width by Height): Maximum: **As directed**.
 - e. Minimum Discharge Opening: **As directed**.
 - f. Ground Height: Minimum **As directed**.
 - g. Ram Face: **As directed**.
 - h. Ram Penetration: 6 inches (152 mm) **OR** 14 inches (355 mm) **OR** 30 inches (762 mm), **as directed**.
 - i. Normal/Maximum Result Ram Forces: 20,000/22,000 lbf (89/98 kN) **OR** 36,000/40,000 lbf (160/178 kN) **OR** 70,000/80,000 lbf (311/356 kN) **OR** 125,000/150,000 lbf (556/667 kN), **as directed**.
 - j. Normal/Maximum System Pressures: 1600/1800 psi (11.0/12.4 MPa) **OR** 2000/2400 psi (13.8/16.5 MPa) **OR** 2500/2800 psi (17.2/19.3 MPa), **as directed**.
 - k. Scale Weight. Maximum: 2500 lb (1134 kg) **OR** 6000 lb (2722 kg) **OR** 12,000 lb (5443 kg) **OR** 20,000 lb (9072 kg), **as directed**.
 - l. Motor Size: 3 hp **OR** 10 hp **OR** 15 hp **OR** 20 hp **OR** 30 hp **OR** 50 hp, **as directed**.
 - m. Electrical Power Supply: 120 **OR** 208 **OR** 240 **OR** 480 V, 1 **OR** 3 phase, **as directed**, 60 Hz.
 - n. Controls: **As Directed**.
 - o. Finish: Manufacturer's standard **OR** as selected by the Owner.
 - p. Deodorizing Device: Manufacturer's standard **OR** as selected by the Owner.
2. Diverter: Compactor Manufacturer's standard **OR** as selected by the Owner coordinated with chute dimensions and designed to divert waste from one chute into two compactors, with chute-relay controls and finished to match compactor or as directed by the Owner.
3. Number of Extra Storage Containers: One **OR** Two, **as directed**.

B. Fabrication

1. Fabricate waste compactors with smooth, eased, exposed edges to prevent injury to persons in vicinity of the equipment.
2. Fabricate containers, hoppers, compaction chambers, unit bodies, and similar components of steel with welded joints. Reinforce with steel members sized and spaced to withstand impacts and pressures of normal operations and to prevent deformation.
3. Fabricate equipment with replaceable parts at points of normal wear.
4. Fabricate liquidtight compactor baffles to stop liquid from leaking out.
5. Fabricate diverter to fit chute and properly align with compactor hoppers.

1.3 EXECUTION

A. Examination

1. Examine areas and conditions, with Installer present, for compliance with requirements for installation tolerances, clearances, service rough-ins, and other conditions affecting performance of waste-compactor work.
 2. Examine walls, floors, and chutes for suitable conditions where each waste compactor will be installed.
 3. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.
 4. Proceed with installation only after unsatisfactory conditions have been corrected.
- B. Installation
1. Install each waste compactor according to manufacturer's written instructions, ANSI Z245.2, and ANSI Z245.21 including annexes.
 2. Install automatic sprinkler in hopper of each chute-fed compactor according to NFPA 82.
 3. Set waste compactors level, plumb, properly aligned, and securely in place. Anchor as required for secure operation.
 4. Install diverter to chute and properly align with compactor hoppers.
- C. Field Quality Control
1. Perform tests and inspections.
 - a. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.
 2. Tests and Inspections:
 - a. Perform installation and startup checks according to ANSI Z245.21, Annex D, "Tests for Evaluation of Equipment and Performance," and manufacturer's written instructions.
 - b. Test and adjust controls, alarms, and safeties. Replace damaged and malfunctioning controls and equipment.
 - c. Verify unrestricted access to each firefighting access door or fire port required by ANSI Z245.21 and NFPA 82 for compactor container(s).
 - d. Verify correct locations, color-coding, and legibility of caution, warning, and danger markings.
 - e. Certify compliance with test parameters.
 3. A waste compactor will be considered defective if it does not pass tests and inspections.
 4. Prepare test and inspection reports.

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Task	Specification	Specification Description
11 82 26 00	11 21 63 00	Food Service Equipment
11 97 26 00	10 86 00 00	Detention Furniture

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SECTION 11 98 12 00 - DETENTION ENCLOSURES

1.1 GENERAL

A. Description Of Work

1. This specification covers the furnishing and installation of materials for detention enclosures. Product shall be as follows or as directed by the Owner. Installation procedures shall be in accordance with the product manufacturer's recommendations. Demolition and removal of materials shall be as required to support the work.

B. Summary

1. Section Includes:
 - a. Bar-grille assemblies.
 - b. Woven-rod-mesh assemblies.
 - c. Security grilles and vents.

C. Submittals

1. Product Data: For each type of product indicated.
2. LEED Submittal:
 - a. Product Data for Credit MR 4.1 and Credit MR 4.2: Indicating percentages by weight of postconsumer and preconsumer recycled content for products having recycled content.
 - 1) Include statement indicating costs for each product having recycled content.
3. Shop Drawings: For detention enclosures. Include plans, elevations, sections, details, and attachments to other work.
 - a. Indicate requirements for cast-in anchors to be installed as work of other Sections.
4. Samples: For units with factory-applied color finishes.
5. Samples for Verification:
 - a. Include 12-by-12-inch (305-by-305-mm) cut-away corner section of bar-grille assembly, constructed of specified round and flat bars, showing fabrication techniques and workmanship.
 - b. Include 12-by-12-inch (305-by-305-mm) cut-away corner section of woven-rod-mesh assembly, constructed of specified framing and woven-rod panel, showing fabrication techniques and workmanship.
 - c. Include one full-size security grille and vent unit.
6. Welding certificates.
7. Material Certificates.
8. Material Test Reports: For tool-resisting steel.
9. Mill Certificates: For tool-resisting steel rods.
10. Maintenance Data.
11. Other Informational Submittals:
 - a. Examination reports documenting inspections of substrates, areas, and conditions.
 - b. Anchor inspection reports documenting inspections of built-in and cast-in anchors.
 - c. Field quality-control reports documenting inspections of installed products.
 - d. Field quality-control certification signed by Contractor and Detention Specialist.

D. Quality Assurance

1. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for installation and maintenance of units required for this Project.
2. Testing Agency Qualifications: Qualified according to ASTM E 329 for testing tool-resisting steel.
3. Welding Qualifications: Qualify procedures and personnel according to the following:
 - a. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
 - b. AWS D1.3, "Structural Welding Code - Sheet Steel."
 - c. AWS D1.6, "Structural Welding Code - Stainless Steel."
4. Preinstallation Conference: Conduct conference at Project site.

1.2 PRODUCTS

A. Materials

1. Recycled Content of Steel Products: Provide products with average recycled content of steel products so postconsumer recycled content plus one-half of preconsumer recycled content is not less than 25 **OR** 60, **as directed**, percent.
2. Mild Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.
3. Cold-Rolled Steel Sheet: ASTM A 1008/A 1008M, CS (Commercial Steel), Type B, suitable for exposed applications.
4. Hot-Rolled Steel Sheet: ASTM A 1011/A 1011M, CS (Commercial Steel), Type B; free of scale, pitting, or surface defects; pickled and oiled.
5. Metallic-Coated Steel Sheet: ASTM A 653/A 653M, CS (Commercial Steel), Type B; with **G60 (Z180)** zinc (galvanized) or **A60 (ZF180)** zinc-iron-alloy (galvannealed) coating designation.
6. Steel Tubing: ASTM A 501 or ASTM A 513, Type B unless otherwise indicated.
7. Tool-Resisting Steel Round and Flat Bars: ASTM A 627.
8. Tool-Resisting Steel Round Rods: Fabricated from material with same chemical and physical properties as tool-resisting steel round bars.
9. Stainless-Steel Sheet, Strip, Plate, and Flat Bars: ASTM A 666 or ASTM A 240/A 240M, austenitic stainless steel, Type 304.
10. Security Fasteners: Operable only by tools produced by fastener manufacturer or other licensed fabricator for use on specific type of fastener. Drive-system type, head style, material, and protective coating as required for assembly, installation, and strength, and as follows:
 - a. Drive-System Type: Pinned Torx-Plus **OR** Pinned Torx, **as directed**.
 - b. Fastener Strength: **120,000 psi (827 MPa)**.
 - c. Socket Button Head Fasteners:
 - 1) Heat-treated alloy steel, **ASTM F 835 (ASTM F 835M)**.
 - 2) Stainless steel, **ASTM F 879 (ASTM F 879M)**, Group 1 CW.
 - d. Socket Flat Countersunk Head Fasteners:
 - 1) Heat-treated alloy steel, **ASTM F 835 (ASTM F 835M)**.
 - 2) Stainless steel, **ASTM F 879 (ASTM F 879M)**, Group 1 CW.
 - e. Socket Head Cap Fasteners:
 - 1) Heat-treated alloy steel, **ASTM A 574 (ASTM A 574M)**.
 - 2) Stainless steel, **ASTM F 837 (ASTM F 837M)**, Group 1 CW.
 - f. Protective Coatings for Heat-Treated Alloy Steel:
 - 1) Zinc and clear trivalent chromium where indicated.
 - 2) Zinc phosphate with oil, ASTM F 1137, Grade I, or black oxide unless otherwise indicated.
11. Concealed Bolts: ASTM A 307, Grade A unless otherwise indicated.
12. Cast-in-Place Anchors in Concrete: Fabricated from corrosion-resistant materials capable of sustaining, without failure, a load equal to four times the load imposed, as determined by testing per ASTM E 488, conducted by a qualified testing agency; of type indicated below.
 - a. Threaded or wedge type; galvanized ferrous castings, either ASTM A 47/A 47M malleable iron or ASTM A 27/A 27M cast steel. Provide bolts, washers, and shims as needed; hot-dip galvanized per ASTM A 153/A 153M or ASTM F 2329.
13. Embedded Plate Anchors: Fabricated from mild steel shapes and plates, minimum **3/16 inch (4.8 mm)** thick; with minimum **1/2-inch- (12.7-mm-)** diameter, headed studs welded to back of plate.
14. Welding Rods and Bare Electrodes: Select according to AWS specifications for metal alloy welded.

B. Bar-Grille Assemblies

1. Tool-Resisting Steel Bar Grilles: ASTM A 627, Grade 1 **OR** Grade 2, **as directed**.
 - a. Vertical Bars: **1-inch- (25.4-mm-)** diameter, double-ribbed, round **OR** hexagonal, **as directed**, composite tool-resisting steel bars at **4 inches (102 mm) OR 5 inches (127 mm) OR 6 inches (152 mm)**, **as directed**, o.c.

- b. Horizontal Flat Bars: **3/8-by-2-1/2-inch (9.6-by-63.5-mm)** composite tool-resisting steel flat bars at **12 inches (305 mm) OR 18 inches (457 mm)**, **as directed**, o.c.
 - c. Perimeter Framing: **3/8-by-2-1/2-inch (9.6-by-63.5-mm)** composite tool-resisting steel flat bars.
 2. Tool-Resisting Steel Bar Grilles: ASTM A 627, Grade 3.
 - a. Vertical Bars: **1-inch- (25.4-mm-)** diameter, double-ribbed, round **OR** hexagonal, **as directed**, homogeneous tool-resisting steel bars at **4 inches (102 mm) OR 5 inches (127 mm) OR 6 inches (152 mm)**, **as directed**, o.c.
 - b. Horizontal Flat Bars: **5/16-by-2-1/4-inch (7.9-by-57.2-mm)** homogeneous tool-resisting steel flat bars at **12 inches (305 mm) OR 18 inches (457 mm)**, **as directed**, o.c.
 - c. Perimeter Framing: **5/16-by-2-1/4-inch (7.9-by-57.2-mm)** homogeneous tool-resisting steel flat bars.
 3. Tool-Resisting Steel Bar Grilles: ASTM A 627, Grade 4.
 - a. Vertical Bars: **7/8-inch- (22.2-mm-)** diameter, double-ribbed, round **OR** hexagonal, **as directed**, homogeneous tool-resisting steel bars at **4 inches (102 mm) OR 5 inches (127 mm) OR 6 inches (152 mm)**, **as directed**, o.c.
 - b. Horizontal Flat Bars: **1/4-by-2-inch (6.4-by-50.8-mm)** homogeneous tool-resisting steel flat bars at **12 inches (305 mm) OR 18 inches (457 mm)**, **as directed**, o.c.
 - c. Perimeter Framing: **1/4-by-2-inch (6.4-by-50.8-mm)** homogeneous tool-resisting steel flat bars.
 4. Mild Steel Bar Grilles:
 - a. Vertical Bars: **7/8-inch- (22.2-mm-)** diameter, double-ribbed, round **OR** hexagonal, **as directed**, mild steel bars at **4 inches (102 mm) OR 5 inches (127 mm) OR 6 inches (152 mm)**, **as directed**, o.c.
 - b. Horizontal Flat Bars: **3/8-by-2-1/4-inch (9.5-by-57-mm)** mild steel flat bars at **12 inches (305 mm) OR 18 inches (457 mm)**, **as directed**, o.c.
 - c. Perimeter Framing: **3/8-by-2-1/4-inch (9.5-by-57-mm)** mild steel flat bars.
 5. Finish: Factory primed for field painting.
- C. Woven-Rod-Mesh Assemblies
 1. Main Framing: Formed from **1-1/2-by-2-1/2-inch (38-by-63.5-mm)** built-up tubular steel consisting of an open channel with fixed concealment plates.
 - a. Open Channel: Formed from **0.134-inch (3.42-mm) OR 0.105-inch (2.66-mm)**, **as directed**, nominal-thickness steel sheet or channel with individual slots along inner edges to support woven-rod panels.
 - b. Concealment Plates: Steel sheet to match open channel.
 2. Supplementary Framing: Formed from **2-inch-square by 3/16-inch- (51-mm-square by 4.8-mm-)** thick steel tubing.
 3. Braces: Formed from same material as main framing.
 4. Woven-Rod Panels: Formed from double crimped, **1/4-inch- (6-mm-) OR 3/8-inch- (9.5-mm-)**, **as directed**, diameter steel rod, woven horizontally and vertically into a rigid grille with rods at **2 inches (51 mm)** o.c.
 - a. Steel Rod for Galvanized Assemblies: Mild **OR** Homogeneous tool-resisting, **as directed**, steel.
 - b. Steel Rod for Nongalvanized Assemblies: Mild **OR** Homogeneous tool-resisting, **as directed**, steel.
 5. Floor Anchor Clips: **2-by-2-by-3/16-inch (51-by-51-by-4.8-mm)** mild steel angles for straight framing; **1-1/2-by-1-1/2-by-3/16-inch (38-by-38-by-4.8-mm)** mild steel angles for corners.
 6. Floor Anchors: **2-inch-square by 3/16-inch- (51-mm-square by 4.8-mm-)** thick, mild steel tubing sleeve welded to **6-inch-square by 3/16-inch- (152-mm-square by 4.8-mm-)** thick, mild steel plate.
 7. Wall and Ceiling Anchorage and Trim: Continuous **2-by-2-by-3/16-inch (51-by-51-by-4.8-mm)** mild steel angle with **2-by-3/16-inch (51-by-4.8-mm)** mild steel flat bar.
 8. Finishes:
 - a. Exterior Locations: Hot-dip galvanized after fabrication. Factory primed for field painting.
 - b. Interior Locations: Factory primed for field painting. Hot-dip galvanized after fabrication where indicated.

D. Security Grilles And Vents

1. Security Grilles:

- a. Face Frame: **3/16-inch- (4.8-mm-)** thick, mild **OR** homogeneous tool-resisting, **as directed**, steel flat bar.
- b. Wire Mesh: **0.135-inch- (3.5-mm-)** diameter steel wire woven into a **3/8-inch (9.5-mm)** mesh, attached to perimeter frame by bolts or studs **OR** welding, **as directed**.
- c. Perimeter Frame: **3/16-inch- (4.8-mm-)** thick, mild steel flat bar with anchor studs **OR** masonry anchors, **as directed**, welded to back.
- d. Vertical Bars: **7/8-inch- (22-mm-)** **OR** **1-inch- (25-mm-)**, **as directed**, diameter, double-ribbed, round **OR** hexagonal, **as directed**, homogeneous tool-resisting steel bars at **4 inches (102 mm)** o.c., welded to vertical bar supports.
- e. Vertical Bar Supports: **2-1/2-by-3/8-inch- (63.5-by-9.5-mm-)** thick, mild steel bars welded to perimeter frame.
- f. Finish: Factory primed for field painting.

2. Perforated-Plate Security Vents:

- a. Faceplate: **3/16-inch- (4.8-mm-)** thick, mild steel **OR** stainless-steel, **as directed**, plate; with **5/16-inch (7.9-mm)** round holes staggered **7/16 inch (11 mm)** o.c. in each direction.
- b. Opening Sleeve: **3/16-inch- (4.8-mm-)** thick steel plate welded to faceplate.
- c. Perimeter Frame: **1-by-1-by-3/16-inch- (25-by-25-by-4.8-mm-)** thick, mild steel angles.
- d. Provide anchor studs welded to back of faceplate for installation into concrete.
- e. Finish: Factory primed for field painting **OR** No. 4 **OR** No. 2B, **as directed**.
- f. Damper: Front-operated **OR** Rear-operated, **as directed**, opposed-blade type.

3. Perforated-Plate Security Vents with Wire Mesh:

- a. Faceplate: **0.075-inch (1.90-mm)** nominal-thickness, mild steel **OR** **0.078-inch- (1.98-mm-)** thick, stainless-steel, **as directed**, sheet; with **3/4-inch- (19-mm-)** square perforations **1/4 inch (6 mm)** apart in each direction.
- b. Wire Mesh: **0.062-inch- (1.6-mm-)** diameter steel wire woven into a **1/4-inch (6-mm)** mesh, welded to opening sleeve behind faceplate.
- c. Opening Sleeve: **0.075-inch (1.90-mm)** nominal thickness, formed from steel sheet and welded to faceplate.
- d. Finish: Factory primed for field painting **OR** No. 4 **OR** No. 2B, **as directed**.
- e. Damper: Front-operated **OR** Rear-operated, **as directed**, opposed-blade type.

4. Perforated-Plate Security Vents with Backup Plate:

- a. Faceplate: **3/16-inch- (4.8-mm-)** thick, mild steel **OR** stainless-steel, **as directed**, plate; with **2-inch- (51-mm-)** square perforations **1 inch (25 mm)** apart in each direction.
- b. Wire Mesh: **0.135-inch- (3.5-mm-)** diameter steel wire woven into a **3/8-inch (9.5-mm)** mesh, secured between faceplate and backup plate.
- c. Backup Plate: **1/4-inch- (6-mm-)** thick, mild steel plate with perforations matching faceplate.
- d. Perimeter Frame: **1-by-1-by-3/16-inch- (25-by-25-by-4.8-mm-)** thick, mild steel angles.
- e. Opening Sleeve: **0.134-inch (3.42-mm)** nominal thickness, formed from steel sheet and welded to faceplate.
- f. Finish: Factory primed for field painting **OR** No. 4 **OR** No. 2B, **as directed**.
- g. Damper: Front-operated **OR** Rear-operated, **as directed**, opposed-blade type.

5. Tool-Resisting Steel, Perforated-Plate Security Vents:

- a. Faceplate: **1/4-inch- (6-mm-)** thick, homogeneous tool-resisting steel plate; with **2-inch- (51-mm-)** square perforations **1 inch (25 mm)** apart in each direction.
- b. Wire Mesh: **0.135-inch- (3.5-mm-)** diameter steel wire woven into a **3/8-inch (9.5-mm)** mesh, attached to faceplate by bolts or studs.
- c. Backup Plate: **1/4-inch- (6-mm-)** thick, homogeneous tool-resisting steel plate with perforations matching faceplate.
- d. Perimeter Frame: **3/16-inch- (4.8-mm-)** thick, mild steel flat bar with anchor studs **OR** masonry anchors, **as directed**, welded to back.
- e. Finish: Factory primed for field painting.

6. Anchors: Unless otherwise indicated, provide minimum **1/2-inch- (12.7-mm-)** diameter, headed stud anchors at **12 inches (305 mm)** o.c.

E. Fabrication, General

1. Shop Assembly: Preassemble items in shop to greatest extent possible to minimize field splicing and assembly. Disassemble units only as necessary for shipping and handling limitations. Use connections that maintain structural value of joined pieces. Clearly mark units for reassembly and coordinated installation.
2. Coordinate dimensions and attachment methods of detention enclosures with those of adjoining construction to produce integrated assemblies with closely fitting joints and with edges and surfaces aligned unless otherwise indicated.
3. Shear and punch metals cleanly and accurately. Remove burrs.
4. Form and grind edges and corners to be free of sharp edges or rough areas.
5. Form metal in maximum lengths to minimize joints. Form sheet-metal corners to smallest radius possible without causing grain separation or otherwise impairing the Work.
6. Weld corners and seams continuously to comply with referenced AWS standard and the following:
 - a. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
 - b. Obtain fusion without undercut or overlap.
 - c. Remove welding flux immediately.
 - d. Finish exposed welds and surfaces smooth and blended at exposed connections so that no roughness shows after finishing and contour of welded surface matches that of adjacent surface.
 - e. Weld before finishing components to greatest extent possible. Remove weld spatter and welding oxides from exposed surfaces by descaling or grinding.
7. Provide for anchorage of type indicated; coordinate with supporting structure. Fabricate and space anchoring devices to secure detention enclosures rigidly in place and to support indicated loads. Build in straps, plates, and brackets as needed to support and anchor fabricated items to adjoining construction. Reinforce formed-metal units as needed to attach and support other construction.
8. Cut, reinforce, drill, and tap detention enclosures as indicated to receive hardware, security fasteners, and similar items.
9. Form exposed work true to line and level with accurate angles, surfaces, and straight sharp edges.
10. Form exposed connections with hairline joints flush and smooth using concealed fasteners where possible. Use exposed security fasteners of type indicated or, if not indicated, flat-head (countersunk) security screws. Locate joints where least conspicuous.
11. Exterior Detention Enclosures: Allow for thermal movements from ambient and surface temperature changes. Base calculations on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.
 - a. Temperature Change (Range): **120 deg F (67 deg C)**, ambient; **180 deg F (100 deg C)**, material surfaces.

F. Fabrication Of Bar-Grille Assemblies

1. General: Fabricate bar-grille assemblies with materials and to sizes and configurations indicated, complete with mounting flanges and anchors.
 - a. Pass vertical round bars through, and positively interlock them with, horizontal flat bars at each intersection without reducing circumference of round bars at these intersections and without using pipe sleeves, swedging, calking, or interlocks that depend on friction. Weld vertical round bars at each intersection with flat bars.
 - b. Pass ends of round bars at least **1 inch (25 mm)** through framing, and weld bars to framing from back side of framing.
 - c. Fabricate cutouts and openings in bar-grille assemblies for penetrations of sizes and at locations indicated. Frame openings with flat bars of same material and size as horizontal flat bars.



- d. Frame connections with plates; use flat bars of same material and size as horizontal flat bars.
 2. Partitions: Connect top horizontal flat bar to vertical flat bar framing members with **2-by-2-by-1/4-inch- (51-by-51-by-6-mm-)** thick, steel plate angle knee welded into place. Connect intersections of horizontal flat bars with vertical flat bar framing members by **3/16-inch (4.8-mm)** fillet welds. Weld vertical bars securely to top and bottom flat bar framing members.
 3. Doors: Fabricate swinging **OR** sliding, **as directed**, doors of same type bar-grille assembly as bar-grille partition in which they are installed. Weld lockbox at lock jamb of door, fabricated of steel plate to match horizontal flat bars. Comply with requirements in Division 08 Section "Detention Door Hardware" for detention hinges and detention locks and latches.
 - a. Food-Pass Openings: Frame top and sides of opening with flat bar of same quality and size as horizontal flat bars. Weld **1/4-inch- (6-mm-)** thick steel plate shelf, of same quality as horizontal flat bars, at bottom of opening.
- G. Fabrication Of Woven-Rod-Mesh Assemblies
1. Main Framing: Before inserting woven-rod panels, weld and grind smooth corners of open channel elements. Fabricate partitions taller than **12 feet (3.6 m)** from multiple panels stacked on top of one another.
 2. Woven-Rod Panels: Insert panels symmetrically in main framing. Extend end of each rod at least **1 inch (25 mm)** into main framing and, from inside of channel, weld into each slot where it contacts main framing.
 3. Concealment Plates: Weld plates to main framing with minimum **1 inch (25 mm)** welds at minimum **10 inches (254 mm)** o.c., staggered side to side and ground smooth, to form a fully enclosed tubular steel frame.
 4. Anchor Clips: For each enclosure panel, weld one anchor clip to secure side of main framing in line with vertical framing.
 5. Swinging Doors: Fabricate doors with framing on four sides of door from same material as adjacent panels and with **2-by-1/4-inch (51-by-6-mm)** flat steel bar astragal continuous on lock jamb. Align bottom of door with bottom of adjacent panels. Comply with requirements in Division 08 Section "Detention Door Hardware" for detention hinges and detention locks and latches.
 6. Sliding Doors: Fabricate doors with framing on four sides of door from same material as adjacent panels. Align bottom of door with bottom of adjacent panels. Comply with requirements in Division 08 Section "Detention Door Hardware" for sliding detention door device assemblies and detention locks and latches.
 7. Hardware Preparation: Mortise, reinforce, drill, and tap doors and main framings for templated hardware to comply with approved Door Hardware Schedule. Frame openings to receive detention door locks.
 8. Fabricate joints that will be exposed to weather in a manner to exclude water, and provide weep holes where water may accumulate.
- H. Fabrication Of Security Grilles And Vents
1. General: Fabricate security grilles and vents with materials and to sizes and configurations indicated, complete with mounting flanges and anchors.
 2. Security Grilles:
 - a. Orient axis of ribs of each tool-resisting steel bar to run parallel to airflow.
 - b. Pass vertical round bars through, and positively interlock them with, vertical bar supports without reducing circumference of round bars at these intersections and without using pipe sleeves, swedging, calking, or interlocks that depend on friction.
 - c. Pass round bars at least **1 inch (25 mm)** through vertical bar supports, and weld bars to supports from back side of supports.
 3. Where bolts are used to secure wire mesh, batter threads to prevent nut removal.
- I. Steel Finishes
1. Steel and Galvanized-Steel Prime Finish: Apply manufacturer's standard primer immediately after cleaning and pretreating.

2. Steel and Galvanized-Steel Factory Finish: Immediately after cleaning and pretreating, apply manufacturer's standard two-coat, baked-on finish consisting of prime coat and thermosetting topcoat, with a minimum dry film thickness of **1 mil (0.025 mm)** for topcoat.
 - a. Color and Gloss: As indicated by manufacturer's designations **OR** Match sample **OR** As selected from manufacturer's full range, **as directed**.

J. Stainless-Steel Finishes

1. Surface Preparation: Remove tool and die marks and stretch lines or blend into finish.
2. Polished Finishes: Grind and polish surfaces to produce uniform finish, free of cross scratches.
 - a. Run grain of directional finishes with long dimension of each piece.
 - b. When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.
 - c. Directional Satin Finish: No. 4.
3. Bright, Cold-Rolled, Unpolished Finish: No. 2B.

1.3 EXECUTION

A. Installation, General

1. Install detention enclosures plumb, rigid, properly aligned, and securely fastened in place, complying with manufacturer's written recommendations.
2. Fastening to In-Place Construction: Provide anchorage devices and fasteners where necessary for securing detention enclosures to in-place construction. Include threaded fasteners for inserts, security fasteners, and other connectors.
 - a. Proprietary Built-in Masonry Anchors: Install integral with unit masonry. Comply with requirements in Division 04 Section "Unit Masonry".
3. Cutting, Fitting, and Placement: Obtain manufacturer's written approval for cutting, drilling, and fitting required for installing detention enclosures. Set detention enclosures accurately in location, alignment, and elevation; with edges and surfaces level, plumb, true, and free of rack; and measured from established lines and levels.
4. Provide temporary bracing or anchors in formwork for items that are to be built into adjacent construction.
5. Fit exposed connections accurately together to form hairline joints. Weld connections that are not to be left as exposed joints but cannot be shop welded because of shipping size limitations. Do not weld, cut, or abrade surfaces of exterior units that have been hot-dip galvanized after fabrication and are for bolted or screwed field connections.
6. Field Welding: Comply with the following requirements:
 - a. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
 - b. Obtain fusion without undercut or overlap.
 - c. Remove welding flux immediately.
 - d. Finish exposed welds and surfaces smooth and blended at exposed connections so that no roughness shows after finishing and contour of welded surface matches that of adjacent surface.

B. Installation Of Bar-Grille Assemblies

1. Wall and Ceiling Anchorage: Weld framing to continuous angles with continuous welds. Anchor angles to embedded anchors by bolting **OR** welding, **as directed**.
2. Partitions: Weld adjacent framing members to each other with continuous **1/4-inch- (6-mm-)** deep welds on both sides; grind smooth.
3. Doors: Install **2 inches (51 mm)** above finish floor. Adjust to operate easily without binding.

C. Installation Of Woven-Rod-Mesh Assemblies

1. Floor Anchorage: Fasten anchor clips to floor with **3/8-inch- (9.5-mm-)** diameter bolts with double-expansion shields.

2. Wall and Ceiling Anchorage: Anchor continuous angle to walls and ceilings with **3/8-inch- (9.5-mm-)** diameter, security-type, double-expansion anchor bolts with "break-off" heads **OR** toggle bolts; weld bolt heads to angle, **as directed**.
 - a. Weld main framing to wall and ceiling angles with **1-inch (25-mm)** welds at **12 inches (305 mm)** o.c.
3. Weld adjacent main framing members to each other with **1/4-inch-deep by 3/4-inch- (6-mm- by 19-mm-)** long welds at **12 inches (305 mm)** o.c. on both sides of framing.
4. Provide supplementary framing at three-way connections and multiple-panel-height partitions. Weld main framing to supplementary framing with **1/8-inch (3-mm)** fillet welds **1 inch (25 mm)** long at **12 inches (305 mm)** o.c. on both sides of framing.
5. Provide additional field bracing as shown or as necessary for rigid, secure installation.
6. Adjust doors to operate easily without binding.

D. Installation Of Security Grilles And Vents

1. Locations: Unless otherwise indicated, install security grilles and vents in penetrations and openings with dimensions exceeding **8 inches (203 mm)** in either direction **OR** diameter, **as directed**.
2. Support Frames: Set support frames in adjacent construction.
3. Grilles: Weld vertical bar supports to support frame.
4. Field weld perimeter frames to duct sleeves.

E. Field Quality Control

1. Detention Specialist shall inspect **OR** Inspect, **as directed**, installed products to verify compliance with requirements. Prepare inspection reports and indicate compliance with and deviations from the Contract Documents.
2. Remove and replace detention work if inspections indicate that work does not comply with specified requirements. Remove malfunctioning units; replace with new units.
3. Perform additional inspections to determine compliance of replaced or additional work. Prepare inspection reports.
4. Prepare field quality-control certification endorsed by Detention Specialist, **as directed**, that states installed products and their installation comply with requirements in the Contract Documents.

F. Cleaning And Protection

1. Touchup Painting: Immediately after erection, clean bolted connections and abraded areas of shop paint, and paint exposed areas with same material used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.
2. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas; repair galvanizing to comply with ASTM A 780.

END OF SECTION 11 98 12 00



Task	Specification	Specification Description
11 98 12 00	08 34 53 00	Detention Doors And Frames
11 98 12 00	08 71 11 00	Detention Door Hardware
11 98 12 00	10 86 00 00	Detention Furniture
11 98 14 00	08 71 11 00	Detention Door Hardware
11 98 21 00	11 98 12 00	Detention Enclosures
11 98 21 00	10 86 00 00	Detention Furniture

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SECTION 12 01 60 00 - FIXED AUDIENCE SEATING

1.1 GENERAL

A. Description Of Work

1. This specification covers the furnishing and installation of materials for fixed audience seating. Products shall be as follows or as directed by the Owner. Installation procedures shall be in accordance with the product manufacturer's recommendations. Demolition and removal of materials shall be as required to support the work.

B. Summary

1. Section includes fixed audience seating with the following:
 - a. Standard, Beam, and Pedestal mounting.
 - b. Upholstered chairs, Molded-plastic chairs and Molded-plastic chairs with upholstered inserts.
 - c. Self-rising seat mechanism.
 - d. Power and data service to individual seats.

C. Submittals

1. Product Data: For each type of product indicated.
2. LEED Submittals:
 - a. Certificates for Credit MR 7: Chain-of-custody certificates certifying that wood and wood-based materials comply with forest certification requirements. Include evidence that manufacturer is certified for chain of custody by an FSC-accredited certification body.
 - 1) Include statement indicating costs for each certified wood product.
 - b. Product Data for Credit EQ 4.4: For each composite wood product, documentation indicating that product contains no urea formaldehyde.
3. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
 - a. Seating Layout: Show seating layout, aisle widths, row-lettering and chair-numbering scheme, chair widths, and chair spacing in each row.
 - b. Accessories: Show accessories, including locations of left- and right-hand tablet arms, electrical devices, accessibility provisions, and attachments to other work.
 - c. Wiring Diagrams: For power, signal, and control wiring.
4. Samples: For each seating component and for each color and texture required.
5. Product Certificates: For each type of flame-retardant treatment of fabric, from manufacturer.
6. Maintenance Data.
7. Warranty: Sample of special warranty.

D. Quality Assurance

1. Source Limitations: Obtain fabric of a single dye lot for each color and pattern of fabric required.
2. Forest Certification: Fabricate products with wood components produced from wood obtained from forests certified by an FSC-accredited certification body to comply with FSC STD-01-001, "FSC Principles and Criteria for Forest Stewardship."
3. Fire-Test-Response Characteristics of Upholstered Chairs:
 - a. Fabric: Class 1 according to DOC CS 191 and 16 CFR 1610.61, tested according to California Technical Bulletin 117.
 - b. Padding: Comply with California Technical Bulletin 117.
 - c. Full-Scale Fire Test: Comply with California Technical Bulletin 133.
4. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
5. Preinstallation Conference: Conduct conference at Project site.

E. Warranty

1. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of fixed audience seating that fail in materials or workmanship within specified warranty period.
 - a. Failures include, but are not limited to, the following:
 - 1) Structural failures including standards, beams, and pedestals.
 - 2) Faulty operation of self-rising seat mechanism.
 - 3) Faulty operation of electrical components.
 - 4) Wear and deterioration of fabric and stitching beyond normal use.
 - 5) Deterioration of metals, metal finishes, and other materials beyond normal weathering and use.
 - b. Warranty Periods: As follows, from date of Final Completion.
 - 1) Structural: Five years **OR** 10 years **OR** Lifetime, **as directed**.
 - 2) Operating Mechanisms: Three years **OR** Five years **OR** Lifetime, **as directed**.
 - 3) Electrical Components: Three **OR** Five, **as directed**, years.
 - 4) Plastic, Wood, and Paint Components: Two **OR** Three **OR** Five, **as directed**, years.

1.2 PRODUCTS

A. Materials And Finishes

1. Steel: ASTM A 36/A 36M plates, shapes, and bars; ASTM A 513 mechanical tubing; ASTM A 1008/A 1008M cold-rolled sheet; and ASTM A 1011 hot-rolled sheet and strip.
2. Cast Iron: ASTM A 48/A 48M, **Class 25 (Class 175)**, gray iron castings free of blow holes and hot checks with parting lines ground smooth.
3. Cast Aluminum: ASTM B 85 aluminum-alloy die castings.
4. Metal Finish: Finish exposed metal parts with manufacturer's standard polyurethane **OR** baked-on **OR** minimum **1.5-mil- (0.04-mm-)** thick, polyester baked-on powder **OR** minimum **1.5-mil- (0.04-mm-)** thick, epoxy baked-on powder, **as directed**, coating.
 - a. Color: As selected from manufacturer's full range.
5. Medium-Density Fiberboard: ANSI A208.2, Grade MD, made with binder containing no urea formaldehyde.
6. Concealed Plywood: HPVA HP-1 hardwood plywood, made with adhesive containing no urea formaldehyde, or DOC PS 1 softwood plywood, as standard with manufacturer.
7. Exposed Plywood: HPVA HP-1, Face Grade A, hardwood veneer core with color-matched hardwood-veneer faces, made with adhesive containing no urea formaldehyde.
8. Hardwood Lumber and Veneer Faces: American black walnut **OR** Red oak **OR** Teak **OR** Birch **OR** Cherry **OR** Maple, **as directed**, selected to be free of visible defects.
 - a. Stain and Finish: As selected from manufacturer's full range.
9. Plastic Laminate: NEMA LD 3, Grade VGS for vertical surfaces and Grade HGS for horizontal surfaces.
 - a. Color and Pattern: As selected from manufacturer's full range.
10. Fabric: Manufacturer's standard 100 percent nylon **OR** 100 percent polyolefin, **as directed**, with flame-retardant treatment.
 - a. Weight: **12 oz./linear yd. (0.37 kg/linear m) OR 16 oz./linear yd. (0.50 kg/linear m) OR 18 oz./linear yd. (0.56 kg/linear m) OR 20 oz./linear yd. (0.62 kg/linear m)**, **as directed**.
 - b. Color and Pattern: As selected from manufacturer's full range.
11. Upholstery Padding: Flexible, cellular, molded or slab polyurethane foam.
12. Molded Plastic: High-density polyethylene or polypropylene, blow or injection molded, with smooth or textured surface that is mar and dent resistant.
 - a. Provide with UV inhibitors to retard fading where exposed to sunlight.
 - b. Color and Texture: As selected from manufacturer's full range.

B. Fixed Audience Seating

1. Chair Mounting Standards: Floor **OR** Riser, **as directed**, attached of the following material:

- a. Steel: One-piece heavy-tube or reinforced sheet with welded mounting plate and welded connections for seat pivots, backs, armrests, and end panels.
- b. Cast Iron **OR** Aluminum, **as directed**: One-piece castings with integral mounting points and attachment anchoring points for seat pivots, backs, and armrests.
- c. Molded Plastic: One-piece, solid injection-molded plastic with integral reinforcing ribs and attachment anchoring points for seat pivots, backs, and armrests.
2. Chair Mounting Beam: Steel horizontal beam mounted on floor-attached **OR** riser-attached, **as directed**, steel support pedestals spaced at intervals of 2 to 2-1/2 chair widths.
3. Chair Mounting Pedestal: Floor-attached pedestal, manufacturer's standard jury base with swivel **OR** diffuser pedestal, **as directed**.
4. End Panels:
 - a. Material: Steel **OR** Cast iron with design **OR** Cast aluminum with design **OR** Plastic laminate **OR** Hardwood-veneer plywood **OR** Solid hardwood **OR** Fabric upholstered **OR** Molded plastic, **as directed**.
 - 1) Cast-Metal Design: As selected from manufacturer's full range.
 - b. Decorative Insert: Plastic laminate **OR** Hardwood-veneer plywood **OR** Solid hardwood **OR** Fabric upholstered **OR** Molded plastic **OR** Customized medallion, **as directed**.
 - c. Style: Rectangular **OR** Oval **OR** Teardrop **OR** Tapered **OR** Panel to floor (pew), **as directed**, with square **OR** rounded, **as directed**, corners.
5. Fabric Upholstered Chairs:
 - a. Backs:
 - 1) Padding Thickness: 1-1/4 inches (32 mm) **OR** 2 inches (51 mm) **OR** 3 inches (76 mm), **as directed**.
 - 2) Rear Panel: Steel **OR** Molded plastic **OR** Fabric upholstered with 1/4-inch (6-mm) padding **OR** Plastic laminate **OR** Hardwood-veneer plywood, **as directed**.
 - 3) Top Corners: Square **OR** Rounded, **as directed**.
 - 4) Upholstery Options: Tufting **OR** Decorative stitching, **as directed**.
 - b. Seats: Two part **OR** One part with slip-on upholstered padding **OR** One part, fully upholstered, **as directed**, and as follows:
 - 1) Padding Thickness: Minimum 1-1/2 inches (38 mm) **OR** 3 inches (76 mm) **OR** 4 inches (102 mm), **as directed**, at front and rear edge.
 - 2) Seat Underside: Steel sheet seat pan **OR** Perforated steel sheet seat pan with acoustical insulation **OR** Hardwood-veneer-faced, formed plywood shell **OR** Molded-plastic shell **OR** Fabric upholstered with padding, **as directed**.
6. Plastic Chairs: One-piece **OR** Two-piece, **as directed**, molded plastic and as follows:
 - a. Back: Smooth surface **OR** Textured surface **OR** Formed slats **OR** Smooth surface with upholstered inserts, **as directed**, with square **OR** rounded, **as directed**, top corners.
 - b. Seat: Smooth surface **OR** Textured surface **OR** With simulated slats **OR** Smooth surface with upholstered inserts, **as directed**.
 - c. Upholstered Inserts: Padding and fabric covering over 1/8-inch (3-mm) plywood or fiberboard backing board, recessed 3/16 inch (5 mm) into seat and back, centered, and attached with hidden, vandal-resistant fasteners.
7. Chair Width: Vary chair widths to accommodate sightlines and row lengths **OR** Single width chair in each row, **as directed**, with minimum chair width of 18 inches (457 mm) **OR** 19 inches (483 mm) **OR** 20 inches (508 mm) **OR** 22 inches (559 mm) **OR** 23 inches (584 mm) **OR** 24 inches (610 mm), **as directed**, from center to center of armrests.
8. Back Height: Standard-style **OR** High-style **OR** Planetarium-style, **as directed**, backs, 31 inches (787 mm) **OR** 32-1/2 inches (826 mm) **OR** 35 inches (889 mm) **OR** 38 inches (965 mm) **OR** 40 inches (1016 mm) **OR** 44 inches (1117 mm), **as directed**, high.
9. Back Pitch: Fixed **OR** Variable, hinged (rocker), **as directed**.
10. Chair Seat Hinges: Self-lubricating, compensating type with noiseless self-rising seat mechanism passing ASTM F 851 and with positive internal stops cushioned with rubber or neoprene.
11. Chair Back Hinges: Self-lubricating type with noiseless mechanism that raises back to vertical position when chair is unoccupied.
12. Self-Rising Seat Mechanism: Spring-actuated, three-quarter fold **OR** Spring-actuated, full fold **OR** Gravity-actuated, full fold, **as directed**.

13. Armrests: Plastic **OR** Hardwood **OR** Upholstered **OR** Plastic laminate on medium-density fiberboard **OR** Integral scrolled cast iron, **as directed**, with rounded edges, concealed mounting, and integral cup holder, **as directed**.
14. Aisle Lighting Fixtures: Manufacturer's standard round **OR** rectangular louvered **OR** concealed in armrest, **as directed**, fixtures.
 - a. Bulb: LED **OR** Incandescent, **as directed**.
 - b. Power: 24 **OR** 120, **as directed**, V.
 - c. For low-voltage lighting, provide manufacturer's voltage-reduction device housed in safety enclosure equipped with fuses, terminal blocks, and safety disconnect.
15. Power and Data Service Package: Manufacturer's standard service **OR** Service, **as directed**, to individual seats including terminal devices and wiring with 18 inches (457 mm) of extra length and as follows.
 - a. Power Receptacles: 120 V with wiring and receptacle as specified in Division 22.
 - b. Data Ports: Data port terminal with wiring and receptacle jack as specified in Division 23.
 - c. Location: Manufacturer's standard location **OR** On raceway beneath the seating **OR** In the armrest **OR** Beneath the armrest on front or side of the standard **OR** In back panel of seat in front, **as directed**.
16. Row-Letter and Chair-Number and Donor Plates: Manufacturer's standard.
 - a. Material: Aluminum **OR** Bronze **OR** Stainless steel, **as directed**, with black embossed characters.
 - b. Attachment: Manufacturer's standard method **OR** Adhesive **OR** Minimum of two mechanical fasteners, **as directed**.
17. Tablet Arms: Manufacturer's standard-size **OR** Manufacturer's oversize, **as directed**, fixed **OR** foldaway, **as directed**, tablet arm with plastic-laminate writing surface over medium-density fiberboard or plywood core and with rounded, matching PVC edges.
 - a. Mounting: Right-hand mounted unless otherwise indicated.
 - b. Fold-Away Mechanism: Cast-iron or steel hinge and swivel mechanism that gives positive support in open position and semiautomatic return to stored position below arm block and parallel to chair.
18. Accessible Seating:
 - a. Provide removable **OR** rollaway **OR** swing-away, **as directed**, chairs where wheelchair spaces are indicated.
 - b. Provide chairs without **OR** with retractable **OR** with foldup, **as directed**, arm on aisle side in locations indicated, but not less than 5 percent of aisle seats. Identify these seats with a sign or marker.

C. Fabrication

1. Floor Attachments: Fabricate to conform to floor slope, if any, so that standards and pedestals are plumb and chairs are maintained at same angular relationship to vertical throughout Project.
 2. For beam-mounted chairs in curved patterns, curve the beam to the various radii required for the rows.
 3. Upholstery: Fabricate fabric-covered cushions with molded padding beneath fabric and with fabric covering free of welts, creases, stretch lines, and wrinkles. For each upholstered component, install pile and pattern run in a consistent direction.
 4. Upholstered Chairs: Fabricate as follows:
 - a. Two-Part Upholstered Back: In length required to protect seat in raised position, with padded cushion glued to a curved steel, plywood, or molded-plastic support panel covered with easily replaceable fabric, and with curved rear shell that fully encloses upholstery edges.
 - b. Two-Part Seats: Upper part, an upholstered cushion with molded padding over no fewer than five serpentine springs attached to reinforced steel frame, with weight-distributing and abrasion-resistant sheeting separating padding from springs, and removable for reupholstering without removing seat from chair. Lower part, steel pan reinforced at stress points and completely enclosing hinges and self-rising mechanism.
- OR**

Two-Part Seats: Upper part, an upholstered cushion with formed padding over a five-ply plywood panel with fabric cover conforming to shape of cushion to conceal inner seat structure and hinge mechanism. Lower part, molded-plastic shell.

- c. One-Part Seats: Double-wall plastic shells fitted with a padded upholstered cushion and covered with easily replaceable fabric **OR** padded and fully upholstered, **as directed**.
- 5. Two-Piece, Molded-Plastic Chairs: Fabricate contoured seat and back separately with double-wall, blow-molded plastic. Fabricate back in length required to protect seat in raised position. Reinforce plastic with steel plates at attachment points.
- 6. One-Piece, Molded-Plastic Chairs: Provide contoured plastic shell with smoothly rolled edges and reinforcing ribs on underside of shell. Fabricate for attachment of chair to support with self-threading, corrosion-resistant screws.

1.3 EXECUTION

A. Installation

- 1. Install seating in locations indicated and fastened securely to substrates according to manufacturer's written installation instructions.
 - a. Use installation methods and fasteners that produce fixed audience seating assemblies with individual chairs capable of supporting an evenly distributed **600-lb (272-kg)** static load without failure or other conditions that might impair the chair's usefulness.
 - b. Install standards and pedestals plumb.
- 2. Install seating with chair end standards aligned from first to last row and with backs and seats varied in width **OR** spacing **OR** width and spacing, **as directed**, to optimize sightlines.
- 3. Install riser-mounted attachments to maintain uniform chair heights above floor.
- 4. Install chairs in curved rows at a smooth radius.
- 5. Install seating so moving components operate smoothly and quietly.
- 6. Install wiring conductors and cables concealed in components of seating and accessible for servicing.

B. Field Quality Control

- 1. Perform tests and inspections.
 - a. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.
 - b. Tests for Power Receptacles: As specified in Division 22.
 - c. Tests for Data Ports: As specified in Division 23.
- 2. Prepare test and inspection reports.

C. Adjusting

- 1. Adjust chair backs so that they are aligned with each other in straight **OR** uniformly curved, **as directed**, rows.
- 2. Adjust self-rising seat mechanisms so seats in each row are aligned when in upright position.
- 3. Verify that all components and devices are operating properly.
- 4. Verify that seating returns to correct at-rest position.
- 5. Repair minor abrasions and imperfections in finishes with coating that matches factory-applied finish.
- 6. Replace upholstery fabric damaged during installation.

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SECTION 12 21 13 13 - HORIZONTAL LOUVER BLINDS

1.1 GENERAL

A. Description Of Work

1. This specification covers the furnishing and installation of materials for horizontal louver blinds. Products shall be as follows or as directed by the Owner. Installation procedures shall be in accordance with the product manufacturer's recommendations. Demolition and removal of materials shall be as required to support the work.

B. Summary

1. This Section includes the following:
 - a. Horizontal louver blinds with aluminum, wood and polymer slats.
 - b. Motorized blind operators.

C. Submittals

1. Product Data: For each type of product indicated.
2. Shop Drawings: Show fabrication and installation details for horizontal louver blinds and motorized blind operators.
 - a. Wiring Diagrams: Power, system, and control wiring.
3. Samples: For each exposed finish.
4. Product certificates **OR** test reports, **as directed**.
5. Maintenance data.

D. Quality Assurance

1. Fire-Test-Response Characteristics: Provide horizontal louver blinds with the fire-test-response characteristics indicated, as determined by testing identical products per test method indicated below by UL or another testing and inspecting agency acceptable to authorities having jurisdiction. Identify materials with appropriate markings of applicable testing and inspecting agency.
 - a. Flame-Resistance Ratings: Passes NFPA 701.
2. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
3. Product Standard: Provide horizontal louver blinds complying with WCSC A 100.1.

E. Delivery, Storage, And Handling

1. Deliver horizontal louver blinds in factory packages, marked with manufacturer and product name, fire-test-response characteristics, lead-free designation, and location of installation using same designations indicated on Drawings and in a window treatment schedule.

1.2 PRODUCTS

A. Horizontal Louver Blinds, Aluminum Slats

1. Slats: Aluminum; alloy and temper recommended by producer for type of use and finish indicated; with crowned profile and radiused corners.
 - a. Width: **2 inches (51 mm) OR 1 inch (25 mm) OR 1/2 to 5/8 inch (13 to 16 mm), as directed.**
 - b. Finish: One color **OR** One color each side **OR** As indicated, **as directed**.
 - 1) Ionized Coating: Antistatic, dust-repellent, baked polyester finish.
 - 2) Reflective Coating: Manufacturer's special coating enhancing the reflection of solar energy on the outside-facing slat surface.
 - c. Perforated Slats: Openness factor of 6 to 7 percent.

2. Headrail: Formed steel or extruded aluminum; long edges returned or rolled; fully enclosing operating mechanisms on three sides and end plugs.
3. Bottom Rail: Formed-steel or extruded-aluminum tube, with plastic or metal capped ends.
4. Maximum Light-Blocking Blinds: Designed for eliminating all visible light gaps if slats are tilted closed and with minimal-sized rout holes for ladders hidden and placed near back edge for maximum slat overlap; with headrail and bottom rail extended and formed for light-tight joints between rail and adjacent slats or construction.
 - a. Finish: Match color, texture, pattern, and gloss of slats **OR** Color, texture, pattern, and gloss differing from slats as indicated by manufacturer's designations **OR** Color, texture, pattern, and gloss differing from slats, matching samples **OR** Color texture, pattern, and gloss differing from slats as selected from manufacturer's full range, **as directed**.
5. Ladders: Evenly spaced to prevent long-term slat sag.
 - a. For Blinds with Nominal Slat Width **1 Inch (25 mm)** or Less: Braided string.
 - b. For Blinds with Nominal Slat Width **1 Inch (25 mm)** **OR 2 Inches (51 mm)**, **as directed**, or More: Braided string **OR** Manufacturer's standard-width reinforced vinyl tapes **OR** Manufacturer's standard-width cloth tapes, **as directed**.
 - 1) Tape Color, Texture, and Pattern: Color, texture, and pattern as indicated by manufacturer's designations **OR** Color, texture, and pattern matching samples **OR** Color, texture, and pattern as selected from manufacturer's full range, **as directed**.
6. Lift-and-Tilt Control: Motorized operator.
7. Lift Cords: Manufacturer's standard.
8. Tilt Control: Enclosed worm-gear mechanism, slip clutch or detachable wand preventing overrotation, and linkage rod.
9. Lift Operation: Manual.
10. Valance: Two slats **OR** PVC strip **OR** Manufacturer's standard, **as directed**.
11. Mounting: Wall mounting **OR** Ceiling mounting **OR** End mounting **OR** Wall extension brackets **OR** As indicated, **as directed**.
12. Hold-Down Brackets and Hooks or Pins: Manufacturer's standard.
13. Side Channels and Perimeter Light Gap Seals: Manufacturer's standard.
14. Colors, Textures, Patterns, and Gloss: As selected from manufacturer's full range.

B. Horizontal Louver Blinds, Wood Slats

1. Slats: Hardwood, North American **OR** basswood **OR** poplar **OR** ramin, **as directed**, species, flame-retardant treated; with flat profile and radiused corners and beaded edges **OR** and double beaded edges, **as directed**.
 - a. Width: **1 inch (25 mm)** **OR 1-3/8 inch (35 mm)** **OR 2 inches (51 mm)** **OR 2-3/8-inch (60-mm)**, **as directed**.
 - b. Finish: Manufacturer's standard colors as indicated, for striped blind with pattern as indicated on Drawings.
2. Headrail: Formed steel or extruded aluminum; long edges returned or rolled; fully enclosing operating mechanisms on three sides and ends.
3. Bottom Rail: Hardwood matching slats.
 - a. Finish Color Characteristics: Match color, texture, pattern, and gloss of slats **OR** Match color, texture, pattern, and gloss of valance **OR** Color, texture, pattern, and gloss differing from slats as indicated by manufacturer's designations **OR** Color, texture, pattern, and gloss differing from slats, matching samples **OR** Color texture, pattern, and gloss differing from slats as selected from manufacturer's full range, **as directed**.
4. Maximum Light-Blocking Blinds: Designed for eliminating all visible light gaps if slats are tilted closed and with minimal-sized rout holes for ladders hidden and placed near back edge for maximum slat overlap; with headrail and bottom rail extended and formed for light-tight joints between rail and adjacent slats or construction.
5. Ladders: Braided string **OR** Manufacturer's standard-width cloth tapes, **as directed**. Evenly spaced to prevent long-term louver sag.

- a. Tape Color, Texture, and Pattern: Color, texture, and pattern as indicated by manufacturer's designations **OR** Color, texture, and pattern matching samples **OR** Color, texture, and pattern as selected from manufacturer's full range, **as directed**.
 6. Tilt Control: Enclosed worm gear mechanism, slip clutch or detachable wand preventing overrotation, and linkage rod.
 7. Lift Operation: Manual.
 8. Lift Operation: Motorized operator.
 9. Valance: Manufacturer's standard.
 10. Cornice: as directed by the Owner.
 11. Mounting: Wall mounting **OR** Ceiling mounting **OR** End mounting **OR** Wall extension brackets **OR** As indicated, **as directed**.
 12. Hold-Down Brackets and Hooks or Pins: Manufacturer's standard, as indicated.
 13. Colors, Textures, Patterns, and Gloss: As selected from manufacturer's full range.
- C. Horizontal Louver Blinds, Polymer Slats
 1. Slats: Lead-free, UV-stabilized, integrally colored, opaque, permanently flexible, extruded PVC **OR** polymer/wood alloy, **as directed**, that will not crack or yellow; antistatic, dust-repellent treated; with crowned **OR** manufacturer's standard, **as directed**, profile.
 - a. Width: 2 inches (51 mm) **OR** 2-1/2 inches (64 mm), **as directed**.
 - 1) Spacing: Manufacturer's standard.
 - b. Finish: Wood-tone **OR** Painted, **as directed**, color as indicated.
 - c. Finish: Two colors **OR** textures **OR** patterns, **as directed**, as indicated, one per side of slat.
 2. Headrail: Formed steel or extruded aluminum; long edges returned or rolled; fully enclosing operating mechanisms on three sides and ends.
 3. Bottom Rail: Manufacturer's standard **OR** Formed-steel or extruded-aluminum tube, with plastic or metal capped ends **OR** Hardwood matching slats and trapezoid-shaped bottom angled for minimizing light gaps, **as directed**.
 4. Ladders: Braided string **OR** Manufacturer's standard-width cloth tapes, **as directed**. Evenly spaced to prevent long-term slat sag.
 - a. Tape Color, Texture, and Pattern: Color, texture, and pattern as selected from manufacturer's full range.
 5. Tilt Control: Enclosed worm-gear mechanism and linkage rod.
 6. Lift Operation: Manual.
 7. Lift Operation: Motorized operator.
 8. Valance: Manufacturer's standard.
 9. Mounting: Wall mounting **OR** Ceiling mounting **OR** End mounting **OR** Wall extension brackets **OR** As indicated, **as directed**.
 10. Hold-Down Brackets and Hooks or Pins: Manufacturer's standard, as indicated.
 11. Colors, Textures, Patterns, and Gloss: As selected from manufacturer's full range.
- D. Horizontal Louver Blind Fabrication
 1. Concealed Components: Noncorrodible or corrosion-resistant-coated materials.
 - a. Lift-and-Tilt Mechanisms: With permanently lubricated moving parts.
 2. Unit Sizes: Obtain units fabricated in sizes to fill window and other openings as follows:
 - a. Blind Units Installed between (inside) Jambs: Width equal to 1/4 inch (6 mm) per side or 1/2 inch (13 mm) total, plus or minus 1/8 inch (3.1 mm), less than jamb-to-jamb dimension of opening in which each blind is installed. Length equal to 1/4 inch (6 mm), plus or minus 1/8 inch (3.1 mm), less than head-to-sill dimension of opening in which each blind is installed.
 - b. Blind Units Installed outside Jambs: Width and length as indicated, with terminations between blinds of end-to-end installations at centerlines of mullion or other defined vertical separations between openings.
 3. Installation Brackets: Designed for easy removal and reinstallation of blind, for supporting headrail, valance, and operating hardware, and for hardware position and blind mounting method indicated.

4. Installation Fasteners: No fewer than two fasteners per bracket, fabricated from metal noncorrosive to blind hardware and adjoining construction; type designed for securing to supporting substrate; and supporting blinds and accessories under conditions of normal use.
5. Color-Coated Finish:
 - a. Metal: For components exposed to view, apply manufacturer's standard baked finish.
 - b. Wood: Apply manufacturer's standard opaque **OR** transparent, **as directed**, factory-applied finish.
6. Component Color: Provide rails, cords, ladders, and exposed-to-view metal, wood, and plastic matching or coordinating with slat color, unless otherwise indicated.

E. Motorized Horizontal Louver Blind Operators

1. General: Provide factory-assembled blind operation systems designed for blind type, size, weight, construction, use, and operation frequency indicated, with lift **OR** tilt **OR** lift-and-tilt, **as directed**, functions. Provide operation systems of size and capacity and with features, characteristics, and accessories suitable for Project conditions and recommended by blind manufacturer, complete with electric motors and factory-prewired motor controls, remote-control stations, remote-control devices, power disconnect switches, enclosures protecting controls and all operating parts, headrail, and accessories required for reliable operation without malfunction. Include wiring from motor controls to motors. Coordinate operator wiring requirements and electrical characteristics with building electrical system.
2. Comply with NFPA 70.
3. Control Equipment: Comply with NEMA ICS 1, NEMA ICS 2, and NEMA ICS 6 with NFPA 70, Class 2 control circuit, maximum 24-V ac or dc.
4. Electric Motors: UL-approved or -recognized, totally enclosed, insulated motor, complying with NEMA MG 1, with thermal-overload protection and internal limit switches; sized by blind manufacturer to start and operate size and weight of blind considering service factor or Project's service conditions without exceeding nameplate ratings.
 - a. Service Factor: According to NEMA MG 1, unless otherwise indicated.
 - b. Motor Characteristics: Single phase, 24 **OR** 110 **OR** 220, **as directed**, V, 60 Hz.
 - c. Motor Mounting: Within manufacturer's standard headrail enclosure.
5. Remote Controls: Electric controls with NEMA ICS 6, Type 1 enclosure for surface **OR** recessed or flush **OR** within headrail, **as directed**, mounting. Provide the following devices for remote-control activation of blinds:
 - a. Control Stations: Keyed, maintained **OR** momentary, **as directed**, -contact, three-position, switch-operated control station with open, close, and off functions. Provide two keys per station.
 - b. Control Stations: Maintained **OR** Momentary, **as directed**, -contact, three-position, toggle **OR** rocker, **as directed**, -style, wall-switch-operated control station with open, close, and center off functions.
 - 1) Color: Ivory **OR** White **OR** As indicated, **as directed**.
6. Limit Switches: Adjustable switches, interlocked with motor controls and set to automatically stop blind at fully raised and fully lowered positions.
7. Operating Features: as directed by the Owner.
8. Accessories:
 - a. Solar Power Unit: For use with control system indicated.

1.3 EXECUTION

A. Installation

1. Install horizontal louver blinds level and plumb and aligned with adjacent units according to manufacturer's written instructions, and located so exterior slat edges in any position are not closer than **1 inch (25 mm) OR 2 inches (51 mm)**, **as directed**, to interior face of glass. Install intermediate support as required to prevent deflection in headrail. Allow clearances between adjacent blinds and for operating glazed opening's operation hardware if any.

2. Flush Mounted: Install horizontal louver blinds with slat edges flush with finish face of opening if slats are tilted open.
3. Jamb Mounted: Install headrail flush with face of opening jamb and head.
4. Head Mounted: Install headrail on face of opening head.
5. Recessed: Install headrail concealed within blind pocket.
6. Connections: Connect motorized operators to building electrical system.
7. Adjust horizontal louver blinds to operate smoothly, easily, safely, and free of binding or malfunction throughout entire operational range.
8. Clean horizontal louver blind surfaces after installation, according to manufacturer's written instructions.

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SECTION 12 21 13 13a - VERTICAL LOUVER BLINDS

1.1 GENERAL

A. Description Of Work

1. This specification covers the furnishing and installation of materials for vertical louver blinds. Products shall be as follows or as directed by the Owner. Installation procedures shall be in accordance with the product manufacturer's recommendations. Demolition and removal of materials shall be as required to support the work.

B. Summary

1. This Section includes the following:
 - a. Vertical louver blinds, aluminum vanes, PVC vanes, PVC vanes with fabric vane insert and fabric vanes.
 - b. Motorized blind operators.

C. Submittals

1. Product Data: For each type of product indicated.
2. Shop Drawings: Show fabrication and installation details for vertical louver blinds and motorized operators.
 - a. Wiring Diagrams: Power, system, and control wiring.
3. Samples: For each exposed finish.
4. Product certificates **OR** test reports, **as directed**.
5. Maintenance data.

D. Quality Assurance

1. Fire-Test-Response Characteristics: Provide vertical louver blinds with the fire-test-response characteristics indicated, as determined by testing identical products per test method indicated below by UL or another testing and inspecting agency acceptable to authorities having jurisdiction. Identify materials with appropriate markings of applicable testing and inspecting agency.
 - a. Flame-Resistance Ratings: Passes NFPA 701.
2. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
3. Product Standard: Provide vertical louver blinds complying with WCSC A 100.1.

E. Delivery, Storage, And Handling

1. Deliver vertical louver blinds in factory packages, marked with manufacturer and product name, fire-test-response characteristics, lead-free designation, and location of installation using same designations indicated on Drawings and in a window treatment schedule.

1.2 PRODUCTS

A. Vertical Louver Blinds, Aluminum Vanes

1. Rail System: Headrail **OR** Dual system with headrail and bottom rail, **as directed**.
 - a. Rails: Extruded aluminum **OR** Formed steel **OR** Manufacturer's standard, **as directed**; long edges returned or rolled; channel-shaped, enclosing operating mechanisms.
 - 1) Color: Custom color **OR** As selected from manufacturer's standard color range, **as directed**.
 - 2) Anodized aluminum, clear **OR** color, **as directed**, anodized.



2. Vanes: Aluminum, alloy, and temper recommended by producer for type of use and finish indicated; with crowned profile and not less than **3/8-inch (9.5-mm)** overlap when vanes are rotated fully closed.
 - a. Nominal Vane Width: **3-1/2 inches (89 mm)** wide.
 - b. Vane Finish: One color as indicated, **OR** Two colors as indicated, one per side of slat, **as directed**.
 3. Vane Directional Control: Manual **OR** Motorized operator, **as directed**.
 4. Traversing Control: Manual **OR** Motorized operator, **as directed**.
 5. Draw and Stack Position: One way, controls and stack left **OR** One way, controls and stack right **OR** One way, controls left and stack opposite **OR** One way, controls right and stack opposite **OR** Center split, controls left **OR** Center split, controls right **OR** Center stack, controls left **OR** Center stack, controls right **OR** Off center, controls left **OR** Off center, controls right **OR** As indicated on Drawings **OR** As indicated in a window treatment schedule, **as directed**.
 6. Cord-Tensioner Mounting: Wall **OR** Floor **OR** Sill **OR** Baseboard **OR** As indicated, **as directed**.
 7. Valance: One **OR** Two-tiered, **as directed**, vane insert; with dust cover.
 - a. Finish Color Characteristics: Match color, texture, pattern, and gloss of vanes **OR** Color, texture, pattern, and gloss differing from vanes as indicated by manufacturer's designations **OR** Color, texture, pattern, and gloss differing from vanes matching samples **OR** Color texture, pattern, and gloss differing from vanes as selected from manufacturer's full range, **as directed**.
 8. Louver Bottom: Connecting or spacing chains.
 9. Mounting: Wall mounting **OR** Ceiling mounting **OR** End mounting **OR** Wall extension brackets **OR** As indicated, **as directed**.
 10. Stack Release: Permitting stacked vanes to be moved away from stacking position for total access to glazed opening.
 11. Colors, Textures, Patterns, and Gloss: As selected from manufacturer's full range.
- B. Vertical Louver Blinds, PVC Vanes
1. Rail System: Headrail **OR** Dual system with headrail and bottom rail, **as directed**.
 - a. Rails: Extruded aluminum **OR** Formed steel **OR** Manufacturer's standard, **as directed**; long edges returned or rolled; channel-shaped, enclosing operating mechanisms.
 - 1) Color: Custom color **OR** As selected from manufacturer's standard color range, **as directed**.
 - 2) Anodized aluminum, clear **OR** color, **as directed**, anodized.
 2. Vanes: Lead-free, UV-stabilized, integrally colored, opaque, permanently flexible, extruded PVC that will not crack or yellow; with flat **OR** crowned **OR** ribbed, **as directed**, profile and not less than **3/8-inch (9.5-mm)** overlap when vanes are rotated fully closed.
 - a. Nominal Vane Width: **2 inches (51 mm)** **OR** **3-1/2 inches (89 mm)** **OR** **4 inches (100 mm)** **OR** **5 inches (125 mm)**, **as directed**.
 - b. Perforated Vanes: Openness factor of 3 **OR** 6 **OR** 8 **OR** 10 **OR** 12, **as directed**, percent.
 3. Vane Directional Control: Manual, **OR** Motorized operator, **as directed**.
 4. Traversing Control: Manual **OR** Motorized operator, **as directed**.
 5. Draw and Stack Position: One way, controls and stack left **OR** One way, controls and stack right **OR** One way, controls left and stack opposite **OR** One way, controls right and stack opposite **OR** Center split, controls left **OR** Center split, controls right **OR** Center stack, controls left **OR** Center stack, controls right **OR** Off center, controls left **OR** Off center, controls right **OR** As indicated on Drawings **OR** As indicated, **as directed**.
 6. Cord-Tensioner Mounting: Wall **OR** Floor **OR** Sill **OR** Baseboard **OR** As indicated, **as directed**.
 7. Valance: One **OR** Two-tiered, **as directed**, vane insert; with dust cover.
 - a. Finish Color Characteristics: Match color, texture, pattern, and gloss of vanes **OR** Color, texture, pattern, and gloss differing from vanes as indicated by manufacturer's designations **OR** Color, texture, pattern, and gloss differing from vanes matching samples **OR** Color texture, pattern, and gloss differing from vanes as selected from manufacturer's full range, **as directed**.
 8. Louver Bottom: Connecting or spacing chains.

9. Mounting: Wall mounting **OR** Ceiling mounting **OR** End mounting **OR** Wall extension brackets **OR** As indicated, **as directed**.
 10. Stack Release: Permitting stacked vanes to be moved away from stacking position for total access to glazed opening.
 11. Colors, Textures, Patterns, and Gloss: As selected from manufacturer's full range.
- C. Vertical Louver Blinds, PVC Vanes With Fabric Vane Inserts
1. Rail System: Headrail **OR** Dual system with headrail and bottom rail, **as directed**.
 - a. Rails: Extruded aluminum **OR** Formed steel **OR** Manufacturer's standard, **as directed**; long edges returned or rolled; channel-shaped, enclosing operating mechanisms.
 - 1) Color: Custom color **OR** As selected from manufacturer's standard color range, **as directed**.
 - 2) Anodized aluminum, clear **OR** color, **as directed**, anodized.
 2. Vanes: Lead-free, UV-stabilized, permanently flexible, extruded PVC that will not crack or yellow; with not less than **3/8-inch (9.5-mm)** overlap when vanes are rotated fully closed. Provide integrally colored, opaque vane with clear grooves for holding fabric insert.
 - a. Nominal Vane Width: **3-1/2 inches (89 mm)**.
 - b. Fabric Insert: Manufacturer's standard; stain and fade resistant.
 3. Vane Directional Control: Manual **OR** Motorized operator, **as directed**.
 4. Traversing Control: Manual **OR** Motorized operator, **as directed**.
 5. Draw and Stack Position: One way, controls and stack left **OR** One way, controls and stack right **OR** One way, controls left and stack opposite **OR** One way, controls right and stack opposite **OR** Center split, controls left **OR** Center split, controls right **OR** Center stack, controls left **OR** Center stack, controls right **OR** Off center, controls left **OR** Off center, controls right **OR** As indicated, **as directed**.
 6. Cord-Tensioner Mounting: Wall **OR** Floor **OR** Sill **OR** Baseboard **OR** As indicated on Drawings, **as directed**.
 7. Valance: One **OR** Two-tiered, **as directed**, vane insert; with dust cover. Fabric vane insert matching vanes.
 8. Louver Bottom: Connecting or spacing chains.
 9. Mounting: Wall mounting **OR** Ceiling mounting **OR** End mounting **OR** Wall extension brackets **OR** As indicated, **as directed**.
 10. Stack Release: Permitting stacked vanes to be moved away from stacking position for total access to glazed opening.
 11. Fabric Colors, Textures, and Patterns: As selected from manufacturer's full range.
- D. Vertical Louver Blinds, Fabric Vanes
1. Rail System: Headrail **OR** Dual system with headrail and bottom rail, **as directed**.
 - a. Rails: Extruded aluminum **OR** Formed steel **OR** Manufacturer's standard, **as directed**; long edges returned or rolled; channel-shaped, enclosing operating mechanisms.
 - 1) Color: Custom color **OR** As selected from manufacturer's standard color range, **as directed**.
 - 2) Anodized aluminum, clear **OR** color, **as directed** anodized.
 2. Vanes: Manufacturer's standard **OR** PVC-coated fiberglass mesh **OR** PVC-coated polyester mesh, **as directed**, freehanging fabric with hemmed, nonraveling edges; stain and fade resistant; with not less than **3/8-inch (9.5-mm)** overlap when vanes are rotated fully closed.
 - a. Nominal Vane Width: **2 inches (51 mm)** **OR** **3-1/2 inches (89 mm)** **OR** **5 inches (125 mm)**, **as directed**.
 3. Vane Directional Control: Manual.
 4. Vane Directional Control: Motorized operator.
 5. Traversing Control: Manual.
 6. Traversing Control: Motorized operator.
 7. Draw and Stack Position: One way, controls and stack left **OR** One way, controls and stack right **OR** One way, controls left and stack opposite **OR** One way, controls right and stack opposite **OR** Center split, controls left **OR** Center split, controls right **OR** Center stack, controls left **OR** Center

stack, controls right **OR** Off center, controls left **OR** Off center, controls right **OR** As indicated, **as directed**.

8. Cord-Tensioner Mounting: Wall **OR** Floor **OR** Sill **OR** Baseboard **OR** As indicated, **as directed**.
9. Valance: One **OR** Two-tiered, **as directed**, vane insert; with dust cover. Fabric vane insert matching vanes.
10. Louver Bottom: Connecting or spacing chains **OR** Weights, **as directed**.
11. Mounting: Wall mounting **OR** Ceiling mounting **OR** End mounting **OR** Wall extension brackets **OR** As indicated, **as directed**.
12. Stack Release: Permitting stacked vanes to be moved away from stacking position for total access to glazed opening.
13. Fabric Colors, Textures, and Patterns: As selected from manufacturer's full range.

E. Vertical Louver Blind Fabrication

1. Product Description: Vertical louver blind consisting of equally spaced, synchronized vanes and rail system with self-aligning carrier mechanisms, carriers, traverse and vane directional mechanisms and controls, and installation hardware.
2. Concealed Components: Noncorrodible or corrosion-resistant-coated materials.
 - a. Louver Directional and Traversing Control Mechanisms: With permanently lubricated moving parts.
3. Unit Sizes: Obtain units fabricated in sizes to fill window and other openings as follows:
 - a. Blind Units Installed between (inside) Jambs: Width equal to **1/4 inch (6 mm)** per side or **1/2 inch (13 mm)** total less than jamb-to-jamb dimension of opening in which each blind is installed. Length equal to **1/4 inch (6 mm)**, plus or minus **1/8 inch (3.1 mm)**, less than head-to-sill dimension of opening in which each blind is installed.
 - b. Blind Units Installed outside Jambs: Width and length as indicated, with terminations between blinds of end-to-end installations at centerlines of mullion or other defined vertical separations between openings.
4. Installation Brackets: Designed for easy removal and reinstallation of blind, for supporting headrail, valance, and operating hardware, and for hardware position and blind mounting method indicated.
5. Installation Fasteners: No fewer than two fasteners per bracket, fabricated from metal noncorrosive to blind hardware and adjoining construction; type designed for securing to supporting substrate; and supporting blinds and accessories under conditions of normal use.
6. Color-Coated Finish: For metal components exposed to view, unless anodized or plated finish is indicated. Apply manufacturer's standard baked finish complying with manufacturer's written instructions for surface preparation including pretreatment, application, baking, and minimum dry film thickness.
7. Component Color: Provide cords and exposed-to-view metal and plastic matching or coordinating with vane color, unless otherwise indicated.

F. Motorized Vertical Louver Blind Operators

1. General: Provide factory-assembled blind operation systems designed for blind type, size, weight, construction, use, and operation frequency indicated, with traverse **OR** rotation **OR** traverse and rotation, **as directed** functions. Provide operation systems of size and capacity and with features, characteristics, and accessories suitable for Project conditions and recommended by blind manufacturer, complete with electric motors and factory-prewired motor controls, remote-control stations, remote-control devices, power disconnect switches, enclosures protecting controls and all operating parts, headrail, and accessories required for reliable operation without malfunction. Include wiring from motor controls to motors. Coordinate operator wiring requirements and electrical characteristics with the building electrical system.
2. Comply with NFPA 70.
3. Control Equipment: Comply with NEMA ICS 1, NEMA ICS 2, and NEMA ICS 6 with NFPA 70, Class 2 control circuit, maximum 24-V ac or dc.
4. Electric Motors: UL-approved or -recognized, totally enclosed, insulated motor, complying with NEMA MG 1, with thermal-overload protection and internal limit switches; sized by blind

- manufacturer to start and operate size and weight of blind considering service factor or Project's service conditions without exceeding nameplate ratings.
- a. Service Factor: According to NEMA MG 1, unless otherwise indicated.
 - b. Motor Characteristics: Single phase, 24 **OR** 110 **OR** 220, **as directed**, V, 60 Hz.
 - c. Motor Mounting: On top of **OR** Behind, **as directed**, track, left **OR** right, **as directed**, side of headrail.
 - d. Motor Mounting: As indicated.
5. Remote Controls: Electric controls with NEMA ICS 6, Type 1 enclosure for surface **OR** recessed or flush **OR** within headrail, **as directed**, mounting. Provide the following devices for remote-control activation of blinds:
 - a. Control Stations: Keyed, maintained **OR** momentary, **as directed**, -contact, three-position, switch-operated control station with open, close, and off functions. Provide two keys per station.
 - b. Control Stations: Maintained **OR** Momentary, **as directed**, -contact, three-position, toggle **OR** rocker, **as directed**, -style, wall-switch-operated control station with open, close, and center off functions.
 - 1) Color: Ivory **OR** White **OR** As indicated, **as directed**.
 6. Limit Switches: Adjustable switches, interlocked with motor controls and set to automatically stop blind at fully traversed, rotated closed and fully retracted, rotated open positions.
 7. Operating Features: **<Insert feature.>**
 8. Accessories:
 - a. Solar Power Unit: For use with control system indicated.

1.3 EXECUTION

A. Installation

1. Install vertical louver blinds level and plumb and aligned with adjacent units according to manufacturer's written instructions, and located so exterior vane edges in any position are not closer than **2 inches (51 mm)** to interior face of glass. Install intermediate support as required to prevent deflection in headrail. Allow clearances between adjacent blinds and for operating glazed opening's operation hardware, if any.
2. Flush Mounted: Install vertical louver blinds with vane edges flush with finish face of opening when vanes are tilted open.
3. Jamb Mounted: Install headrail flush with face of opening jamb and head.
4. Head Mounted: Install headrail on face of opening head.
5. Recessed: Install headrail concealed within blind pocket.
6. Connections: Connect motorized operators to building electrical system.
7. Adjust vertical louver blinds to operate smoothly, easily, safely and free of binding or malfunction throughout entire operational range.
8. Clean vertical louver blind surfaces after installation, according to manufacturer's written instructions.

END OF SECTION 12 21 13 13a

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Task	Specification	Specification Description
12 21 13 33	12 21 13 13	Horizontal Louver Blinds
12 21 13 33	12 21 13 13a	Vertical Louver Blinds
12 21 16 13	12 21 13 13	Horizontal Louver Blinds
12 21 16 13	12 21 13 13a	Vertical Louver Blinds
12 21 16 33	12 21 13 13	Horizontal Louver Blinds
12 21 16 33	12 21 13 13a	Vertical Louver Blinds

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SECTION 12 22 13 00 - DRAPERIES AND TRACKS

1.1 GENERAL

A. Description Of Work

1. This specification covers the furnishing and installation of materials for draperies and tracks. Products shall be as follows or as directed by the Owner. Installation procedures shall be in accordance with the product manufacturer's recommendations. Demolition and removal of materials shall be as required to support the work.

B. Summary

1. This Section includes draperies and drapery tracks.

C. Submittals

1. Product Data: For the following:
 - a. Tracks: Include maximum weights of draperies that can be supported.
 - 1) Motorized Tracks: Indicate motor weights, motor-mounting requirements, and electrical requirements.
 - b. Fabrics and textile treatments.
2. Shop Drawings: For tracks. Show installation and anchorage details, locations of components and controls, and field measurements.
 - a. Draperies: Show sizes, locations, and details of installation.
3. Coordination Drawings: For track installation; reflected ceiling plans drawn to scale and coordinating track installation with openings and ceiling-mounted items.
4. Samples: For each drapery and for each fabric color and texture required.
5. Product Schedule: Use same designations indicated on Drawings.
6. Product Certificates: For each fabric treated with flame retardant, signed by fabric supplier.
7. Maintenance data.

D. Quality Assurance

1. Installer Qualifications: For draperies and tracks, fabricator of draperies.
2. Source Limitations: For draperies, obtain each color and pattern of fabric and trim from one dye lot.
3. Fire-Test-Response Characteristics: For fabrics treated with fire retardants, provide products that pass NFPA 701 as determined by testing of fabrics that were treated using treatment-application method intended for use for this Project by a testing and inspecting agency acceptable to authorities having jurisdiction.
4. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
5. Corded Window Covering Product Standard: Provide drapery tracks operated by pull cords complying with ANSI A100.1.

1.2 PRODUCTS

A. Drapery Tracks

1. Manually Operated Track:
 - a. Construction: Extruded aluminum, slotted for mounting at interval of not more than **24 inches (610 mm)** o.c., and bendable to radii indicated.
 - 1) Lengths and Configurations: As directed.
 - 2) Support Capability: Weight of drapery indicated **OR 30 lb (14 kg) OR 45 lb (20 kg) OR 60 lb (27 kg) OR 80 lb (36 kg) OR 140 lb (64 kg) OR 210 lb (95 kg), as directed,** mounted on track length indicated.

- 3) Finish: Manufacturer's standard **OR** White baked enamel **OR** Clear anodic coating, **as directed**.
 - b. Mounting Brackets: Aluminum, of type suitable for fastening track to surface indicated and designed to support weight of track assembly and drapery plus force applied to operate track.
 - 1) Mounting Surface: As indicated on Drawings **OR** Wall **OR** Ceiling **OR** Drapery pocket, **as directed**.
 - c. Installation Fasteners: Sized to support track assembly and drapery, and fabricated from metal compatible with track, brackets, and supporting construction. Provide two fasteners to fasten each bracket to supporting construction.
 - d. Operation: Baton **OR** Cord **OR** Cord tension pulley, **as directed**.
 - 1) Pulley Mounting Location: Wall **OR** Baseboard **OR** Floor, **as directed**.
 - 2) Draw: One way, stack as indicated on Drawings **OR** One way, stack left **OR** One way, stack right **OR** Two way, center opening, **as directed**.
 - 3) Operating Hardware Location: On stack side **OR** Left **OR** Right **OR** As indicated on Drawings, **as directed**.
 - e. Carriers: Rollers **OR** Rollers with hooks **OR** Rollers with snaps **OR** Coordinate with drapery headings indicated, **as directed**.
 - 1) Master Carriers: Butt **OR** Overlap, **as directed**.
 - f. Accessories: <Insert accessories.>
2. Motorized Track:
- a. Construction: Extruded aluminum, slotted for mounting at interval of not more than **24 inches (610 mm)** o.c., and bendable to radii indicated.
 - 1) Lengths and Configurations: As directed.
 - 2) Support Capability: Weight of drapery indicated **OR 30 lb (14 kg) OR 45 lb (20 kg) OR 60 lb (27 kg) OR 80 lb (36 kg) OR 140 lb (64 kg) OR 210 lb (95 kg)**, **as directed**, mounted on track length indicated.
 - 3) Finish: Manufacturer's standard **OR** White baked enamel **OR** Clear anodic coating, **as directed**.
 - b. Mounting Brackets: Suitable for fastening track to surface indicated and designed to support weight of track assembly and drapery plus force applied to operate track.
 - 1) Mounting Surface: As indicated on Drawings **OR** Wall **OR** Ceiling **OR** Drapery pocket, **as directed**.
 - c. Installation Fasteners: Sized to support track assembly and drapery, and fabricated from metal compatible with track, brackets, and supporting construction. Provide two fasteners to fasten each bracket to supporting construction.
 - d. Motor Operation: Low-voltage motor with built-in low-voltage interface for direct access to control systems, with thermal-overload switch; sized for weight of drapery and track length indicated; and equipped with stops to prevent overdrawing.
 - 1) Control: Wall switch **OR** Remote, infrared **OR** Remote, radio controlled **OR** Digital timer, **as directed**.
 - 2) Draw: One way, stack as indicated on Drawings **OR** One way, stack left **OR** One way, stack right **OR** Two way, center opening, **as directed**.
 - 3) Electrical Requirements: 115 V/60 Hz/120 W/1.10 A **OR** 115 V/60 Hz/140 W/1.20 A **OR** 110 V/60 Hz/150 W/1.0 A **OR** 110 V/60 Hz/550 W/5.0 A, **as directed**.
 - 4) Travel Speed: **6 inches (152 mm) OR 8 inches (203 mm) OR 12 inches (305 mm)**, **as directed**, per second.
 - e. Carriers: Rollers **OR** Rollers with hooks **OR** Rollers with snaps **OR** Coordinate with drapery headings indicated, **as directed**.
 - 1) Master Carriers: Butt **OR** Overlap, **as directed**.
 - f. Accessories: <Insert accessories.>

B. Draperies

1. Drapery:
 - a. Heading:

- 1) Pinch (French) Pleats: 100 **OR** 150 **OR** 200, **as directed**, percent fullness.
- 2) Stack Pleats: 60 **OR** 80 **OR** 100 **OR** 120, **as directed**, percent fullness.
- 3) Roll Pleats: 60 **OR** 80 **OR** 100 **OR** 120, **as directed**, percent fullness.
- 4) Accordion Pleats: 40 **OR** 80 **OR** 100 **OR** 120, **as directed**, percent fullness.
- 5) Pleat Spacing: **<Insert dimension.>**
- 6) Heading Accessories:
 - a) Nonwoven buckram.
 - b) Woven snap tape, **7/8 inch (22 mm)** wide, with nickel-plated snaps at **4 inches (102 mm)** o.c.
 - c) Hooks.
- b. Drapery Fabric:
 - 1) Manufacturer, Designation, Pattern, Color, and Fiber Content: **As directed**.
 - 2) Orientation: Run right (up the bolt).
 - 3) Width and Pattern Repeat Distance: **As directed**.
 - 4) Textile Treatments: Stain repellent **OR** Flame retardant, polymer type **OR** Stain repellent; and flame retardant, polymer type, **as directed**.
- c. Lining Fabric:
 - 1) Lining Type: Blackout; light tight **OR** Water resistant, **as directed**.
 - 2) Manufacturer, Manufacturer's Designation, Color, Fiber Content, and Width: **As directed**.
 - 3) Textile Treatments: Stain repellent **OR** Flame retardant, polymer type **OR** Stain repellent; and flame retardant, polymer type, **as directed**.
- d. Interlining: Acoustical.
 - 1) Manufacturer: **As directed**.
- e. Textile Trim and Tiebacks: **As directed**.
- f. Hem Weights: **1-inch- (25-mm-)** square lead weights **OR** Tape type (string weights), **as directed**.

C. Drapery Fabrication

1. Fabricate draperies in heading styles and fullnesses indicated. Fabricate headings to stand erect. If less than a full width of fabric is required to produce panel of specified fullness, use equal widths of not less than one-half width of fabric located at ends of panel.
 - a. One-Way-Stacking Draperies: Add **5 inches (127 mm)** to overall width for returns.
 - b. Center-Opening Draperies: Add **10 inches (254 mm)** to overall width for overlap.
2. Seams: Sew vertical seams with twin-needle sewing machine with selvage trimmed and overlocked. Join widths so that patterns match and vertical seams lay flat and straight without puckering. Horizontal seams are not acceptable.
3. Side Hems: Double-turned, **1-1/2-inch- (38-mm-)** wide hems consisting of three layers of fabric, and blindstitched so that stitches are not visible on face of drapery.
4. Bottom Hems: Double-turned, **4-inch- (102-mm-)** wide hems consisting of three layers of fabric, and weighted and blindstitched so that weights and stitches are not visible on face of drapery.
 - a. Sew in square lead weights at each seam and at panel corners.
5. Interlinings: Extend from top of drapery to within **1/2 inch (13 mm)** of lining's bottom hem and to leading edge of side hems to produce full-shadowed appearance.
6. Linings: Equal to widths of drapery fabric and joined to drapery fabric at top by inside invisible seam, and hand stitched at side hems and shadowed with **1-1/2-inch (38-mm)** return of face fabric.
 - a. Bottom Hem: Hem separately from **OR** Blind stitch to, **as directed**, drapery fabric.

1.3 EXECUTION

A. Drapery Track Installation

1. Install track systems according to manufacturer's written instructions, level and plumb, and at height and location in relation to adjoining openings as indicated on Drawings.

2. Isolate metal parts of tracks and brackets from concrete, masonry, and mortar to prevent galvanic action. Use tape or another method recommended in writing by track manufacturer.

B. Drapery Installation

1. Where draperies abut overhead construction, hang draperies so that clearance between headings and overhead construction is **1/4 inch (6.4 mm)**.
2. Where draperies extend to floor, install so that bottom hems clear finished floor by not more than **1 inch (25 mm)** and not less than **1/2 inch (13 mm)**.
3. Where draperies extend to windowsill, install so that bottom hems hang above sill line and clear sill line by not more than **1/2 inch (13 mm)**.

C. Adjusting

1. After hanging draperies, test and adjust each track to produce unencumbered, smooth operation.
2. Steam and dress down draperies as required to produce crease- and wrinkle-free installation.
3. Remove and replace draperies that are stained or soiled.

END OF SECTION 12 22 13 00



Task	Specification	Specification Description
12 22 16 00	12 22 13 00	Draperies and Tracks
12 23 00 00	12 21 13 13	Horizontal Louver Blinds
12 23 00 00	12 21 13 13a	Vertical Louver Blinds

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SECTION 12 24 13 00 - ROLLER SHADES

1.1 GENERAL

A. Description Of Work

1. This specification covers the furnishing and installation of materials for roller shades. Products shall be as follows or as directed by the Owner. Installation procedures shall be in accordance with the product manufacturer's recommendations. Demolition and removal of materials shall be as required to support the work.

B. Summary

1. This Section includes roller shades and motorized shade operators.

C. Submittals

1. Product Data: For each type of product indicated.
2. Shop Drawings: Include plans, elevations, sections, details, details of installation, operational clearances, wiring diagrams, and relationship to adjoining Work.
 - a. Verify dimensions by field measurements before fabrication and indicate measurements on Shop Drawings.
3. Samples: For each exposed finish and for each color and texture required.
4. Window Treatment Schedule: Use same designations indicated on Drawings.
5. Maintenance data.

D. Quality Assurance

1. Fire-Test-Response Characteristics: Provide products passing flame-resistance testing according to NFPA 701 by a testing agency acceptable to authorities having jurisdiction.
2. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
3. Comply with WCMA A 100.1.

E. Delivery, Storage, And Handling

1. Deliver shades in factory packages, marked with manufacturer and product name, fire-test-response characteristics, lead-free designation, and location of installation using same designations indicated on Drawings and in a window treatment schedule.

1.2 PRODUCTS

A. Roller Shades

1. Shade Band Material: PVC-coated fiberglass **OR** PVC-coated polyester **OR** PVC-coated fiberglass and polyester blends **OR** Fiberglass and acrylic blend **OR** Metallized film **OR** Mirror film **OR** Tinted film **OR** Owner-furnished material, **as directed**.
 - a. Colors: Match samples **OR** As selected from manufacturer's full range **OR** As indicated in a window treatment schedule, **as directed**.
 - b. Material Solar-Optical Properties: **As directed**.
 - c. Material Openness Factor: **As directed** percent.
 - d. Material UV Blockage: **As directed** percent.
2. Rollers: Electrogalvanized or epoxy primed steel or extruded-aluminum tube of diameter and wall thickness required to support and fit internal components of operating system and the weight and width of shade band material without sagging; designed to be easily removable from support brackets. Provide capacity for one **OR** two, **as directed**, roller shade band(s) per roller.

3. Direction of Roll: Regular, from back of roller **OR** Reverse, from front of roller **OR** Regular, from back of roller, and reverse, from front of roller, as indicated on Drawings for double-roller shades, **as directed**.
4. Mounting Brackets: Galvanized or zinc-plated steel **OR** Fascia end caps, fabricated from steel finished to match fascia or headbox, **as directed**.
5. Fascia: L-shaped, formed-steel sheet or extruded aluminum; long edges returned or rolled; continuous panel concealing front and bottom of shade roller, brackets, and operating hardware and operators; removable design for access.
6. Top/Back Cover: L-shaped; material and finish to match fascia; combining with fascia and end caps to form a six-sided headbox enclosure sized to fit shade roller and operating hardware inside.
7. Pocket-Style Headbox: U-shaped, formed-steel sheet or extruded aluminum; long edges returned or rolled; with a bottom cover consisting of slot opening of minimum dimension to allow lowering and raising of shade and a removable or an openable, continuous metal access panel concealing shade roller, brackets, and operating hardware and operators within.
8. Pocket with Ceiling Slot Opening: Six-sided box units for recessed installation; fabricated from formed-steel sheet, extruded aluminum, or wood; with a bottom consisting of slot opening of minimum dimension to allow lowering and raising of shade and a removable or an openable, continuous metal access panel concealing rollers, brackets, and operating hardware and operators within.
 - a. Corner Section: Factory formed and welded.
9. Bottom Bar: Steel or extruded aluminum, with plastic or metal capped ends. Provide exposed-to-view, external **OR** concealed, by pocket of shade material, internal, **as directed**, -type.
10. Audiovisual Light-Blocking Shades: Designed for eliminating all visible light gaps when shades are fully closed; fabricated from blackout shade band material with fascia **OR** headbox **OR** pocket, **as directed**, and bottom bar extended and formed for light-tight joints among shade components and between shade components and adjacent construction.
11. Skylight Shades: Manufacturer's complete system for operable skylight shades, including operator, operating hardware, and accessories for smooth operation, designed for installation in horizontal position **OR** inclined position, slope as indicated on Drawings, **as directed**.
12. Valance: As indicated by manufacturer's designation for style and color **OR** Style matching hem; as indicated by manufacturer's designation color **OR** As indicated in a window treatment schedule, **as directed**.
13. Mounting: Inside **OR** Outside **OR** Ceiling **OR** Recessed in ceiling pocket **OR** Wall extension brackets **OR** Bottom-up brackets **OR** As indicated on Drawings, **as directed**.
14. Shade Operation: Manual; with spring roller **OR** continuous-loop bead-chain, clutch, and cord tensioner and bracket **OR** gear and crank **OR** cordless system, **as directed**, lift operator.
15. Hold-Down Brackets and Hooks or Pins and Side Channels: Manufacturer's standard for fixing shade in place, keeping shade band material taut, and reducing light gaps when shades are closed.
16. Shade Operation: Manual; with spring roller **OR** continuous-loop bead-chain, clutch, and cord tensioner and bracket **OR** gear and crank **OR** cordless system, **as directed**, lift operator.

B. Roller Shade Fabrication

1. Unit Sizes: Obtain units fabricated in sizes to fill window and other openings as follows, measured at **74 deg F (23 deg C)**:
 - a. Shade Units Installed between (Inside) Jambs: Edge of shade not more than **1/4 inch (6 mm)** from face of jamb. Length equal to head to sill dimension of opening in which each shade is installed.
 - b. Shade Units Installed Outside Jambs: Width and length as indicated, with terminations between shades of end-to-end installations at centerlines of mullion or other defined vertical separations between openings.
2. Installation Brackets: Designed for easy removal and reinstallation of shade, for supporting fascia, headbox, roller, and operating hardware and for hardware position and shade mounting method indicated.

3. Installation Fasteners: No fewer than two fasteners per bracket, fabricated from metal noncorrosive to shade hardware and adjoining construction; type designed for securing to supporting substrate; and supporting shades and accessories under conditions of normal use.

C. Motorized Roller Shade Operators

1. General: Provide factory-assembled motorized shade operation systems designed for lifting shades of type, size, weight, construction, use, and operation frequency indicated. Include wiring from motor controls to motors. Coordinate operator wiring requirements and electrical characteristics with the building electrical system.
2. Comply with NFPA 70.
3. Control Equipment: Comply with NEMA ICS 1, NEMA ICS 2, and NEMA ICS 6 with NFPA 70, Class 2 control circuit, maximum 24-V ac or dc.
4. Electric Motors: UL-approved or -recognized, totally enclosed, insulated motor, complying with NEMA MG 1, with thermal-overload protection, brake, permanently lubricated bearings, and limit switches; sized by shade manufacturer to start and operate size and weight of shade considering service factor or considering Project's service conditions without exceeding nameplate ratings.
 - a. Service Factor: According to NEMA MG 1, unless otherwise indicated.
 - b. Motor Characteristics: Single phase, 24 **OR** 110 **OR** 220, **as directed**, V, 60 Hz.
 - c. Motor Mounting: Within manufacturer's standard roller enclosure.
5. Remote Controls: Electric controls with NEMA ICS 6, Type 1 enclosure surface **OR** recessed or flush, **as directed**, mounting. Keyed switch **OR** Toggle-style, wall switch Rocker-style, wall switch **OR** Rocker-style, group-control wall switch **OR** Rocker-style, individual/group-control wall switch **OR** Sun sensor **OR** Radio **OR** Infrared **OR** Timer **OR** Microprocessor, **as directed**.
6. Limit Switches: Adjustable switches, interlocked with motor controls and set to automatically stop shade at fully raised and fully lowered positions.

1.3 EXECUTION

A. Roller Shade Installation

1. Install roller shades level, plumb, and aligned with adjacent units according to manufacturer's written instructions, and located so shade band is not closer than **2 inches (50 mm)** to interior face of glass. Allow clearances for window operation hardware.
2. Connections: Connect motorized operators to building electrical system.
3. Adjust and balance roller shades to operate smoothly, easily, safely, and free from binding or malfunction throughout entire operational range.
4. Clean roller shade surfaces after installation, according to manufacturer's written instructions.

END OF SECTION 12 24 13 00

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SECTION 12 24 13 00a - PLEATED SHADES

1.1 GENERAL

A. Description Of Work

1. This specification covers the furnishing and installation of materials for pleated shades. Products shall be as follows or as directed by the Owner. Installation procedures shall be in accordance with the product manufacturer's recommendations. Demolition and removal of materials shall be as required to support the work.

B. Summary

1. This Section includes the following types of horizontal-fold shades and accessories:
 - a. Z-pleated shades.
 - b. Cellular shades.
 - c. Motorized shade operators.

C. Definitions

1. Cellular Shades: Pleated shades with more than one horizontally folded fabric layer forming accordion-folded fabric with enclosed air spaces or cells. Cellular shades may consist of two fabric layers forming a continuous accordion fold of enclosed air spaces or cells for a linear row of cells, one cell wide; three fabric layers forming two interconnected accordion folds of enclosed air spaces or cells for two honeycombed rows of cells, nominally two cells wide; or four fabric layers forming three interconnected accordion folds of enclosed air spaces or cells for three honeycombed rows of cells, nominally three cells wide.
2. Pleated Shades: Permanently creased, horizontally folded shades. Alternatively, pleated shades are synonymous with Z-pleated shades according to the industry. Z-pleated shades consist of one fabric layer forming Z-folded pleats.

D. Submittals

1. Product Data: For each type of product indicated.
 - a. Motorized Shade Operators: Include operating instructions.
 - b. Motors: Show nameplate data, ratings, characteristics, and mounting arrangements.
2. Shop Drawings: Show location and extent of pleated shades. Include elevations, sections, details, and dimensions not shown in Product Data. Show installation details, mountings, attachments to other work, operational clearances, and relationship to adjoining work.
 - a. Motorized Shade Operators: Show locations and details for installing operator components, switches, and controls. Indicate motor size, electrical characteristics, drive arrangement, mounting, and grounding provisions.
 - b. Wiring Diagrams: Power, system, and control wiring.
3. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which the following items are shown and coordinated with each other, based on input from installers of the items involved:
 - a. Suspended ceiling components.
 - b. Structural members to which equipment **OR** suspension systems, **as directed**, will be attached.
 - c. Sizes and locations of initial access modules for acoustical tile.
 - d. Items penetrating finished ceiling, including the following:
 - 1) Lighting fixtures.
 - 2) Air outlets and inlets.
 - 3) Speakers.
 - 4) Sprinklers.
 - 5) Access panels.
 - e. Perimeter moldings.
4. Samples: For the following products:

- a. Shade Fabrics: Not less than **3 inches (76 mm)** square, with specified treatments applied. Mark face of material.
- b. Valance: Full-size unit, not less than **12 inches (300 mm)** long.
- 5. Maintenance Data.

E. Quality Assurance

- 1. Fire-Test-Response Characteristics: Provide pleated shades with the fire-test-response characteristics indicated, as determined by testing identical products per test method indicated below by UL or another testing and inspecting agency acceptable to authorities having jurisdiction. Identify materials with appropriate markings of applicable testing and inspecting agency:
 - a. Flame-Resistance Ratings: Passes NFPA 701.
- 2. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- 3. Product Standard: Provide pleated shades complying with WCMA A 100.1.

F. Delivery, Storage, And Handling

- 1. Deliver shades in factory packages, marked with manufacturer and product name, fire-test-response characteristics, **OR** lead-free designation, **as directed**, and location of installation using same designations indicated on Drawings and in a window treatment schedule.

1.2 PRODUCTS

A. Z-Pleated Shades

- 1. Z-Pleated Shade Construction: One-fabric thickness, with uniform pleat spacing maintained at all positions.
 - a. Nominal Pleat Width: **1 inch (25 mm) OR 2 inches (50 mm) OR 3 inches (76 mm) OR 4 inches (100 mm), as directed.**
- 2. Shade Fabric: Manufacturer's standard **OR** 100 percent nonwoven polyester with antistatic treatment **OR** PVC-coated polyester mesh **OR** 100 percent spun-woven polyester, **as directed**; stain and fade resistant, width as wide as required for seamless shade.
 - a. Fabric Width: **36 inches (910 mm) OR 48 inches (1220 mm) OR 60 inches (1520 mm) OR 72 inches (1830 mm) OR 84 inches (2130 mm) OR 96 inches (2440 mm) OR** As indicated on Drawings **OR** As indicated in a window treatment schedule, **as directed.**
 - b. Pattern: as directed by the Owner.
 - c. Style: as directed by the Owner.
 - d. Colors: Match samples **OR** As selected from manufacturer's full range **OR** As indicated in a window treatment schedule, **as directed.**
 - e. **Material Solar-Optical Properties: as directed by the Owner.**
 - f. Material Opennes Factor: percent as directed by the Owner..
 - g. Material UV Blockage: percent as directed by the Owner..
- 3. Headrail: Formed steel or extruded aluminum; long edges returned or rolled; fully enclosing operating mechanisms on three sides and ends; capacity for one **OR** two, **as directed**, shade(s) per headrail, unless otherwise indicated on Drawings **OR** in a window treatment schedule, **as directed.**
- 4. Bottom Rail: Formed-steel or extruded-aluminum tube, sealed with plastic or metal capped ends.
- 5. Valance: Clear plastic with fabric insert matching fabric shade.
- 6. R-Value: Not less than **2.22 deg F x h x sq. ft./Btu (0.39 K x sq. m/W) OR 4.8 deg F x h x sq. ft./Btu (0.85 K x sq. m/W), as directed.**
- 7. Mounting: Wall **OR** Ceiling **OR** End **OR** Wall extension brackets **OR** As indicated on Drawings, **as directed**, mounting permitting easy removal and replacement without damaging shade or adjacent surfaces and finishes; with spacers and shims required for shade placement and alignment indicated.

8. Hold-Down Brackets and Hooks or Pins: Manufacturer's standard, as indicated.
 9. Side Channels and Perimeter Seals: Manufacturer's standard for eliminating light gaps when shades are closed.
 10. Shade Operation: Manual.
 - a. Lift Control: System including lift cord, crash-proof cord lock, and cord joiner ball **OR** System including continuous-cord loop, clutch, and cord tensioner and bracket **OR** Cordless system, **as directed**, designed to hold shade in place unless force is applied to move shade.
 - b. Length of Lift Cord **OR** Cord Loop, **as directed**: Manufacturer's standard length **OR** Full length of shade **OR** Length required to make operation convenient from floor level **OR** As indicated on Drawings, **as directed**.
 - c. Position of Lift Cord **OR** Cord Loop, **as directed**: As indicated on Drawings **OR** in a window treatment schedule, **as directed**.
 - d. Position of Lift Cord **OR** Cord Loop, **as directed**: Left side **OR** Right side **OR** Left end **OR** Right end, **as directed**, of headrail, unless otherwise indicated on Drawings **OR** in a window treatment schedule, **as directed**.
 - e. Cord Tensioner Mounting: Wall **OR** Floor **OR** Sill **OR** Baseboard **OR** As indicated on Drawings, **as directed**.
 11. Shade Operation: Motorized operator.
- B. Cellular Shades
1. Cellular Shade Construction: Two-fabric thicknesses and one row of cells, one cell wide.
 - a. Nominal Cell Width: **3/8 to 7/16 inch (10 to 11 mm) OR 1/2 inch (13 mm) OR 9/16 inch (14.2 mm) OR 3/4 inch (19 mm), as directed.**
 2. Cellular Shade Construction: Three-fabric thicknesses and two honeycombed cells, nominally two cells wide.
 - a. Nominal Cell Width: **3/8 inch (10 mm).**
 3. Cellular Shade Construction: Four-fabric thicknesses and three honeycombed cells, nominally three cells wide.
 - a. Nominal Cell Width: **3/8 inch (10 mm).**
 4. Shade Fabric: Manufacturer's standard **OR** 100 percent nonwoven polyester with antistatic treatment **OR** 100 percent spun-woven polyester, **as directed**; stain and fade resistant, width as wide as required for seamless shade.
 - a. Fabric Width: **36 inches (910 mm) OR 48 inches (1220 mm) OR 60 inches (1520 mm) OR 72 inches (1830 mm) OR 84 inches (2130 mm) OR 96 inches (2440 mm) OR** As indicated on Drawings **OR** As indicated in a window treatment schedule, **as directed**.
 - b. Pattern: as directed by the Owner.
 - c. Style: as directed by the Owner.
 - d. Colors: Match samples **OR** As selected from manufacturer's full range **OR** As indicated in a window treatment schedule, **as directed**.
 5. Headrail: Formed steel or extruded aluminum; long edges returned or rolled; fully enclosing operating mechanisms on three sides and ends; capacity for one **OR** two, **as directed**, shade(s) per headrail, unless otherwise indicated on Drawings **OR** in a window treatment schedule, **as directed**.
 6. Bottom Rail: Formed-steel or extruded-aluminum tube, sealed with plastic or metal capped ends.
 7. Valance: Clear plastic with fabric insert matching fabric shade.
 8. R-Value: Not less than **2.22 deg F x h x sq. ft./Btu (0.39 K x sq. m/W) OR 4.8 deg F x h x sq. ft./Btu (0.85 K x sq. m/W), as directed.**
 9. Mounting: Wall **OR** Ceiling **OR** End **OR** Wall extension brackets **OR** As indicated on Drawings, **as directed**, mounting permitting easy removal and replacement without damaging shade or adjacent surfaces and finishes; with spacers and shims required for shade placement and alignment indicated.
 10. Hold-Down Brackets and Hooks or Pins: Manufacturer's standard, as indicated.
 11. Side Channels and Perimeter Seals: Manufacturer's standard for eliminating light gaps when shades are closed.
 12. Shade Operation: Manual.

- a. Lift Control: System including lift cord, crash-proof cord lock, and cord joiner ball **OR** System including continuous-cord loop, clutch, and cord tensioner and bracket **OR** Cordless system, **as directed**, designed to hold shade in place unless force is applied to move shade.
 - b. Length of Lift Cord **OR** Cord Loop, **as directed**: Manufacturer's standard length **OR** Full length of shade **OR** Length required to make operation convenient from floor level **OR** As indicated on Drawings, **as directed**.
 - c. Position of Lift Cord **OR** Cord Loop, **as directed**: As indicated on Drawings **OR** in a window treatment schedule, **as directed**.
 - d. Position of Lift Cord **OR** Cord Loop, **as directed**: Left side **OR** Right side **OR** Left end **OR** Right end, **as directed**, of headrail, unless otherwise indicated on Drawings **OR** in a window treatment schedule, **as directed**.
 - e. Cord Tensioner Mounting: Wall **OR** Floor **OR** Sill **OR** Baseboard **OR** As indicated on Drawings, **as directed**.
13. Shade Operation: Motorized operator.

C. Pleated Shade Fabrication

1. Product Description: Pleated shades each consisting of fabric, rails, ladders, lifting mechanism, self-leveling device, and installation hardware.
2. Concealed Components: Noncorrodible or corrosion-resistant-coated materials.
 - a. Lifting Mechanism: With permanently lubricated moving parts.
3. Unit Sizes: Obtain units fabricated in sizes to fill window and other openings as follows, measured at **74 deg F (23 deg C)**:
 - a. Shade Units Installed between (Inside) Jambs: Edge of shade not more than **1/4 inch (6 mm)** from face of jamb. Length equal to head-to-sill dimension of opening in which each shade is installed.
 - b. Shade Units Installed Outside Jambs: Width and length as indicated, with terminations between shades of end-to-end installations at centerlines of mullion or other defined vertical separations between openings.
4. Installation Brackets: Designed for easy removal and reinstallation of shade, for supporting headrail, valance, **as directed**, and operating hardware and for hardware position and shade mounting method indicated.
5. Installation Fasteners: No fewer than two fasteners per bracket, fabricated from metal noncorrosive to shade hardware and adjoining construction; type designed for securing to supporting substrate; and supporting shades and accessories under conditions of normal use.
6. Color-Coated Finish: For metal components exposed to view, apply manufacturer's standard baked finish complying with manufacturer's written instructions for surface preparation including pretreatment, application, baking, and minimum dry film thickness.
7. Component Color: Provide rails and cords, **as directed**, and exposed-to-view ladders, **as directed**, metal and plastic matching or coordinating with fabric color, unless otherwise indicated.

D. Motorized Pleated Shade Operators

1. General: Provide factory-assembled shade operation systems designed for lifting shades of type, size, weight, construction, use, and operation frequency indicated. Provide operation systems of size and capacity and with features, characteristics, and accessories suitable for Project conditions and recommended by shade manufacturer, complete with electric motors and factory-prewired motor controls, remote-control stations, remote-control devices, power disconnect switches, enclosures protecting controls and all operating parts, headrail, and accessories required for reliable operation without malfunction. Include wiring from motor controls to motors. Coordinate operator wiring requirements and electrical characteristics with the building electrical system.
2. Comply with NFPA 70.
3. Control Equipment: Comply with NEMA ICS 1, NEMA ICS 2, and NEMA ICS 6 with NFPA 70, Class 2 control circuit, maximum 24-V ac or dc, **as directed**.

4. Electric Motors: UL-approved or -recognized, totally enclosed, insulated motor, complying with NEMA MG 1, with thermal-overload protection, brake, permanently lubricated bearings, and internal limit switches; sized by shade manufacturer to start and operate size and weight of shade considering service factor or considering Project's service conditions without exceeding nameplate ratings.
 - a. Service Factor: According to NEMA MG 1, unless otherwise indicated.
 - b. Motor Characteristics: Single phase, 24 **OR** 110 **OR** 220, **as directed**, V, 60 Hz.
 - c. Motor Mounting: Within manufacturer's standard headrail enclosure.
5. Remote Controls: Electric controls with NEMA ICS 6, Type 1 enclosure for surface **OR** recessed or flush **OR** within headrail, **as directed**, mounting. Provide the following devices for remote-control activation of shades:
 - a. Control Stations: Keyed, maintained **OR** momentary, **as directed**, -contact, three-position, switch-operated control station with open, close, and off functions. Provide two keys per station.
 - b. Control Stations: Maintained **OR** Momentary, **as directed**, -contact, three-position, toggle **OR** rocker, **as directed**, -style, wall switch-operated control station with open, close, and center off functions.
 - 1) Color: Ivory **OR** White **OR** As indicated in a window treatment schedule, **as directed**.
 - c. Group Control Stations: Maintained **OR** Momentary, **as directed**, -contact, three-position, rocker-style, wall switch-operated control station with open, close, and center off functions for single-switch group control.
 - 1) Color: Ivory **OR** White **OR** As indicated in a window treatment schedule, **as directed**.
 - d. Individual/Group Control Stations: Maintained **OR** Momentary, **as directed**, -contact, three-position, rocker-style, wall switch-operated control station with open, close, and center-off functions for individual and group control.
 - 1) Color: Ivory **OR** White **OR** As indicated in a window treatment schedule, **as directed**.
 - e. Sun Sensor Controls: Programmable system activated by LEDs detecting daylight intensity and responding by automatically adjusting shades.
 - f. Radio Controls: Digital system consisting of code-compatible universal coaxial receiver, one per shade **OR** one per headrail **OR** where indicated on Drawings, **as directed**, and two, **as directed**, portable, multiple-channel transmitters for operating two **OR** four **OR** up to 12, **as directed**, shades individually, each with a single button to open and close shades.
 - g. Infrared Controls: System consisting of concealed receiver complete with external eye and connecting modular cable, and two, **as directed**, portable, multiple-channel transmitters with separate buttons to open and close up to 12, **as directed**, individual shades or groups of shades, to open and close all shades simultaneously, and to stop.
 - h. Timer Controls: Clock timer, 24-hour **OR** seven-day, **as directed**, programmable for regular events.
 - i. Microprocessor Controls: Electronic programmable means for setting, changing, and adjusting control features. Provide unit isolated from voltage spikes and surges.
6. Limit Switches: Adjustable switches, interlocked with motor controls and set to automatically stop shade at fully raised and fully lowered positions.
7. Operating Features: Include the following:
 - a. Group switching with integrated switch control; one face plate for multiple switch cut-outs.
 - b. Capable of interface with audiovisual **OR** multiroom, **as directed**, control system.
 - c. Capable of accepting input from building automation control system.
 - d. Override switch.
8. Accessories: Include the following:
 - a. Solar Power Unit: For use with control system indicated.
9. Headrail: Manufacturer's standard formed steel or extruded aluminum; long edges returned or rolled; fully enclosing operating mechanisms on three sides and ends; capacity for one **OR** two,



as directed, shade(s) per headrail, unless otherwise indicated on Drawings **OR** in a window treatment schedule, **as directed**.

- a. Color: Match shade **OR** As indicated by manufacturer's designations **OR** As selected from manufacturer's full range **OR** As indicated in a window treatment schedule, **as directed**.

1.3 EXECUTION

A. Pleated Shade Installation

1. Install shades level, plumb, and aligned with adjacent units according to manufacturer's written instructions, and located so pleat edges are not closer than **2 inches (50 mm)** to interior face of glass. Install intermediate support as required to prevent deflection in headrail. Allow clearances for window operation hardware.
2. Flush Mounted: Install shades with pleat edges flush with finish face of opening if shade is in fully lowered position.
3. Jamb Mounted: Install headrail flush with face of opening jamb and head.
4. Head Mounted: Install headrail on face of opening head.
5. Recessed: Install headrail concealed within shade pocket.
6. Connections: Connect motorized operators to building electrical system.

B. Adjusting

1. Adjust and balance pleated shades to operate smoothly, easily, safely, and free from binding or malfunction throughout entire operational range.

C. Cleaning And Protection

1. Clean pleated shade surfaces after installation, according to manufacturer's written instructions.
2. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and Installer, that ensure that pleated shades are without damage or deterioration at time of Final Completion.
3. Replace damaged pleated shades that cannot be repaired, in a manner approved, before time of Final Completion.

END OF SECTION 12 24 13 00a



Task	Specification	Specification Description
12 24 13 00	01 22 16 00	No Specification Required
12 24 13 00	12 21 13 13	Horizontal Louver Blinds
12 24 13 00	12 21 13 13a	Vertical Louver Blinds

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SECTION 12 31 16 00 - STONE COUNTERTOPS

1.1 GENERAL

A. Description Of Work

1. This specification covers the furnishing and installation of materials for stone countertops. Products shall be as follows or as directed by the Owner. Installation procedures shall be in accordance with the product manufacturer's recommendations. Demolition and removal of materials shall be as required to support the work.

B. Summary

1. This Section includes stone countertops.

C. Submittals

1. Product Data: For each variety of stone and manufactured products.
2. Shop Drawings: Include plans, sections, details, and attachments to other work.
3. Samples: For each stone type indicated.
4. LEED Submittal:
 - a. Product Data for Credit EQ 4.1: For adhesives and sealants, documentation including printed statement of VOC content.
5. Sealant Compatibility Test Report: From sealant manufacturer, complying with requirements in Division 07 Section "Joint Sealants" and indicating that sealants will not stain or damage stone.
6. Maintenance Data: For stone countertops to include in maintenance manuals. Include Product Data for stone-care products used or recommended by Installer, and names, addresses, and telephone numbers of local sources for products.

D. Quality Assurance

1. Installer Qualifications: Fabricator of products.
2. Source Limitations for Stone: Obtain each variety of stone from a single quarry with resources to provide materials of consistent quality in appearance and physical properties.
 - a. Make stone slabs available for the Owner to examine for appearance characteristics. the Owner will select aesthetically acceptable slabs.

E. Delivery, Storage, And Handling

1. Lift stone with wide-belt slings; do not use wire rope or ropes that might cause staining. Move stone, if required, using dollies with cushioned wood supports.
2. Store stone on wood A-frames or pallets with nonstaining separators and nonstaining, waterproof covers. Ventilate under covers to prevent condensation.

F. Project Conditions

1. Field Measurements: Verify dimensions of construction to receive stone countertops by field measurements before fabrication.

1.2 PRODUCTS

A. Granite

1. Granite: Comply with ASTM C 615.
2. Cut stone from contiguous, matched slabs in which natural markings occur, **as directed**.
3. Finish: Polished **OR** Honed **OR** Thermal **OR** As indicated **OR** Match the Owner's sample, **as directed**.

B. Marble

1. Marble: Comply with ASTM C 503.

- a. Stone Abrasion Resistance: Minimum value of 10, based on testing according to ASTM C 241 or ASTM C 1353.
 2. Cut stone from contiguous, matched slabs in which natural markings occur, **as directed**.
 3. Finish: Polished **OR** Honed **OR** As indicated **OR** Match the Owner's sample, **as directed**.
- C. Serpentine
1. Serpentine: Comply with ASTM C 1526, Classification I Exterior **OR** II Interior, **as directed**.
 - a. Stone Abrasion Resistance: Minimum value of 10, based on testing according to ASTM C 241 or ASTM C 1353.
 2. Cut stone from contiguous, matched slabs in which natural markings occur, **as directed**.
 3. Finish: Polished **OR** Honed **OR** As indicated **OR** Match the Owner's sample, **as directed**.
- D. Slate
1. Slate: Comply with ASTM C 629, Classification I Exterior **OR** II Interior, **as directed**, with a fine, even grain and unfading color, from clear, sound stock.
 - a. Stone Abrasion Resistance: Minimum value of 8, based on testing according to ASTM C 241 or ASTM C 1353.
 2. Finish: Honed **OR** Sand rubbed **OR** Natural cleft **OR** As indicated **OR** Match the Owner's sample, **as directed**.
- E. Adhesives, Grout, Sealants, And Stone Accessories
1. General: Use only adhesives formulated for stone and ceramic tile and recommended by their manufacturer for the application indicated.
 2. Water-Cleanable Epoxy Adhesive: ANSI A118.3, with a VOC content of 65 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 3. Water-Cleanable Epoxy Grout: ANSI A118.3, chemical-resistant, water-cleanable, tile-setting and -grouting epoxy.
 4. Stone Adhesive: 2-part epoxy or polyester adhesive, formulated specifically for bonding stone to stone, with an initial set time of not more than 2 hours at 70 deg F (21 deg C), and with a VOC content of 65 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 - a. Color: Clear **OR** Match stone, **as directed**.
 5. Sealant for Countertops: Manufacturer's standard sealant of characteristics indicated below that comply with applicable requirements in Division 07 Section "Joint Sealants" and will not stain the stone it is applied to.
 - a. Single-component, neutral-curing **OR** acid-curing, **as directed**, silicone sealant.
 - b. Color: Clear **OR** As selected by the Owner from manufacturer's full range, **as directed**.
 - c. Use sealants that have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 6. Stone Joint Splines: Stainless-steel or brass washers approximately 1 inch (25 mm) in diameter and of thickness to fit snugly in saw-cut kerf in edge of stone units.
 7. Stone Cleaner: Cleaner specifically formulated for stone types, finishes, and applications indicated, as recommended by stone producer and, if a sealer is specified, by sealer manufacturer. Do not use cleaning compounds containing acids, caustics, harsh fillers, or abrasives.
 8. Stone Sealer: Colorless, stain-resistant sealer that does not affect color or physical properties of stone surfaces, as recommended by stone producer for application indicated.
- F. Stone Fabrication, General
1. Select stone for intended use to prevent fabricated units from containing cracks, seams, and starts that could impair structural integrity or function.
 - a. Repairs that are characteristic of the varieties specified are acceptable provided they do not impair structural integrity or function and are not aesthetically unpleasing, as judged by the Owner.
 2. Grade and mark stone for final locations to produce assembled countertop units with an overall uniform appearance.

3. Fabricate stone countertops in sizes and shapes required to comply with requirements indicated, including details on Drawings and Shop Drawings.
 - a. For granite, comply with recommendations in NBGQA's "Specifications for Architectural Granite."
 - b. For marble and serpentine, comply with recommendations in MIA's "Dimension Stone-- Design Manual."
 - c. Clean sawed backs of stones to remove rust stains and iron particles.
 - d. Dress joints straight and at right angle to face, unless otherwise indicated.
 - e. Cut and drill sinkages and holes in stone for anchors, supports, and attachments.
 - f. Provide openings, reveals, and similar features as needed to accommodate adjacent work.
 - g. Fabricate molded edges with machines having abrasive shaping wheels made to reverse contour of edge profile to produce uniform shape throughout entire length of edge and with precisely formed arris slightly eased to prevent snipping, and matched at joints between units. Form corners of molded edges as indicated with outside corners slightly eased, unless otherwise indicated.
 - h. Finish exposed faces of stone to comply with requirements indicated for finish of each type of stone required and to match approved Samples and mockups. Provide matching finish on exposed edges of countertops, splashes, and cutouts.
 4. Carefully inspect finished stone units at fabrication plant for compliance with requirements for appearance, material, and fabrication. Replace defective units.
- G. Stone Countertops
1. General: Comply with recommendations in MIA's "Dimension Stone - Design Manual."
 2. Nominal Thickness: Provide thickness indicated, but not less than **3/4 inch (20 mm) OR 7/8 inch (22 mm) OR 1-1/4 inches (32 mm), as directed.** Gage backs to provide units of identical thickness.
 3. Edge Detail: Straight, slightly eased at top **OR 3/8-inch (10-mm) bevel OR 3/4-inch (20-mm) full bullnose OR 1-1/4-inch (20-mm) full bullnose OR 3/8-inch (10-mm) radius with 2-inch (50-mm) apron OR 1-1/2-inch (40-mm) laminated bullnose OR As indicated, as directed.**
 4. Splashes: Provide **3/4-inch- (20-mm-) thick backsplashes OR end splashes OR backsplashes and end splashes, as directed,** unless otherwise indicated.
 5. Joints: Fabricate countertops without joints.
OR
Fabricate countertops in sections for joining in field, with joints at locations indicated and as follows:
 - a. Bonded Joints: **1/32 inch (0.8 mm)** or less in width.
 - b. Grouted Joints: **1/16 inch (1.5 mm)** in width.
 - c. Sealant-Filled Joints: **1/16 inch (1.5 mm)** in width.
 - d. Splined Joints: Accurately cut kerfs in edges at joints for insertion of metal splines to maintain alignment of surfaces at joints where indicated. Make width of cuts slightly more than thickness of splines to provide snug fit. Provide at least three splines in each joint.
 6. Cutouts and Holes:
 - a. Undercounter Fixtures: Make cutouts for undercounter fixtures in shop using template or pattern furnished by fixture manufacturer. Form cutouts to smooth, even curves.
 - 1) Provide vertical edges, slightly eased at juncture of cutout edges with top and bottom surfaces of countertop and projecting **3/16 inch (5 mm)** into fixture opening.
 - 2) Provide vertical edges, rounded to **3/8-inch (10-mm)** radius at juncture of cutout edges with top surface of countertop, slightly eased at bottom, and projecting **3/16 inch (5 mm)** into fixture opening.
 - 3) Provide **3/4-inch (20-mm)** full bullnose edges projecting **3/8 inch (10 mm)** into fixture opening.
 - b. Counter-Mounted Fixtures: Prepare countertops in shop for field cutting openings for counter-mounted fixtures. Mark tops for cutouts and drill holes at corners of cutout locations. Make corner holes of largest radius practical.
 - c. Fittings: Drill countertops in shop for plumbing fittings, undercounter soap dispensers, and similar items.

1.3 EXECUTION

A. Preparation

1. Advise installers of other work about specific requirements for placement of inserts and similar items to be used by stone countertop Installer for anchoring stone countertops. Furnish installers of other work with Drawings or templates showing locations of these items.
2. Clean dirty or stained stone surfaces by removing soil, stains, and foreign materials before setting. Clean stone by thoroughly scrubbing with fiber brushes and then drenching with clear water. Use only mild cleaning compounds that contain no caustic or harsh materials or abrasives. Allow stone to dry before installing.

B. Construction Tolerances

1. Variation from Plumb: For vertical lines and surfaces, do not exceed **1/16 inch in 48 inches (1.5 mm in 1200 mm)**.
2. Variation from Level: Do not exceed **1/8 inch in 96 inches (3 mm in 2400 mm)**, **1/4 inch (6 mm)** maximum.
3. Variation in Joint Width: Do not vary joint thickness more than 1/4 of nominal joint width.
4. Variation in Plane at Joints (Lipping): Do not exceed **1/64-inch (0.4-mm)** difference between planes of adjacent units.
5. Variation in Line of Edge at Joints (Lipping): Do not exceed **1/64-inch (0.4-mm)** difference between edges of adjacent units, where edge line continues across joint.

C. Installation Of Countertops

1. General: Install countertops over plywood subtops with full spread of water-cleanable epoxy adhesive.
OR
Install countertops by adhering to supports with water-cleanable epoxy adhesive.
2. Do not cut stone in field, unless otherwise indicated. If stone countertops or splashes require additional fabrication not specified to be performed at Project site, return to fabrication shop for adjustment.
OR
Do necessary field cutting as stone is set. Use power saws with diamond blades to cut stone. Cut lines straight, true, and at right angles to finished surfaces unless beveling is required for clearance. Ease edges slightly to prevent snipping.
3. Set stone to comply with requirements indicated on Drawings and Shop Drawings. Shim and adjust stone to locations indicated, with uniform joints of widths indicated and with edges and faces aligned according to established relationships and indicated tolerances. Install anchors and other attachments indicated or necessary to secure stone countertops in place.
4. Bond joints with stone adhesive and draw tight as countertops are set. Mask areas of countertops adjacent to joints to prevent adhesive smears.
5. If joints are allowed, space joints with **1/16-inch (1.5-mm)** gap for filling with grout **OR** sealant, **as directed**. Use temporary shims to ensure uniform spacing.
 - a. Install metal splines in kerfs in stone edges at joints where indicated. Fill kerfs with stone adhesive **OR** setting adhesive **OR** sealant, **as directed**, before inserting splines and remove excess immediately after adjoining units are drawn into position.
 - b. Clamp units to temporary bracing, supports, or each other to ensure that countertops are properly aligned and joints are of specified width.
6. Complete cutouts not finished in shop. Mask areas of countertops adjacent to cutouts to prevent damage while cutting. Use power saws with diamond blades to cut stone. Make cutouts to accurately fit items to be installed, and at right angles to finished surfaces unless beveling is required for clearance. Ease edges slightly to prevent snipping.
7. Install backsplash and end splash by adhering to wall with water-cleanable epoxy adhesive and to countertops with stone adhesive. Mask areas of countertops and splashes adjacent to joints to prevent adhesive smears.
OR

Install backsplash and end splash by adhering to countertops with stone adhesive. Mask areas of countertops and splashes adjacent to joints to prevent adhesive smears. Leave **1/16-inch (1.5-mm)** gap between splash and wall for filling with sealant. Use temporary shims to ensure uniform spacing.

OR

Install backsplash and end splash by adhering to wall with water-cleanable epoxy adhesive. Leave **1/16-inch (1.5-mm)** gap between countertop and splash for filling with sealant. Use temporary shims to ensure uniform spacing.

8. If grouted joints are acceptable, grout joints to comply with ANSI A108.10. Remove temporary shims before grouting. Tool grout uniformly and smoothly with plastic tool.
9. Apply sealant to joints and gaps specified for filling with sealant; comply with Division 07 Section "Joint Sealants". Remove temporary shims before applying sealant.

D. Adjusting And Cleaning

1. In-Progress Cleaning: Clean countertops as work progresses. Remove adhesive, grout, mortar, and sealant smears immediately.
2. Remove and replace stone countertops of the following description:
 - a. Broken, chipped, stained, or otherwise damaged stone. Stone may be repaired if methods and results are approved by the Owner.
 - b. Defective countertops.
 - c. Defective joints, including misaligned joints.
 - d. Interior stone countertops and joints not matching approved Samples and mockups.
 - e. Interior stone countertops not complying with other requirements indicated.
3. Replace in a manner that results in stone countertops matching approved Samples and mockups, complying with other requirements, and showing no evidence of replacement.
4. Clean stone countertops not less than six days after completion of sealant installation **OR** installation, **as directed**, using clean water and soft rags. Do not use wire brushes, acid-type cleaning agents, cleaning compounds with caustic or harsh fillers, or other materials or methods that could damage stone.
5. Sealer Application: Apply stone sealer to comply with stone producer's and sealer manufacturer's written instructions.

END OF SECTION 12 31 16 00

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SECTION 12 31 16 00a - KITCHEN CASEWORK, STAINLESS STEEL CABINETS

1.1 GENERAL

A. Description of Work

1. This specification covers the furnishing and installation of materials for kitchen casework, stainless steel cabinets. Products shall be as follows or as directed by the Owner. Installation procedures shall be in accordance with the product manufacturer's recommendations. Demolition and removal of materials shall be as required to support the work.

B. Quality Assurance

1. Comply with all provisions of specifications for the design, quality testing. Manufacturing and installation of metal kitchen cabinets and specified equipment.
2. All kitchen cabinetry and equipment herein specified and shown on the drawings shall meet the standards, quality of materials, construction, workmanship and finish of Innovative Laboratory Systems Co., 1336 Industrial Rd., Omaha Nebraska, (402) 333-0679. Equal manufacturers acceptable.
3. All metal cabinetry and equipment herein shall be the product of one manufacturer and be the one on which this specification is based or approved of substitutes must be obtained in writing from the Owner ten days prior to the bid due date. All manufacturers other than the specified product shall provide evidence of having a minimum of five years experience in the manufacturing and installation of stainless steel kitchen cabinetry.
4. The manufacturer shall, from one year to date of installation, warrant parts or products manufactured and finished against manufacturing defects in material and any such parts which under normal use prove defective within one year form date of installation, shall be repaired or replaced without charge to the Owner.
5. Wood shall not be used in any portion of the casework construction whether exposed or hidden from view.

C. Submittals

1. Shop Drawings
 - a. Identify location of metal cabinetry and related items.
 - b. Detail cabinets, shelving, countertops, etc, in related and dimensional position, with sections. Locations for roughing-in of plumbing, including sinks, faucets, strainers, cocks, etc. shall be included
2. Certificates: All bidders shall provide to the Owner independent test results from a nationally recognized testing laboratory on the finishes required for this project with the bid.

1.2 PRODUCTS

A. Material

1. All metal cabinetry shall be fabricated to Type 304 stainless steel free of scales buckles or other defects.
2. Minimum metal gauge: All minimum thickness of metal referred to herein shall be U.S. standard gauge.
 - a. 20 Gauge: Inner door panels, inner and outer drawer panels, drawer body, and shelves.
 - b. 18 Gauge: Outer door panels, sides, backs, bottoms, and tops.
 - c. 16 Gauge: Top rails, cross rails, drawer slides.
 - d. 14 Gauge: Leveling and corner gussets.

B. Fabrications

1. Cabinet Grade: Premium and complying with the following.
 - a. Align sides, top rails, bottoms and vertical stiles, at intersections, without overlap.

- b. Rounded edges.
 - c. Full welded seams.
 - d. Grind exposed welds flush and smooth.
2. Cases: The sides of cabinets shall be formed to make a rabbeted stile 1-1/8" wide. Top of case stiles shall be closed by a mitered 45-degree bend from tip of case side. Stiles shall be closed by welded channel, which contains front shelf adjustment louvers. All case members including intermediate cross rails shall be welded for maximum strength. Use of sheet metal screws to hold intermediate cross rails in place is not acceptable. Sides of all cabinets shall be free from any holes to prevent dust and bacteria from entering the cabinet. Pre-punched holes in the side of any cabinet will not be allowed. All drawer cabinets and cupboard cabinets shall have full backs and bottoms welded into place. Any cabinet without any backs or bottoms will be rejected. All interior bottoms of base and tall cabinets shall be turned down to provide a clean, flush interior free from dust catching ledges and preventing bacterial accumulation. Bottoms of all wall units shall be flushed; recessed bottoms are not acceptable.
3. Doors
- a. Doors shall be double panel reinforced construction 5/8" thick and sound deadened with vertical steel battens. Door fronts and liners shall be welded together for added strength. Door fronts and cases shall be slotted to receive hinges. Hinge wings must be concealed when doors open. Wrap around type hinges are not acceptable. All doors shall have soft rubber bumpers for quiet closing. Rubber bumpers must be securely locked in place. Rubber Bumpers attached by adhesives are not acceptable. All corners of doors shall be welded and ground smooth.
 - b. Sliding doors shall be double panel reinforced construction 5/8" thick and operate on nylon rollers suspended from stainless steel track at top of unit and center guide at bottom. Sliding doors shall have recessed door pulls.
4. Drawers
- a. Drawers front shall be double panel reinforced construction with 5/8" thick fronts and sound deadened with vertical steel battens. Drawers shall be all welded construction. All drawers shall have soft rubber bumpers for quiet closing. Rubber bumpers must be securely locked in place. Rubber bumpers attached by adhesives are not acceptable. All edges of drawer fronts shall be closed.
 - b. Drawer bodies shall be formed from a single sheet of steel including the bottom, two sides, back and inner front. Interior bottoms of drawers shall be fully covered on four sides for ease in cleaning. The top front of the inner drawer shall be offset to interlock with the outer drawer front.
 - c. Flanges on the top of drawer body shall be fully formed channel and bent at a 6-degree angle for maximum strength. Flanges shall be formed to leave the inside of the drawer free from sharp edges. Drawer slide shall be welded to drawer body and be part of a "Z" shaped member in a wrap around design to support drawer body. Drawer slides shall have a 15/16" nylon tired ball bearing roller. Drawer slide shall be roller type, positive in action permitting drawer to be fully opened; yet preventing drawer from accidental removal. Case slides shall be a formed piece of galvanized steel with 15/16" nylon tired ball bearing roller at front of slide. All ball bearing rollers for drawer slide and case slide shall be pre-lubricated to guarantee a smooth, quiet operation. All drawers shall rise upward when opened to prevent engaging of drawers and doors below. Drawers shall have self-closing design during the last 5" of travel.
5. Shelves: Shelves shall be formed from a single sheet of stainless steel with 7/8" face turned back and up at a 30-degree angle and edge of flange shall make firm contact with underside of shelf for sound deadening. All shelves in cabinets shall be adjustable on 1-1/2" center and supported by stainless steel clips placed in embossed louvers. All shelves shall be solid.
6. Hardware: Door catch shall be positive type latch located at upper inside edge of door. Stainless steel strike bracket shall be installed inside of door with accessible removable screws. Bolt shall be nylon self-closing type tested for 300,000 opening and closing cycles. Complete bolt housing shall be recessed behind cross rail. Roller catches and/or friction catches are not acceptable.

7. Hinges: Hinges shall be institutional type, 2-1/2" long, with a metal thickness of least 0.090", containing 5-knuckles, and centered 3" above bottom and below top of door. Doors 45" high and over shall have an additional hinge in center. Hinges shall be stainless steel with smooth rounded joints for easy cleaning. When door is closed, only the joint shall be exposed. Both hinge wings shall be encased, one within the door, the other within the case. Hinges shall be attached to the door and the case by screws. Hinges welded to door and/or case are not acceptable.
 8. Door and Drawer Pull: Door and drawer pull shall be stainless steel with a brushed satin finish. Shoulder screws shall be used so that when handles are mounted they do not cause the door to buckle or cave. Sliding doors shall have recessed door pulls.
 9. Base Cabinet Legs: All base cabinets and sink units shall be furnished with integral stainless steel legs with adjustable levelers. Bottom of base cabinets shall be approximately 6" above the floor.
 10. Locking Mechanism: All cabinet doors shall be provided with stainless steel angle hasps, with half-inch diameter holes for pad locking, as shown on the drawings. The left door of each door pair shall have a sliding flush bolt on the inside face, as shown on the drawings, to prevent the pair of doors from swinging open when pad locked.
- C. Steel Cabinet Finish
1. Test Procedure: Chemical spot tests shall be made by applying 10 to 15 drops (approximately 0.5 cubic cm) of each reagent listed in Table 1 to the surface to be tested. Each reagent spot shall be open to the atmosphere. Ambient temperature is 68-72 degrees F (20-22 degrees C). After one hour, chemicals shall be flushed away with cold water and the surface, washed with detergent and warm water at 150 degrees F (65 degrees C). Surface shall be examined under 100-foot candles of illumination.
- D. Kitchen Cabinets Performance Requirements
1. Base Cabinets.
 - a. Cabinets Load Test: A 48" wide standing height combination cupboard and drawer cabinet shall be freestanding with installed counter top. Cabinet shall sit 1" off the floor on all four leveling screws and be capable of supporting a uniform distributed load of 2,000 lbs. Door and drawer operation shall not be affected by the load.
 - b. Leveling device for floor mounted cabinets shall be capable of supporting a load of 500 lbs. Without failure and capable of adjustment after load is removed.
 - c. Cabinet Door Test: An open door shall withstand a load of 200 lbs. applied directly at the outer edge. Door shall be moved through a 180 degree arc and weight removed. Operation of the door after test shall be normal without distortion that will adversely affect operation for the door catch.
 - d. Life Cycle Test.
 - 1) Door hinge shall operate for 300,000 opening and closing cycles without a failure.
 - 2) Positive door catch shall operate for 300,000 opening and closing cycles without failure.
 - 3) Drawer shall be tested and operated with a load of 100 lbs. for a minimum of 150,000 opening and closing cycles. After test, drawers shall operate freely without evidence of dragging or scraping.
 2. Wall Cabinets
 - a. A 48" wide, 30" high, 12 3/4" deep hinged wall case shall support a load of 1lbs. on cabinet bottom and 100 lbs. on each adjustable shelf for a total of 300 lbs. Cabinet shall not show any significant permanent defection of cabinet, cabinet bottom or shelves. Doors shall operate smoothly when cabinet is fully loaded.
 - b. An adjustable shelf shall support a uniformly distributed load of 100 lbs. When load is removed, shelf should show no significant permanent distortion.
 - c. Performance of hinge and catch shall be the same as used on base cabinets.
- E. Working Surfaces
1. Stainless Steel: Sink and counter tops shall be fabricated of 16 gauge, Type 304, 18-8 solid stainless steel formed down and back making a 1 1/2" high face on all exposed edges.

Drainboards and cabinet tops shall be rigidly reinforced the full length of the top. Drainboards shall be two-way pitched to the bowl to provide drainage without channeling or grooving. Drainboards, flanges and splashes shall be integral, being formed from one sheet of metal. Raised edge surrounding unit shall be seamless die formed at front and ends of unit. Sink bowls shall be fabricated of 16 gauge, Type 304, 18-8 solid stainless steel seamless electrically welded to drainboard. All joints shall be electrically welded, ground and polished to a satin finish. Entire units shall be thoroughly sound deadened on under surface with sprayed or trowelled undercoating. Wood shall not be used. All tops shall have stainless steel runners to facilitate fastening to cabinets.

1.3 EXECUTION

A. Insulations

1. Install cabinets, shelves, counter tops and other equipment level and square. Install sink units to provide positive drainage of bottom surface of the sinks.
2. Wall cabinets shall be hung from the metal stud framing system wherever possible. If the wall cabinets must be hung from the wall surfacing at any location, proper anchors shall be used. Install wall cabinets level and aligned.
3. Install base cabinets firmly on ground. Level all the surfaces by adjusting the leg levelers. Attached countertops to inslatted base cabinets with stainless steel screws as required. Caulk with silicone all around counter tops where it interfaces with the existing walls. Install the flat back panels to the wall surfaces by the most appropriate method and caulk as required.
4. All work, including installation of new casework, flooring, ceiling, ductwork, etc., as well as the demolition of the existing casework, flooring, etc. shall be completed within three (3) consecutive days of work start. Hours of work shall be between 7:30 a.m. 9:00 p.m. All work, including work noted on Punch List, shall be completed by 9:00 p.m. of the third work day after work starts.

B. Temporary Work Station

1. During the period of demolition and new casework installation (3 days maximum) the contractor shall provide a temporary cabinet assembly for use by the Owner. The temporary assembly shall have a 6-foot section of cabinets with countertop, sink and faucet. The faucet shall be temporary connected to an apparatus hose bib for providing cold water to the sink. The sink shall be temporarily connected to a sewer line or floor drain if possible for the discharge or to another approved system of temporary discharge by means of a suitable container. For the latter method, the Contractor shall be responsible for periodically disposing of the waste container's contents. The temporary cabinet assembly shall be located reasonably close to the existing kitchens and/or dining areas being remodeled. the Owner shall approve the location of the temporary cabinets.

C. Inspection

1. Inspect installed work of other trades and installation conditions for acceptability. Inform the Owner of discrepancies that will jeopardize a complete and proper installation
2. Cleaning: Touching up marred and/or abraded finished surfaces, clean components to post construction accepted levels, remove crating and packing material, broom sweep premises.

END OF SECTION 12 31 16 00a



Task	Specification	Specification Description
12 31 16 00	01 22 16 00	No Specification Required
12 31 16 00	06 41 13 00	Interior Architectural Woodwork
12 35 70 13	01 22 16 00	No Specification Required
12 36 23 13	06 41 13 00	Interior Architectural Woodwork
12 36 23 13	12 31 16 00	Stone Countertops

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SECTION 12 36 61 16 - SOLID POLYMER FABRICATIONS

1.1 GENERAL

A. Description Of Work

1. This specification covers the furnishing and installation of materials for cast, mineral filled, nonporous, solid polymer material used for countertops, vanity tops, sinks, bowls, window sills, tub and shower walls, and other applications where a hard, durable, stain resistant surface is desired. Products shall be as follows or as directed by the Owner. Installation procedures shall be in accordance with the product manufacturer's recommendations. Demolition and removal of materials shall be as required to support the work.

B. Submittals

1. Shop Drawings: Fabrications; indicate joints, shapes, dimensions, accessories and installation details.
2. Product Data: Solid polymer fabrications; panel adhesive; joint adhesive; sealant; heat reflective tape.
3. Samples: Solid polymer fabrications; where colors and patterns are not indicated, submit at least 3 different samples of manufacturer's standard colors and patterns for selection.
4. Test Reports: Tensile strength; hardness; flammability; thermal expansion; boiling water resistance; high temperature resistance; liquid absorption; mold and mildew growth; bacteria growth; impact resistance; sanitation.
5. Operation and Maintenance Data: Solid polymer fabrications; provide manuals indicating manufacturer's care and maintenance data, including repair and cleaning instructions. Provide maintenance kit(s) for selected finish(es).

- #### C. Quality Assurance:
- Do not change source of supply for materials after work has started if the appearance of finished work would be affected. Variation in component size and location of openings to be plus or minus **1/8 inch (3 mm)**.

- #### D. Delivery:
- Do not deliver until areas are ready for installation. Deliver components and materials to the site undamaged in containers, clearly marked and labeled with manufacturer's name. Store in dry, weathertight enclosure. Protect materials to prevent damage to finished surfaces. Provide protective coverings to prevent physical damage or staining after installation until completion of the project.

- #### E. Warranty:
- Provide the solid surface material manufacturer's 10 year warranty, from date of acceptance of the work.

1.2 PRODUCTS

- #### A. Solid Polymer Fabrications:
- Provide fabrication of cast, solid polymer material composed of acrylic polymer, mineral fillers and pigments. Material shall not be coated or laminated to substrates. Polymer thickness to be as indicated but not less than **1/4 inch (6 mm)**. Superficial damage to a depth of **0.010 inch (0.25 mm)** shall be repairable by sanding or polishing.

1. Performance Requirements

- a. Tensile strength, ASTM D 638: **5800 psi (40 Mpa)** minimum
- b. Hardness, ASTM D 2583: Barcol Impressor 55 minimum
- c. Flammability, ASTM E 84: Class I/A, flame spread 25 maximum; smoke developed 30 maximum
- d. Thermal Expansion, ASTM D 696: **0.00002 in/in/F (0.000036 mm/mm/K)** maximum
- e. Boiling water resistance, NEMA LD 3: No effect
- f. High temperature resistance, NEMA LD 3: No effect
- g. Liquid absorption, ASTM D 570 (24 hours): 0.10 percent maximum

- h. Mold and mildew growth, ASTM G 21: No growth, no effect
- i. Bacteria growth, ASTM G 22: No growth, no effect
- j. Sanitation, NSF 51: "Food Contact" approval for food area applications
- k. Impact resistance, NEMA LD 3 (1/2 lb. (0.227 kg) ball drop): 1/4 inch (6 mm) material, 36 inch (914 mm) drop, no failure OR 1/2 inch (13 mm) material, 120 inch (3048 mm) drop, no failure, **as directed**.
- 2. Joint Adhesive: Two part acrylic joint adhesive as recommended by the solid polymer manufacturer to form inconspicuous, non-porous joints by chemical bond.
- 3. Panel Adhesive: Neoprene based panel adhesive as recommended by the solid polymer manufacturer, UL listed.
- 4. Sealant: Mildew resistant, FDA compliant and UL listed, silicone sealant as recommended by the solid polymer manufacturer.
- 5. Heat Reflective Tape: Heat reflective tape as recommended by the solid polymer manufacturer for use with cutouts for heat sources.
- 6. Mounting Hardware: Provide mounting hardware including sink/bowl clips, inserts and fasteners for attachment of undermount sinks and lavatories.

B. Fabrications: Fabrication requirements.

- 1. Factory fabricate components to the greatest extent possible to the sizes and shapes indicated, in accordance with approved shop drawings. Where indicated, factory fabricate side and back splashes with 1/2 inch (13 mm) cove at intersections.
- 2. Form joints between components using manufacturer's standard acrylic joint adhesive. Joints shall be inconspicuous, non-porous, and reinforced with strips of solid polymer material in accordance with the manufacturer's printed instructions.
- 3. Provide factory cutouts for plumbing and accessories as indicated. Reinforce heated or cooled cutouts in accordance with approved shop drawings and the manufacturer's printed instructions. Support all cutouts in accordance with approved shop drawings and the manufacturer's printed instructions.
- 4. Cut and finish component edges with clean returns. Round edges of cutouts to 1/8 inch (3 mm) radius. Round corners of cutouts with 1/2 inch (13 mm) minimum radius. Use router to form all cutouts. Provide thick edges where indicated using strips of solid polymer material and manufacturer's acrylic joint adhesive. All joints to be inconspicuous and non-porous. All exposed surfaces to have uniform finish and gloss.

1.3 EXECUTION

A. Installation: Deliver fabrications to the locations indicated. Assemble and install complete with accessories and hardware.

- 1. Assembly Requirements
 - a. Install components plumb and level and scribed to adjacent finishes in accordance with approved shop drawings and data.
 - b. Fasten and support fabrications to walls, brackets, and partitions as indicated. Fasteners shall be appropriate for use with adjoining construction.
 - c. Form field joints using manufacturer's recommended acrylic adhesive. Joints shall be inconspicuous and non-porous. Keep components and hands clean when forming joints. Seal flexible joints using manufacturer's recommended sealant.
 - d. Provide integral backsplashes and sidesplashes as indicated. Attach splashes with silicone or joint adhesive as indicated.
 - e. Keep components and hands clean during installation. Remove excessive adhesive and sealants. Clean finished surfaces of all dirt and stains.
- 2. Protection: Provide protective coverings to prevent physical damage or staining following installation.



END OF SECTION 12 36 61 16

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Task	Specification	Specification Description
12 36 61 16	06 41 13 00	Interior Architectural Woodwork
12 36 61 16	12 31 16 00	Stone Countertops
12 36 61 19	06 41 13 00	Interior Architectural Woodwork
12 36 61 19	12 31 16 00	Stone Countertops
12 36 61 19	12 36 61 16	Solid Polymer Fabrications

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SECTION 12 48 13 13 - FLOOR MATS AND FRAMES

1.1 GENERAL

A. Description Of Work

1. This specification covers the furnishing and installation of materials for floor mats and frames. Products shall be as follows or as directed by the Owner. Installation procedures shall be in accordance with the product manufacturer's recommendations. Demolition and removal of materials shall be as required to support the work.

B. Summary

1. This Section includes the following:
 - a. Roll-up mats in recessed and surface-mounted frames.
 - b. Entrance mats in recessed and surface-mounted frames.
 - c. Entrance tiles in recessed and surface-mounted frames.

C. Submittals

1. Product Data: For each type of floor mat and frame.
2. Shop Drawings: Show the following:
 - a. Items penetrating floor mats and frames, including the following:
 - 1) Door control devices.
 - b. Divisions between mat sections.
 - c. Perimeter floor moldings.
 - d. Custom Graphics: Scale drawing indicating colors.
3. Samples: For each floor mat, tread rail, and frame member.
4. Maintenance Data.

D. Quality Assurance

1. Accessibility Requirements: Provide installed floor mats that comply with Section 4.5 in the U.S. Architectural & Transportation Barriers Compliance Board's "Americans with Disabilities Act (ADA), Accessibility Guidelines for Buildings and Facilities (ADAAG)" **OR** Sections 302 and 303 in ICC A117.1, **as directed**.

1.2 PRODUCTS

A. Roll-Up Mats

1. Roll-up, Vinyl-Rail Hinged Mats: Vinyl-acrylic tread rails **1-1/2 inches (38 mm) OR 2 inches (50 mm), as directed**, wide by **3/8 inch (9.5 mm)** thick, with slotted or perforated vinyl **OR** aluminum, **as directed**, hinges.
 - a. Tread Inserts: Textured-surface, resilient vinyl **OR** Ribbed-design-surface, resilient vinyl **OR** Mineral abrasive particles bonded to or embedded in vinyl **OR** Aluminum-oxide or silicon-carbide grit in epoxy matrix **OR** **1/4-inch- (6-mm-)** high, **28-oz./sq. yd. (950-g/sq. m)** weight, level-cut, nylon-pile, fusion-bonded carpet, **as directed**.
 - b. Colors, Textures, and Patterns of Inserts: As selected from manufacturer's full range.
 - c. Rail Color: Light bronze **OR** Medium bronze **OR** Dark bronze **OR** Black **OR** As selected from manufacturer's full range, **as directed**.
 - d. Mat Size: As indicated **OR as directed**.
2. Roll-up, Aluminum-Rail Hinged Mats: Extruded-aluminum tread rails **1-1/2 inches (38 mm) OR 2 inches (50 mm), as directed**, wide by **3/8 inch (9.5 mm)** thick, sitting on continuous vinyl cushions.
 - a. Tread Inserts: Plain serrated aluminum treads **OR** Textured-surface, resilient vinyl **OR** Ribbed-design-surface, resilient vinyl **OR** Mineral abrasive particles bonded to or embedded in vinyl **OR** Aluminum-oxide or silicon-carbide grit in epoxy matrix **OR** **1/4-inch-**

- (6-mm-) high, 28-oz./sq. yd. (950-g/sq. m) weight, level-cut, nylon-pile, fusion-bonded carpet, **as directed**.
- b. Colors, Textures, and Patterns of Inserts: As selected from manufacturer's full range.
 - c. Rail Color: Mill-finish **OR** Clear **OR** Light bronze **OR** Medium bronze **OR** Dark bronze **OR** Black **OR** As selected from manufacturer's full range, **as directed**.
 - d. Hinges: Plastic **OR** Aluminum, **as directed**.
 - e. Mat Size: As indicated **OR as directed**.
3. Surface-Mounted Frames:
 - a. Tapered Frames: Tapered flexible vinyl edge-frame **OR** aluminum frame, **as directed**, members, not less than 1-1/2 inches (38 mm) wide, attached to mat at all 4 edges, with welded mitered corners.
 - b. Color: Mill finish **OR** Clear **OR** Light bronze **OR** Medium bronze **OR** Dark bronze **OR** Black **OR** As selected from manufacturer's full range, **as directed**.
 4. Recessed Frames:
 - a. Extruded Aluminum: ASTM B 221 (ASTM B 221M), Alloy 6061-T6 or Alloy 6063-T5, T6, or T52.
 - b. Color: Mill finish **OR** Clear **OR** Light bronze **OR** Medium bronze **OR** Dark bronze **OR** Black **OR** As selected from manufacturer's full range, **as directed**.
 - c. Architectural Bronze: ASTM B 455, Alloy UNS No. C38500.
 5. Structural Performance (if floor mats must withstand heavy wheeled-cart loads): Provide roll-up mats and frames capable of withstanding the following loads and stresses within limits and under conditions indicated:
 - a. Uniform floor load of 300 lbf/sq. ft. (14.36 kN/sq. m) **OR as directed**.
 - b. Wheel load of 350 lb (159 kg) per wheel **OR as directed**.
- B. Entrance Mats
1. Resilient Link Mats: 3/8-inch- (9.5-mm-) **OR** 7/16-inch- (11-mm-), **as directed**, thick, reversible vinyl **OR** rubber **OR** rubber-tire, **as directed**, link mats with galvanized spring-steel **OR** stainless-steel, **as directed**, wire link rods, vulcanized edge-nosing trim, steel-reinforced end trim, and links consisting of rectangular units or continuous strips in a heel-proof, solid-weave pattern with no openings between links **OR** heel-proof, close-weave pattern with openings between links not exceeding 1/8 inch (3 mm) wide by 1 inch (25.4 mm) long **OR** open-weave pattern with openings between links about 1/2 inch (13 mm) wide by 1 inch (25.4 mm) long, **as directed**.
 - a. Color: As selected from manufacturer's full range.
 - b. Mat Size: As indicated **OR as directed**.
 2. Rubber **OR** Vinyl, **as directed**, Mats: 1/4-inch- (6-mm-) **OR** 3/8-inch- (9.5-mm-) **OR** 7/16-inch- (11-mm-) **OR** 1/2-inch- (13-mm-), **as directed**, thick mats; with square edges for recessed installations **OR** beveled edges for surface applications, **as directed**, and with solid sheet (no perforations) style **OR** perforated style, 1/4-inch (6-mm) diameter on standard spacing **OR** perforated style, 3/16 by 3/4 inch (5 by 19 mm) on standard spacing, **as directed**, standard pyramid design **OR** standard wide-wale corrugated **OR** hi-rib, narrow-wale corrugated, **as directed**, top profile, and low-rib, narrow-wale corrugated **OR** standard knob-base **OR** flat-base, **as directed**, bottom surface.
 - a. Color: As selected from manufacturer's full range.
 - b. Mat Size: As indicated, **OR as directed**.
 3. Cocoa Mats: Constructed from cocoa fiber yarn permanently bonded to PVC backing for dimensional stability and resistance to shedding; 5/8- to 3/4-inch (16- to 19-mm) overall thickness; 1.5-lb/sq. ft (7.3-kg/sq. m) **OR** 1-inch (25.4-mm) overall thickness; 2.0-lb/sq. ft (10-kg/sq. m) **OR** 1-1/4-inch (32-mm) overall thickness; 2.5-lb/sq. ft (12-kg/sq. m), **as directed**, weight.
 - a. Color: As selected from manufacturer's full range.
 - b. Mat Size: As indicated, **as directed**.
 4. Rubber-Tire Mats: Units of edge-grain-laminated and chenille-buffed, rubber-tire wall cuts; bonded to sheet rubber or other durable flexible backing sheet to form 3/8- to 7/16-inch- (9.5- to

- 11-mm-) thick, 12-inch- (300-mm-) square tile **OR** wide, continuous linear strip up to 25 feet (7.6 m) long, **as directed**.
- a. Mat Size: As indicated **OR as directed**.
 5. Carpet-Type Mats: Nylon **OR** Polypropylene **OR** Olefin **OR** Polyester, **as directed**, carpet bonded to 1/8- to 1/4-inch- (3- to 6-mm-) thick, flexible vinyl backing to form mats 3/8 or 7/16 inch (9.5 or 11 mm) thick with nonraveling edges.
 - a. Colors, Textures, and Patterns: As selected from manufacturer's full range.
 - b. Mat Size: As indicated **OR as directed**.
 6. Loop Filament Mats: 3M's "Nomad" loop filament vinyl material 3/8 inch (9.5 mm) **OR** 1/2 inch (13 mm), **as directed**, thick, with solid vinyl sheet **OR** foam sheet, **as directed**, backing and with built-in chemical agents to reduce fungus and mildew.
 - a. Color: As selected from manufacturer's full range.
 - b. Mat Size: As indicated **OR as directed**.
 7. Nuway Mats: Nylon-reinforced, 1/2-inch- (13-mm-) wide by 7/16-inch- (11-mm-) **OR** 11/16-inch- (17.4-mm-), **as directed**, thick, vulcanized laminated rubber strips alternating with 9/16-inch- (14-mm-) wide, profile shapes assembled on 0.1055-inch- (2.7-mm-) diameter, galvanized steel wire, 1-1/2 inches (38 mm) o.c. Fibered surface buffed on rubber strips for interior **OR** unbuffed on rubber strips for exterior, **as directed**, installations.
 - a. Semiopen construction incorporating a 1/8-inch- (3-mm-) thick, PVC spacer on each wire between each profile shape and rubber strip to allow dirt, grit, and water to drop through.
 - b. Profile Shape Finish: Extruded-aluminum, mill finish **OR** Solid architectural-quality brass **OR** High-impact, solid PVC in color selected, **as directed**.
 - c. Color: As selected from manufacturer's full range.
 - d. Mat Size: As indicated **OR as directed**.
 8. Surface-Mounted Frames:
 - a. Tapered Frames: Tapered flexible vinyl edge-frame **OR** aluminum frame, **as directed**, members, not less than 2 inches (50 mm) **OR** 1-1/2 inches (38 mm), **as directed**, wide, attached to mat at all 4 edges, **as directed**, with welded mitered corners.
 - b. Color: Mill finish **OR** Clear **OR** Light bronze **OR** Medium bronze **OR** Dark bronze **OR** Black **OR** As selected from manufacturer's full range, **as directed**.
 9. Recessed Frames:
 - a. Extruded Aluminum: ASTM B 221 (ASTM B 221M), Alloy 6061-T6 or Alloy 6063-T5, T6, or T52.
 - b. Color: Mill-finish **OR** Clear **OR** Light bronze **OR** Medium bronze **OR** Dark bronze **OR** Black **OR** As selected from manufacturer's full range, **as directed**.
 - c. Architectural Bronze: ASTM B 455, Alloy UNS No. C38500.
 10. Graphics: Custom inlaid or woven-in graphic design **OR** logo **OR** emblem **OR** characters, **as directed**, as indicated.
- C. Entrance Tiles
1. Rubber-Tire Tiles: Units of edge-grain-laminated and chenille-buffed, rubber-tire wall cuts; bonded to sheet rubber or other durable flexible backing sheet to form 3/8- to 7/16-inch- (9.5- to 11-mm-) thick, square tile **OR** continuous linear strip, **as directed**.
 - a. Colors, Textures, and Patterns: As selected from manufacturer's full range.
 - b. Tile Size: 12 inches (300 mm) **OR** As indicated, **as directed**.
 2. Rubber **OR** Vinyl, **as directed**, Tiles: 5/8-inch- (16-mm-) **OR** 7/16-inch- (11-mm-), **as directed**, thick, solid **OR** open-grid, **as directed**, rubber **OR** vinyl, **as directed**, compound molded tiles with concealed interlocking joint tabs **OR** 1/4-inch- (6-mm-) deep, serpentine-grooved top face and knob-base back face on solid tile, **as directed**.
 - a. Colors, Textures, and Patterns: As selected from manufacturer's full range.
 - b. Tile Size: As indicated **OR as directed**.
 3. Carpet-Type Tiles: Nylon **OR** Polypropylene **OR** Olefin **OR** Polyester, **as directed**, carpet bonded to 1/8- to 1/4-inch- (3- to 6-mm-) thick, flexible vinyl backing to form mats 3/8 or 7/16 inch (9.5 or 11 mm) thick with nonraveling edges.
 - a. Colors, Textures, and Patterns: As selected from manufacturer's full range.
 - b. Tile Size: As indicated **OR as directed**.

4. Surface-Mounted Frames:
 - a. Tapered Frames: Tapered flexible vinyl edge-frame **OR** aluminum frame, **as directed**, members, not less than **2 inches (50 mm) OR 1-1/2 inches (38 mm)**, **as directed**, wide, attached to mat at all 4 edges, **as directed**, with welded mitered corners.
 - b. Color: Mill finish **OR** Clear **OR** Light bronze **OR** Medium bronze **OR** Dark bronze **OR** Black **OR** As selected from manufacturer's full range, **as directed**.
 5. Recessed Frames: Manufacturer's standard extrusion.
 - a. Extruded Aluminum: **ASTM B 221 (ASTM B 221M)**, Alloy 6061-T6 or Alloy 6063-T5, T6, or T52.
 - b. Color: Mill-finish **OR** Clear **OR** Light bronze **OR** Medium bronze **OR** Dark bronze **OR** Black **OR** As selected from manufacturer's full range, **as directed**.
- D. Concrete Fill And Grout Materials
1. Provide concrete grout and fill equivalent in strength to cast-in-place concrete slabs for recessed mats and frames. Use aggregate no larger than one-third fill thickness.
- E. Fabrication
1. Floor Mats: Shop fabricate units to greatest extent possible in sizes indicated. Unless otherwise indicated, provide single unit for each mat installation; do not exceed manufacturer's recommended maximum sizes for units that are removed for maintenance and cleaning. Where joints in mats are necessary, space symmetrically and away from normal traffic lanes. Miter corner joints in framing elements with hairline joints or provide prefabricated corner units without joints.
 2. Surface-Mounted Frames: As indicated for permanent surface-mounted installation, complete with corner connectors, splice plates or connecting pins, and postinstalled expansion anchors.
 3. Recessed Frames: As indicated, for permanent recessed installation, complete with corner pins or reinforcement and anchorage devices.
 - a. Fabricate edge-frame members in single lengths or, where frame dimensions exceed maximum available lengths, provide minimum number of pieces possible, with hairline joints equally spaced and pieces spliced together by straight connecting pins.
 4. Coat surfaces of aluminum frames that will contact cementitious material with manufacturer's standard protective coating.
- F. Aluminum Finishes
1. General: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
 2. Finish designations prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.
 3. Class II, Clear Anodic Finish: AA-M12C22A31 (Mechanical Finish: nonspecular as fabricated; Chemical Finish: etched, medium matte; Anodic Coating: Architectural Class II, clear coating 0.010 mm or thicker) complying with AAMA 611.
 4. Class I, Clear Anodic Finish: AA-M12C22A41 (Mechanical Finish: nonspecular as fabricated; Chemical Finish: etched, medium matte; Anodic Coating: Architectural Class I, clear coating 0.018 mm or thicker) complying with AAMA 611.
 5. Class II, Color Anodic Finish: AA-M12C22A32/A34 (Mechanical Finish: nonspecular as fabricated; Chemical Finish: etched, medium matte; Anodic Coating: Architectural Class II, integrally colored or electrolytically deposited color coating 0.010 mm or thicker) complying with AAMA 611.
 6. Class I, Color Anodic Finish: AA-M12C22A42/A44 (Mechanical Finish: nonspecular as fabricated; Chemical Finish: etched, medium matte; Anodic Coating: Architectural Class I, integrally colored or electrolytically deposited color coating 0.018 mm or thicker) complying with AAMA 611.
- G. Copper-Alloy (Bronze) Finishes

1. Finish designations prefixed by CDA comply with the system established by the Copper Development Association for designating copper-alloy finishes, as defined in NAAMM's "Metal Finishes Manual for Architectural and Metal Products."
 - a. Remove tool and die marks and stretch lines or blend into finish.
 - b. Grind and polish surfaces to produce uniform, directionally textured, polished finish indicated, free of cross scratches. Run grain with long dimension of each piece.
2. CDA Mechanical Finish Designation: M11, specular, as fabricated **OR** M32, directionally textured, medium satin, **as directed**.

1.3 EXECUTION

A. Installation

1. Install recessed mat frames to comply with manufacturer's written instructions. Set mat tops at height recommended by manufacturer for most effective cleaning action; coordinate top of mat surfaces with bottom of doors that swing across mats to provide clearance between door and mat.
 - a. For installation in terrazzo flooring areas, provide allowance for grinding and polishing of terrazzo without grinding surface of recessed frames. Coordinate with other trades as required.
 - b. Install necessary shims, spacers, and anchorages for proper location and secure attachment of frames.
 - c. Install grout and fill around frames and, if required to set mat tops at proper elevations, in recesses under mats. Finish grout and fill smooth and level.
2. Install surface-type units to comply with manufacturer's written instructions at locations indicated; coordinate with entrance locations and traffic patterns.
 - a. Anchor fixed surface-type frame members to floor with devices spaced as recommended by manufacturer.

B. Protection

1. After completing frame installation and concrete work, provide temporary filler of plywood or fiberboard in recesses and cover frames with plywood protective flooring. Maintain protection until construction traffic has ended and Project is near Final Completion.

END OF SECTION 12 48 13 13

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SECTION 12 48 13 13a - FOOT GRILLES

1.1 GENERAL

A. Description Of Work

1. This specification covers the furnishing and installation of materials for foot grilles. Products shall be as follows or as directed by the Owner. Installation procedures shall be in accordance with the product manufacturer's recommendations. Demolition and removal of materials shall be as required to support the Work.

B. Summary

1. This Section includes recessed foot grilles and frames.

C. Performance Requirements

1. Structural Performance: Provide foot grilles and frames capable of withstanding the following loads and stresses:
 - a. Uniform floor load of **300 lbf/sq. ft. (14.36 kN/sq. m) OR as directed.**
 - b. Wheel load of **350 lb (159 kg) OR as directed**, per wheel.

D. Submittals

1. Product Data: For each type of foot grille and frame.
2. Shop Drawings: Show the following:
 - a. Items penetrating foot grilles and frames, including the following:
 - 1) Door control devices.
 - b. Divisions between grille sections.
 - c. Perimeter floor moldings.
3. Samples: For each type of product involving color selection.
 - a. Foot Grille: **12-inch- (300-mm-)** square assembled sections.
 - b. Frame Members: **12-inch- (300-mm-)** long Sample of each type and color.
4. Maintenance data.

E. Quality Assurance

1. Accessibility Requirements: Provide installed foot grilles that comply with Section 4.5 in the U.S. Architectural & Transportation Barriers Compliance Board's "Americans with Disabilities Act (ADA), Accessibility Guidelines for Buildings and Facilities (ADAAG)" **OR** Sections 302 and 303 in ICC A117.1., **as directed**

1.2 PRODUCTS

A. Materials

1. Metallic-Coated Steel Sheet: ASTM A 653/A 653M, Commercial Steel (CS), Type B, with **A60 (ZF180)** zinc-iron-alloy (galvannealed) coating or with **G60 (Z180)** mill-phosphatized zinc coating; stretcher-leveled standard of flatness; with minimum thickness indicated representing specified thickness according to ASTM A 924/A 924M.
2. Stainless-Steel Sheet, Strip, Plate, and Flat Bars: ASTM A 666, Type 304.
3. Aluminum Sheet: **ASTM B 209 (ASTM B 209M)**, alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated, and with not less than strength and durability properties of Alloy 5005-H15.
4. Extruded Aluminum: **ASTM B 221 (ASTM B 221M)**, Alloy 6061-T6 or Alloy 6063-T5, T6, or T52 as standard with manufacturer. Coat surface of frame in contact with cementitious materials with manufacturer's standard protective coating.
5. Extruded Architectural Bronze: ASTM B 455, Alloy No. C38500.
6. Stainless-Steel Angles: ASTM A 276 or ASTM A 479/A 479M, corrosion resistant, Type 304.

B. Foot Grilles

1. General: Provide manufacturer's standard foot-grille assemblies consisting of treads of type and profile indicated, interlocked or joined together by cross members, and with support legs (if any) and other components needed to produce a complete installation.
2. Aluminum **OR** Bronze, **as directed**, Foot Grilles: Provide manufacturer's standard foot grilles with extruded members, top-surfaced tread rails, and as follows:
 - a. Tread Rails: Extruded-aluminum **OR** Extruded-bronze, **as directed**, tread rails with extruded-aluminum frame, **as directed**.
 - b. Tread Rail Spacing: 1-1/2 inches (38 mm) o.c. with 1/8- to 3/16-inch- (3- to 4.8-mm-) **OR** 2 inches (50 mm) o.c. with 1/4-inch- (6-mm-), **as directed**, wide openings between treads.
 - c. Aluminum Finish: Mill **OR** Anodized, **as directed**.
 - 1) Colors: Clear natural aluminum **OR** Light bronze **OR** Medium bronze **OR** Dark bronze **OR** Black **OR** As selected from manufacturer's full range, **as directed**.
 - d. Top Surface: Serrated aluminum **OR** Serrated bronze **OR** Serrated vinyl cap with UV stabilizer and antifungal additive **OR** Textured-surface, resilient vinyl insert **OR** Aluminum-oxide or silicon-carbide grit in epoxy matrix **OR** Abrasive particles bonded to or imbedded in vinyl insert **OR** Fusion-bonded, level-cut-pile nylon carpet insert; 1/4 inch (6 mm) high, 28 oz./sq. yd. (950 g/sq. m), **as directed**.
 - 1) Colors: As selected from manufacturer's full range, **as directed**.
 - e. Grille Size: As indicated **OR as directed**.
3. Stainless-Steel Foot Grille: Type 304.
 - a. Surface Treads: 0.071-by-0.177-inch (1.8-by-4.49-mm) wire with 0.125-inch- (3.17-mm-) **OR** 0.090-by-0.172-inch (2.2-by-4.37-mm) wire with 0.145-inch- (3.68-mm-) **OR** 0.093-by-0.156-inch (2.36-by-3.96-mm) wire with 0.125-inch- (3.17-mm-), **as directed**, wide openings between wires.
 - b. Support Rods: Spaced 1 inch (25 mm) o.c., welded to each wire.
 - c. Mat Grating: 5/8 inch (16 mm) deep.
 - d. Pit Grating: 1-1/8 inches (28.5 mm) deep.
 - e. Stainless-Steel Finish: Mill **OR** No. 4, **as directed**, finish.
 - f. Grille Size: As indicated **OR as directed**.
4. PVC Foot Grille: 1/8-by-1-1/2-by-1-inch (3-by-38-by-25-mm) ribbed top, PVC tread bars joined with 3/8-inch (10-mm) stainless-steel rods with 1-1/16-inch- (27-mm-) long nylon spacers at 12 inches (300 mm) o.c. Provide PVC frame with nylon anchors.
 - a. Colors: As selected from manufacturer's full range.
 - b. Grille Size: As indicated **OR as directed**.
5. Lockdown: Manufacturer's standard **OR** Hidden **OR** In view, **as directed**.

C. Frames

1. Provide manufacturer's standard frames of size and style for grille type, for permanent recessed installation in subfloor, complete with installation anchorages and accessories. Unless otherwise indicated, fabricate frame of same material and finish as grilles.

D. Support System

1. Level Bed Applications: Provide manufacturer's standard, vinyl cushion support system.
2. Drainage Pit Applications: Provide manufacturer's special deep-pit frame and support extrusion system with intermediate support beams, sized and spaced as recommended by manufacturer for indicated spans and equipped with vinyl support cushions.

E. Drain Pans

1. Provide manufacturer's standard, 0.060-inch- (1.52-mm-) thick, **as directed**, metallic-coated steel **OR** aluminum **OR** stainless-steel, **as directed**, sheet drain pan with NPS 2 (DN 50) drain outlet for each floor grille unit. Coat bottom of pan with protective coating recommended by manufacturer.

F. Fabrication

1. Shop fabricate foot grilles to greatest extent possible in sizes as indicated. Unless otherwise indicated, provide each grille as a single unit; do not exceed manufacturer's recommended maximum sizes for units that are removed for maintenance and cleaning. Where joints in grilles are necessary, space symmetrically and away from normal traffic lanes.
2. Fabricate frame members in single lengths or, where frame dimensions exceed maximum available lengths, provide minimum number of pieces possible, with hairline joints equally spaced and pieces spliced together by straight connecting pins.

G. Finishes, General

1. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
2. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

H. Aluminum Finishes

1. Finish designations prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.
2. Mill Finish: AA-M10 (Mechanical Finish: as fabricated); grind and buff as required to remove scratches, welding, or abrasions produced in fabrication process.
3. Class II, Clear Anodic Finish: AA-M12C22A31 (Mechanical Finish: nonspecular as fabricated; Chemical Finish: etched, medium matte; Anodic Coating: Architectural Class II, clear coating 0.010 mm or thicker) complying with AAMA 611.
4. Class I, Clear Anodic Finish: AA-M12C22A41 (Mechanical Finish: nonspecular as fabricated; Chemical Finish: etched, medium matte; Anodic Coating: Architectural Class I, clear coating 0.018 mm or thicker) complying with AAMA 611.
5. Class II, Color Anodic Finish: AA-M12C22A32/A34 (Mechanical Finish: nonspecular as fabricated; Chemical Finish: etched, medium matte; Anodic Coating: Architectural Class II, integrally colored or electrolytically deposited color coating 0.010 mm or thicker).
6. Class I, Color Anodic Finish: AA-M12C22A42/A44 (Mechanical Finish: nonspecular as fabricated; Chemical Finish: etched, medium matte; Anodic Coating: Architectural Class I, integrally colored or electrolytically deposited color coating 0.018 mm or thicker) complying with AAMA 611.

I. Stainless-Steel Finishes

1. Mill finish.
2. Directional Satin Finish: No. 4.
 - a. When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.

J. Copper-Alloy (Bronze) Finishes

1. Finish designations for copper alloys comply with the system established for designating copper-alloy finish systems defined in NAAMM's "Metal Finishes Manual for Architectural and Metal Products."
 - a. Remove tool and die marks and stretch lines or blend into finish.
 - b. Grind and polish surfaces to produce uniform, directionally textured, polished finish indicated, free of cross scratches. Run grain with long dimension of each piece.
2. Mechanical Finish Designation: M11, specular, as fabricated **OR** M32, directionally textured, medium satin, **as directed**.

1.3 EXECUTION

A. Installation

1. Install recessed foot grilles and frames and drain pans to comply with manufacturer's written instructions at locations indicated and with top of foot grilles and frames in relationship to one another and to adjoining finished flooring as recommended by manufacturer. Set foot-grille tops



at height for most effective cleaning action. Coordinate top of foot-grille surfaces with doors that swing across grilles to provide clearance under door.

B. Protection

1. After completing frame installations, provide temporary filler of plywood or fiberboard in foot-grille recesses and cover frames with plywood protective flooring. Maintain protection until construction traffic has ended and Project is near Final Completion.

END OF SECTION 12 48 13 13a

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Task	Specification	Specification Description
12 48 13 16	12 48 13 13	Floor Mats And Frames
12 48 13 16	12 48 13 13a	Foot Grilles
12 55 13 00	10 86 00 00	Detention Furniture
12 55 16 00	10 86 00 00	Detention Furniture
12 55 19 00	10 86 00 00	Detention Furniture
12 55 23 00	10 86 00 00	Detention Furniture
12 55 26 00	10 28 13 13a	Detention Toilet Accessories
12 55 26 00	10 86 00 00	Detention Furniture
12 55 86 00	10 86 00 00	Detention Furniture
12 61 13 00	12 01 60 00	Fixed Audience Seating
12 61 16 00	12 01 60 00	Fixed Audience Seating
12 61 19 00	12 01 60 00	Fixed Audience Seating

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SECTION 12 62 23 00 - PORTABLE BLEACHERS

1.1 GENERAL

A. Description Of Work

1. This specification covers the furnishing and installation of portable bleachers. Products shall match existing materials and/or shall be as follows or as directed by the Owner. Installation procedures shall be in accordance with the product manufacturer's recommendations. Demolition and removal of materials shall be as required to support the work.

B. Submittals

1. Product Data: For each type of product indicated.

C. Warranty

1. Contractor shall warranty any and all materials or workmanship covered by these specifications for a period of one (1) year. Defects shall be corrected by the Contractor at once without charge to the Owner.

1.2 PRODUCTS

A. Design:

1. The design shall be in accordance with the generally accepted standards as published by The American Institute of Steel Construction and The Aluminum Association.
2. Design Loads:
 - a. A uniformly distributed live load of not less than 100 psf of gross horizontal projection of the bleachers.
 - b. Bleachers shall be designed to withstand, with or without live loads, the horizontal and uplift pressures due to the wind. Wind pressures shall be derived from ANSI/ASCE 7-93, Minimum Design Loads in Buildings and Other Structures.
 - c. A horizontal swaying force applied to the seats, in a direction parallel to the length of the seats, of 24 lbs./ft.
 - d. A horizontal swaying force applied to the seats, in a direction perpendicular to the length of the seats, of 10 lb./ft.
 - e. All seat and footboard members shall be designed for live loads of not less than 120 lb. per lineal foot.
 - f. Guardrails shall be capable of sustaining a vertical load of 100 plf and a horizontal thrust of 50 plf. Acting outwardly at the top of the rail.
 - g. Under these loads, stresses shall not exceed those allowed in the "Specifications for Structural Steel Buildings, June 1, 1989" as adopted by the American Institute of Steel Construction.
3. Shop Connections: Welded and capable of carrying stress put upon them as per AWS standards.
4. Supporting Members (Framework):
 - a. Main supporting members are to be of a welded angle frame design.
 - b. Spaced at 6'-0" centers (maximum).
 - c. Constructed of a minimum 2 x 2 x 3/16" angle.
 - d. Every frame shall be laterally supported with cross-bracing to the adjacent frame.
5. Dimensions:
 - a. Length of Unit: 15" **OR** 21" **OR** 27," **as directed**.
 - b. Number of rows: 2 **OR** 3 **OR** 4 **OR** 5 **OR** 10, **as directed**.
 - c. Seat Height: 17 inches.
 - d. Typical Stands: 8" Rise with a 24" row depth.
6. Deck Arrangements:

- a. Seats: Nominal 2 x 10, anodized aluminum.
 - b. Footboards: Nominal 2 x 10 mill finish aluminum. (Optional 2 @ 2 x 10 mill finish aluminum on 2, 3, 4, 5 row units; Standard on 10 row units).
 - c. Riser: Optional on 2,3,4 & 5 row units, Standard on 10 row units
 - d. Vertical aisles with handrails as required by code.
7. Guardrails:
- a. Furnished on sides of any bleacher that is 5 rows high or higher per code. (Optional on 2, 3, & 4 row units).
 - b. All pipes shall be 1 5/8" O.D. anodized aluminum pipe with end plugs and elbows at corners. Secured to angle rail posts with galvanized fasteners.
 - c. Rails not less than 42" vertically above the center of the seatboard surface shall be provided at the back and sides of the bleacher.
 - d. Included on all sides of the bleacher shall be 2" x 9 gauge galvanized chain link fencing fastened in place with aluminum ties and galvanized tension bars and aluminum rail clamps.
8. Mudills: 2 x 4 pressure treated wood shall be provided on all frames.
9. Transporting Options:
- a. Galvanized steel angle tow bar
 - b. Pneumatic wheels with axles
10. Tip-N-Roll Package: Optional on 2, 3, & 4 row units up to 21'-0" long.
- a. Non-marking rubber grommets shall be provided on all frames.
 - b. Caster wheels shall be 4" diameter, swivel mounted, non-marking soft rubber.

B. Materials

- 1. Steel: ASTM A572 (Hot-Dipped Galvanized), ASTM A586 (Weathering Steel).
- 2. Aluminum: Extruded alloy 6063-T6.
- 3. Accessories:
 - a. High Strength Bolts and Nuts - ASTM A325 steel.
 - b. Ordinary Bolts and Nuts - ASTM A307.
 - c. Hold-Down Clip Assemblies - Aluminum alloy 6063-T6.
 - d. End Caps - Channel aluminum alloy 6063-T6.

C. Finishes

- 1. Steel: Galvanized Steel and Weathering Steel.
- 2. Aluminum:
 - a. Anodized: Seat planks, backrest, stanchions and also risers if requested clear anodized 204R1, AA-M10C22A31, Class II.
 - b. Mill Finish: Footboards and riser boards (6063-T6).
 - c. Paint: Electrostatically applied, baked-on siliconized acrylic or siliconized polyester enamel.

1.3 EXECUTION

A. Installation

- 1. Install bleacher unit in accordance with manufacturer's installation procedures.

END OF SECTION 12 62 23 00



Task	Specification	Specification Description
12 62 23 00	01 22 16 00	No Specification Required

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Task	Specification	Specification Description
13 11 46 00	01 22 16 00	No Specification Required

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SECTION 13 12 13 00 - WATER DISTRIBUTION

1.1 GENERAL

A. Description Of Work

1. This specification covers the furnishing and installation of materials for water distribution. Products shall be as follows or as directed by the Owner. Installation procedures shall be in accordance with the product manufacturer's recommendations. Demolition and removal of materials shall be as required to support the work.

B. Summary

1. This Section includes water-distribution piping and related components outside the building for water service **OR** fire-service mains **OR** combined water service and fire-service mains, **as directed**.
2. Utility-furnished products include water meters that will be furnished to the site, ready for installation.

C. Definitions

1. EPDM: Ethylene propylene diene terpolymer rubber.
2. LLDPE: Linear, low-density polyethylene plastic.
3. PA: Polyamide (nylon) plastic.
4. PE: Polyethylene plastic.
5. PP: Polypropylene plastic.
6. PVC: Polyvinyl chloride plastic.
7. RTRF: Reinforced thermosetting resin (fiberglass) fittings.
8. RTRP: Reinforced thermosetting resin (fiberglass) pipe.

D. Submittals

1. Product Data: For each type of product indicated.
2. Shop Drawings: Detail precast concrete vault assemblies and indicate dimensions, method of field assembly, and components.
 - a. Wiring Diagrams: Power, signal, and control wiring for alarms.
3. Field quality-control test reports.
4. Operation and Maintenance Data.

E. Quality Assurance

1. Regulatory Requirements:
 - a. Comply with requirements of utility company supplying water. Include tapping of water mains and backflow prevention.
 - b. Comply with standards of authorities having jurisdiction for potable-water-service piping, including materials, installation, testing, and disinfection.
 - c. Comply with standards of authorities having jurisdiction for fire-suppression water-service piping, including materials, hose threads, installation, and testing.
2. Piping materials shall bear label, stamp, or other markings of specified testing agency.
3. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
4. Comply with ASTM F 645 for selection, design, and installation of thermoplastic water piping.
5. Comply with FMG's "Approval Guide" or UL's "Fire Protection Equipment Directory" for fire-service-main products.
6. NFPA Compliance: Comply with NFPA 24 for materials, installations, tests, flushing, and valve and hydrant supervision for fire-service-main piping for fire suppression.
7. NSF Compliance:

- a. Comply with NSF 14 for plastic potable-water-service piping. Include marking "NSF-pw" on piping.
- b. Comply with NSF 61 for materials for water-service piping and specialties for domestic water.

F. Delivery, Storage, And Handling

- 1. Preparation for Transport: Prepare valves, including fire hydrants, according to the following:
 - a. Ensure that valves are dry and internally protected against rust and corrosion.
 - b. Protect valves against damage to threaded ends and flange faces.
 - c. Set valves in best position for handling. Set valves closed to prevent rattling.
- 2. During Storage: Use precautions for valves, including fire hydrants, according to the following:
 - a. Do not remove end protectors unless necessary for inspection; then reinstall for storage.
 - b. Protect from weather. Store indoors and maintain temperature higher than ambient dew-point temperature. Support off the ground or pavement in watertight enclosures when outdoor storage is necessary.
- 3. Handling: Use sling to handle valves and fire hydrants if size requires handling by crane or lift. Rig valves to avoid damage to exposed parts. Do not use handwheels or stems as lifting or rigging points.
- 4. Deliver piping with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe-end damage and to prevent entrance of dirt, debris, and moisture.
- 5. Protect stored piping from moisture and dirt. Elevate above grade. Do not exceed structural capacity of floor when storing inside.
- 6. Protect flanges, fittings, and specialties from moisture and dirt.
- 7. Store plastic piping protected from direct sunlight. Support to prevent sagging and bending.

G. Project Conditions

- 1. Interruption of Existing Water-Distribution Service: Do not interrupt service to facilities occupied by the Owner or others unless permitted under the following conditions and then only after arranging to provide temporary water-distribution service according to requirements indicated:
 - a. Notify the Owner no fewer than two days in advance of proposed interruption of service.
 - b. Do not proceed with interruption of water-distribution service without the Owner's written permission.

H. Coordination

- 1. Coordinate connection to water main with utility company.

1.2 PRODUCTS

A. Copper Tube And Fittings

- 1. Soft Copper Tube: **ASTM B 88, Type K (ASTM B 88M, Type A) OR ASTM B 88, Type L (ASTM B 88M, Type B), as directed**, water tube, annealed temper.
 - a. Copper, Solder-Joint Fittings: ASME B16.18, cast-copper-alloy or ASME B16.22, wrought-copper, solder-joint pressure type. Furnish only wrought-copper fittings if indicated.
 - b. Copper, Pressure-Seal Fittings:
 - 1) **NPS 2 (DN 50) and Smaller**: Wrought-copper fitting with EPDM O-ring seal in each end.
 - 2) **NPS 2-1/2 to NPS 4 (DN 65 to DN 100)**: Bronze fitting with stainless-steel grip ring and EPDM O-ring seal in each end.
- 2. Hard Copper Tube: **ASTM B 88, Type K (ASTM B 88M, Type A) OR ASTM B 88, Type L (ASTM B 88M, Type B), as directed**, water tube, drawn temper.
 - a. Copper, Solder-Joint Fittings: ASME B16.18, cast-copper-alloy or ASME B16.22, wrought-copper, solder-joint pressure type. Furnish only wrought-copper fittings if indicated.
 - b. Copper, Pressure-Seal Fittings:

- 1) **NPS 2 (DN 50)** and Smaller: Wrought-copper fitting with EPDM O-ring seal in each end.
 - 2) **NPS 2-1/2 to NPS 4 (DN 65 to DN 100)**: Bronze fitting with stainless-steel grip ring and EPDM O-ring seal in each end.
 3. Bronze Flanges: ASME B16.24, Class 150, with solder-joint end. Furnish Class 300 flanges if required to match piping.
 4. Copper Unions: MSS SP-123, cast-copper-alloy, hexagonal-stock body with ball-and-socket, metal-to-metal seating surfaces, and solder-joint or threaded ends.
- B. Ductile-Iron Pipe And Fittings
1. Mechanical-Joint, Ductile-Iron Pipe: AWWA C151, with mechanical-joint bell and plain spigot end unless grooved or flanged ends are indicated.
 - a. Mechanical-Joint, Ductile-Iron Fittings: AWWA C110, ductile- or gray-iron standard pattern or AWWA C153, ductile-iron compact pattern.
 - b. Glands, Gaskets, and Bolts: AWWA C111, ductile- or gray-iron glands, rubber gaskets, and steel bolts.
 2. Push-on-Joint, Ductile-Iron Pipe: AWWA C151, with push-on-joint bell and plain spigot end unless grooved or flanged ends are indicated.
 - a. Push-on-Joint, Ductile-Iron Fittings: AWWA C110, ductile- or gray-iron standard pattern or AWWA C153, ductile-iron compact pattern.
 - b. Gaskets: AWWA C111, rubber.
 3. Grooved-Joint, Ductile-Iron Pipe: AWWA C151, with cut, rounded-grooved ends.
 - a. Grooved-End, Ductile-Iron Pipe Appurtenances:
 - 1) Grooved-End, Ductile-Iron Fittings: ASTM A 47/A 47M, malleable-iron castings or ASTM A 536, ductile-iron castings with dimensions matching pipe.
 - 2) Grooved-End, Ductile-Iron-Piping Couplings: AWWA C606, for ductile-iron-pipe dimensions. Include ferrous housing sections, gasket suitable for water, and bolts and nuts.
 4. Flanges: ASME 16.1, Class 125, cast iron.
- C. PE Pipe And Fittings
1. PE, ASTM Pipe: ASTM D 2239, SDR No. 5.3, 7, or 9; with PE compound number required to give pressure rating not less than **160 psig (1100 kPa) OR 200 psig (1380 kPa), as directed**.
 - a. Insert Fittings for PE Pipe: ASTM D 2609, made of PA, PP, or PVC with serrated male insert ends matching inside of pipe. Include bands or crimp rings.
 - b. Molded PE Fittings: ASTM D 3350, PE resin, socket- or butt-fusion type, made to match PE pipe dimensions and class.
 2. PE, AWWA Pipe: AWWA C906, DR No. 7.3, 9, or 9.3; with PE compound number required to give pressure rating not less than **160 psig (1100 kPa) OR 200 psig (1380 kPa), as directed**.
 - a. PE, AWWA Fittings: AWWA C906, socket- or butt-fusion type, with DR number matching pipe and PE compound number required to give pressure rating not less than **160 psig (1100 kPa) OR 200 psig (1380 kPa), as directed**.
 3. PE, Fire-Service Pipe: ASTM F 714, AWWA C906, or equivalent for PE water pipe; FMG approved, with minimum thickness equivalent to FMG Class 150 and Class 200.
 - a. Molded PE Fittings: ASTM D 3350, PE resin, socket- or butt-fusion type, made to match PE pipe dimensions and class.
- D. PVC Pipe And Fittings
1. PVC, Schedule 40 Pipe: ASTM D 1785.
 - a. PVC, Schedule 40 Socket Fittings: ASTM D 2466.
 2. PVC, Schedule 80 Pipe: ASTM D 1785.
 - a. PVC, Schedule 80 Socket Fittings: ASTM D 2467.
 - b. PVC, Schedule 80 Threaded Fittings: ASTM D 2464.
 3. PVC, AWWA Pipe: AWWA C900, Class 150 **OR** Class 200, **as directed**, with bell end with gasket, and with spigot end.
 - a. Comply with UL 1285 for fire-service mains if indicated.



- b. PVC Fabricated Fittings: AWWA C900, Class 150 **OR** Class 200, **as directed**, with bell-and-spigot or double-bell ends. Include elastomeric gasket in each bell.
 - c. PVC Molded Fittings: AWWA C907, Class 150, with bell-and-spigot or double-bell ends. Include elastomeric gasket in each bell.
 - d. Push-on-Joint, Ductile-Iron Fittings: AWWA C110, ductile- or gray-iron standard pattern or AWWA C153, ductile-iron compact pattern.
 - 1) Gaskets: AWWA C111, rubber.
 - e. Mechanical-Joint, Ductile-Iron Fittings: AWWA C110, ductile- or gray-iron standard pattern or AWWA C153, ductile-iron compact pattern.
 - 1) Glands, Gaskets, and Bolts: AWWA C111, ductile- or gray-iron glands, rubber gaskets, and steel bolts.
- E. Fiberglass Pipe And Fittings
 - 1. AWWA RTRP: AWWA C950, Class 150 **OR** Class 200 **OR** Class 250, **as directed**, Type I **OR** II, **as directed**, Grade 1, epoxy **OR** Grade 2, polyester, **as directed**, with bell-and-spigot ends for bonded **OR** with gasket or seal for gasketed, **as directed**, joints. Liner is optional, unless otherwise indicated.
 - a. RTRF: AWWA C950, similar to pipe in material, pressure class, and joining method.
 - 2. UL RTRP: UL 1713, Class 150 **OR** Class 200 **OR** Class 250, **as directed**, with bell-and-spigot ends with gasket or seal for gasketed joints. Liner is optional, unless otherwise indicated.
 - a. RTRF: Similar to pipe in material, pressure class, and joining method.
- F. Special Pipe Fittings
 - 1. Ductile-Iron Rigid Expansion Joints:
 - a. Description: Three-piece, ductile-iron assembly consisting of telescoping sleeve with gaskets and restrained-type, ductile-iron, bell-and-spigot end sections complying with AWWA C110 or AWWA C153. Select and assemble components for expansion indicated. Include AWWA C111, ductile-iron glands, rubber gaskets, and steel bolts.
 - 1) Pressure Rating: 250 psig (1725 kPa) minimum.
 - 2) Expansion Required: As directed by the manufacturer or as directed by the Owner.
 - 2. Ductile-Iron Flexible Expansion Joints:
 - a. Description: Compound, ductile-iron fitting with combination of flanged and mechanical-joint ends complying with AWWA C110 or AWWA C153. Include two gasketed ball-joint sections and one or more gasketed sleeve sections. Assemble components for offset and expansion indicated. Include AWWA C111, ductile-iron glands, rubber gaskets, and steel bolts.
 - 1) Pressure Rating: 250 psig (1725 kPa) minimum.
 - 2) Offset: As directed by the manufacturer or as directed by the Owner.
 - 3) Expansion Required: As directed by the manufacturer or as directed by the Owner.
 - 3. Ductile-Iron Deflection Fittings:
 - a. Description: Compound, ductile-iron coupling fitting with sleeve and 1 or 2 flexing sections for up to 15-degree deflection, gaskets, and restrained-joint ends complying with AWWA C110 or AWWA C153. Include AWWA C111, ductile-iron glands, rubber gaskets, and steel bolts.
 - 1) Pressure Rating: 250 psig (1725 kPa) minimum.
- G. Joining Materials
 - 1. Refer to Division 33 Section "Common Work Results For Utilities" for commonly used joining materials.
 - 2. Brazing Filler Metals: AWS A5.8, BCuP Series.
 - 3. Bonding Adhesive for Fiberglass Piping: As recommended by fiberglass piping manufacturer.
 - 4. Plastic Pipe-Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer, unless otherwise indicated.
- H. Piping Specialties

1. Transition Fittings: Manufactured fitting or coupling same size as, with pressure rating at least equal to and ends compatible with, piping to be joined.
2. Tubular-Sleeve Pipe Couplings:
 - a. Description: Metal, bolted, sleeve-type, reducing or transition coupling, with center sleeve, gaskets, end rings, and bolt fasteners and with ends of same sizes as piping to be joined.
 - 1) Standard: AWWA C219.
 - 2) Center-Sleeve Material: Manufacturer's standard **OR** Carbon steel **OR** Stainless steel **OR** Ductile iron **OR** Malleable iron, **as directed**.
 - 3) Gasket Material: Natural or synthetic rubber.
 - 4) Pressure Rating: **150 psig (1035 kPa) OR 200 psig (1380 kPa), as directed**, minimum.
 - 5) Metal Component Finish: Corrosion-resistant coating or material.
3. Split-Sleeve Pipe Couplings:
 - a. Description: Metal, bolted, split-sleeve-type, reducing or transition coupling with sealing pad and closure plates, O-ring gaskets, and bolt fasteners.
 - 1) Standard: AWWA C219.
 - 2) Sleeve Material: Manufacturer's standard **OR** Carbon steel **OR** Stainless steel, **as directed**.
 - 3) Sleeve Dimensions: Of thickness and width required to provide pressure rating.
 - 4) Gasket Material: O-rings made of EPDM rubber, unless otherwise indicated.
 - 5) Pressure Rating: **150 psig (1035 kPa) OR 200 psig (1380 kPa), as directed**, minimum.
 - 6) Metal Component Finish: Corrosion-resistant coating or material.
4. Flexible Connectors:
 - a. Nonferrous-Metal Piping: Bronze hose covered with bronze wire braid; with copper-tube, pressure-type, solder-joint ends or bronze flanged ends brazed to hose.
 - b. Ferrous-Metal Piping: Stainless-steel hose covered with stainless-steel wire braid; with ASME B1.20.1, threaded steel pipe nipples or ASME B16.5, steel pipe flanges welded to hose.
5. Dielectric Fittings: Combination of copper alloy and ferrous; threaded, solder, or plain end types; and matching piping system materials.
 - a. Dielectric Unions: Factory-fabricated union assembly, designed for **250-psig (1725-kPa)** minimum working pressure at **180 deg F (82 deg C)**. Include insulating material that isolates dissimilar metals and ends with inside threads according to ASME B1.20.1.
 - b. Dielectric Flanges: Factory-fabricated companion-flange assembly, for **150- or 300-psig (1035- or 2070-kPa)** minimum working pressure to suit system pressures.
 - c. Dielectric-Flange Insulation Kits: Field-assembled companion-flange assembly, full-face or ring type. Components include neoprene or phenolic gasket, phenolic or polyethylene bolt sleeves, phenolic washers, and steel backing washers.
 - 1) Provide separate companion flanges and steel bolts and nuts for **150- or 300-psig (1035- or 2070-kPa)** minimum working pressure to suit system pressures.
 - d. Dielectric Couplings: Galvanized-steel couplings with inert and noncorrosive thermoplastic lining, with threaded ends and **300-psig (2070-kPa)** minimum working pressure at **225 deg F (107 deg C)**.
 - e. Dielectric Nipples: Electroplated steel nipples with inert and noncorrosive thermoplastic lining, with combination of plain, threaded, or grooved end types, and **300-psig (2070-kPa)** minimum working pressure at **225 deg F (107 deg C)**.
- I. Corrosion-Protection Piping Encasement
 1. Encasement for Underground Metal Piping:
 - a. Standards: ASTM A 674 or AWWA C105.
 - b. Form: Sheet **OR** Tube, **as directed**.
 - c. Material: LLDPE film of **0.008-inch (0.20-mm)** minimum thickness.
 - d. Material: LLDPE film of **0.008-inch (0.20-mm)** minimum thickness, or high-density, crosslaminated PE film of **0.004-inch (0.10-mm)** minimum thickness.

- e. Material: High-density, crosslaminated PE film of 0.004-inch (0.10-mm) minimum thickness.
- f. Color: Black **OR** Natural, **as directed**.

J. Gate Valves

1. AWWA, Cast-Iron Gate Valves:

- a. Nonrising-Stem, Metal-Seated Gate Valves:
 - 1) Description: Gray- or ductile-iron body and bonnet; with cast-iron or bronze double-disc gate, bronze gate rings, bronze stem, and stem nut.
 - a) Standard: AWWA C500.
 - b) Minimum Pressure Rating: 200 psig (1380 kPa).
 - c) End Connections: Mechanical joint.
 - d) Interior Coating: Complying with AWWA C550.
- b. Nonrising-Stem, Resilient-Seated Gate Valves:
 - 1) Description: Gray- or ductile-iron body and bonnet; with bronze or gray- or ductile-iron gate, resilient seats, bronze stem, and stem nut.
 - a) Standard: AWWA C509.
 - b) Minimum Pressure Rating: 200 psig (1380 kPa).
 - c) End Connections: Mechanical joint.
 - d) Interior Coating: Complying with AWWA C550.
- c. Nonrising-Stem, High-Pressure, Resilient-Seated Gate Valves:
 - 1) Description: Ductile-iron body and bonnet; with bronze or ductile-iron gate, resilient seats, bronze stem, and stem nut.
 - a) Standard: AWWA C509.
 - b) Minimum Pressure Rating: 250 psig (1725 kPa).
 - c) End Connections: Push on or mechanical joint.
 - d) Interior Coating: Complying with AWWA C550.
- d. OS&Y, Rising-Stem, Metal-Seated Gate Valves:
 - 1) Description: Cast- or ductile-iron body and bonnet, with cast-iron double disc, bronze disc and seat rings, and bronze stem.
 - a) Standard: AWWA C500.
 - b) Minimum Pressure Rating: 200 psig (1380 kPa).
 - c) End Connections: Flanged.
- e. OS&Y, Rising-Stem, Resilient-Seated Gate Valves:
 - 1) Description: Cast- or ductile-iron body and bonnet, with bronze or gray- or ductile-iron gate, resilient seats, and bronze stem.
 - a) Standard: AWWA C509.
 - b) Minimum Pressure Rating: 200 psig (1380 kPa).
 - c) End Connections: Flanged.

2. UL/FMG, Cast-Iron Gate Valves:

- a. UL/FMG, Nonrising-Stem Gate Valves:
 - 1) Description: Iron body and bonnet with flange for indicator post, bronze seating material, and inside screw.
 - a) Standards: UL 262 and FMG approved.
 - b) Minimum Pressure Rating: 175 psig (1207 kPa).
 - c) End Connections: Flanged.
- b. OS&Y, Rising-Stem Gate Valves:
 - 1) Description: Iron body and bonnet and bronze seating material.
 - a) Standards: UL 262 and FMG approved.
 - b) Minimum Pressure Rating: 175 psig (1207 kPa).
 - c) End Connections: Flanged.

3. Bronze Gate Valves:

- a. OS&Y, Rising-Stem Gate Valves:
 - 1) Description: Bronze body and bonnet and bronze stem.
 - a) Standards: UL 262 and FMG approved.

- b) Minimum Pressure Rating: 175 psig (1207 kPa).
 - c) End Connections: Threaded.
 - b. Nonrising-Stem Gate Valves:
 - 1) Description: Class 125, Type 1, bronze with solid wedge, threaded ends, and malleable-iron handwheel.
 - a) Standard: MSS SP-80.
- K. Gate Valve Accessories And Specialties
 - 1. Tapping-Sleeve Assemblies:
 - a. Description: Sleeve and valve compatible with drilling machine.
 - 1) Standard: MSS SP-60.
 - 2) Tapping Sleeve: Cast- or ductile-iron or stainless-steel, two-piece bolted sleeve with flanged outlet for new branch connection. Include sleeve matching size and type of pipe material being tapped and with recessed flange for branch valve.
 - 3) Valve: AWWA, cast-iron, nonrising-stem, metal **OR** resilient, **as directed**, -seated gate valve with one raised face flange mating tapping-sleeve flange.
 - 2. Valve Boxes: Comply with AWWA M44 for cast-iron valve boxes. Include top section, adjustable extension of length required for depth of burial of valve, plug with lettering "WATER," and bottom section with base that fits over valve and with a barrel approximately 5 inches (125 mm) in diameter.
 - a. Operating Wrenches: Steel, tee-handle with one pointed end, stem of length to operate deepest buried valve, and socket matching valve operating nut.
 - 3. Indicator Posts: UL 789, FMG-approved, vertical-type, cast-iron body with operating wrench, extension rod, and adjustable cast-iron barrel of length required for depth of burial of valve.
- L. Check Valves
 - 1. AWWA Check Valves:
 - a. Description: Swing-check type with resilient seat. Include interior coating according to AWWA C550 and ends to match piping.
 - 1) Standard: AWWA C508.
 - 2) Pressure Rating: 175 psig (1207 kPa).
 - 2. UL/FMG, Check Valves:
 - a. Description: Swing-check type with pressure rating; rubber-face checks, unless otherwise indicated; and ends matching piping.
 - 1) Standards: UL 312 and FMG approved.
 - 2) Pressure Rating: 175 psig (1207 kPa) **OR** 250 psig (1725 kPa), **as directed**.
- M. Detector Check Valves
 - 1. Detector Check Valves:
 - a. Description (with water meter): Galvanized cast-iron body, bolted cover with air-bleed device for access to internal parts, and flanged ends. Include one-piece bronze disc with bronze bushings, pivot, and replaceable seat. Include threaded bypass taps in inlet and outlet for bypass meter connection. Set valve to allow minimal water flow through bypass meter when major water flow is required.
 - 1) Standards: UL 312 and FMG approved.
 - 2) Pressure Rating: 175 psig (1207 kPa).
 - 3) Water Meter: AWWA C700, disc type, at least one-fourth size of detector check valve. Include meter, bypass piping, gate valves, check valve, and connections to detector check valve.
 - b. Description (without water meter): Iron body, corrosion-resistant clapper ring and seat ring material, flanged ends, with connections for bypass and installation of water meter.
 - 1) Standards: UL 312 and FMG approved.
 - 2) Pressure Rating: 175 psig (1207 kPa).
- N. Butterfly Valves
 - 1. AWWA Butterfly Valves:

- a. Description: Rubber seated.
 - 1) Standard: AWWA C504.
 - 2) Body: Cast or ductile iron.
 - 3) Body Type: Wafer **OR** Flanged, **as directed**.
 - 4) Pressure Rating: **150 psig** (1035 kPa).
 2. UL Butterfly Valves:
 - a. Description: Metal on resilient material seating.
 - 1) Standards: UL 1091 and FMG approved.
 - 2) Body: Cast or ductile iron.
 - 3) Body Type: Wafer **OR** Flanged, **as directed**.
 - 4) Pressure Rating: **175 psig** (1207 kPa).
- O. Plug Valves
 1. Plug Valves:
 - a. Description: Resilient-seated eccentric.
 - 1) Standard: MSS SP-108.
 - 2) Body: Cast iron.
 - 3) Pressure Rating: **175-psig** (1207-kPa) minimum CWP.
 - 4) Seat Material: Suitable for potable-water service.
- P. Corporation Valves And Curb Valves
 1. Service-Saddle Assemblies: Comply with AWWA C800. Include saddle and valve compatible with tapping machine.
 - a. Service Saddle: Copper alloy with seal and AWWA C800, threaded outlet for corporation valve.
 - b. Corporation Valve: Bronze body and ground-key plug, with AWWA C800, threaded inlet and outlet matching service piping material.
 - c. Manifold (if utility company requires multiple connections): Copper fitting with two to four inlets as required, with ends matching corporation valves and outlet matching service piping material.
 2. Curb Valves: Comply with AWWA C800. Include bronze body, ground-key plug or ball, and wide tee head, with inlet and outlet matching service piping material.
 3. Service Boxes for Curb Valves: Similar to AWWA M44 requirements for cast-iron valve boxes. Include cast-iron telescoping top section of length required for depth of burial of valve, plug with lettering "WATER," and bottom section with base that fits over curb valve and with a barrel approximately **3 inches** (75 mm) in diameter.
 - a. Shutoff Rods: Steel, tee-handle with one pointed end, stem of length to operate deepest buried valve, and slotted end matching curb valve.
- Q. Water Meters
 1. Water meters will be furnished by utility company.

NOTE: If water meters are specified in this Section, delete paragraph above and retain and edit paragraphs and subparagraphs below.

 2. Displacement-Type Water Meters:
 - a. Description: With bronze main case.
 - 1) Standard: AWWA C700.
 - 2) Registration: Flow in **gallons** (liters) **OR** **cubic feet** (cubic meters), **as directed**.
 3. Turbine-Type Water Meters:
 - a. Description:
 - 1) Standard: AWWA C701.
 - 2) Registration: Flow in **gallons** (liters) **OR** **cubic feet** (cubic meters), **as directed**.
 4. Compound-Type Water Meters:
 - a. Description:
 - 1) Standard: AWWA C702.
 - 2) Registration: Flow in **gallons** (liters) **OR** **cubic feet** (cubic meters), **as directed**.

5. Remote Registration System:
 - a. Description: Utility company standard; direct-reading type. Include meter modified with signal-transmitting assembly, low-voltage connecting wiring, and remote register assembly.
 - 1) Standard: AWWA C706.
 - 2) Registration: Flow in **gallons (liters) OR cubic feet (cubic meters), as directed.**
 6. Remote Registration System:
 - a. Description: Utility company standard; encoder type. Include meter modified with signal-transmitting assembly, low-voltage connecting wiring, and remote register assembly.
 - 1) Standard: AWWA C707.
 - 2) Registration: Flow in **gallons (liters) OR cubic feet (cubic meters), as directed.**
 - 3) Data-Acquisition Units: Comply with utility company requirements for type and quantity.
OR
Visible Display Units: Comply with utility company requirements for type and quantity.
- R. Detector-Type Water Meters
1. Detector-Type Water Meters
 2. Description: Main line, proportional meter with second meter on bypass. Register flow in **gallons (liters) OR cubic feet (cubic meters), as directed.**
 - a. Standards: AWWA C703, UL listed, and FMG approved.
 - b. Pressure Rating: **150 psig (1035 kPa).**
 - c. Bypass Meter: AWWA C701, turbine **OR** AWWA C702, compound, **as directed**, -type, bronze case.
 - 1) Size: At least one-half nominal size of main-line meter.
 3. Description: Main-line turbine meter with strainer and second meter on bypass. Register flow in **gallons (liters) OR cubic feet (cubic meters), as directed.**
 - a. Standards: AWWA C703, UL listed, and FMG approved.
 - b. Pressure Rating: **175 psig (1207 kPa).**
 - c. Bypass Meter: AWWA C701, turbine-type, bronze case.
 - 1) Size: At least **NPS 2 (DN 50).**
 4. Remote Registration System:
 - a. Description: Utility company standard; direct-reading type. Include meter modified with signal-transmitting assembly, low-voltage connecting wiring, and remote register assembly.
 - 1) Standard: AWWA C706.
 - 2) Registration: Flow in **gallons (liters) OR cubic feet (cubic meters), as directed.**
 5. Remote Registration System:
 - a. Description: Utility company standard; encoder type. Include meter modified with signal-transmitting assembly, low-voltage connecting wiring, and remote register assembly.
 - 1) Standard: AWWA C707.
 - 2) Registration: Flow in **gallons (liters) OR cubic feet (cubic meters), as directed.**
 - 3) Data-Acquisition Units: Comply with utility company requirements for type and quantity.
OR
Visible Display Units: Comply with utility company requirements for type and quantity.
- S. Pressure-Reducing Valves
1. Water Regulators:
 - a. Standard: ASSE 1003.
 - b. Pressure Rating: Initial pressure of **150 psig (1035 kPa).**
 - c. Size: As directed by the manufacturer or as directed by the Owner.
 - d. Design Flow Rate: As directed by the manufacturer or as directed by the Owner.
 - e. Design Inlet Pressure: As directed by the manufacturer or as directed by the Owner.
 - f. Design Outlet Pressure Setting: As directed by the manufacturer or as directed by the Owner.

- g. Body: Bronze with chrome-plated finish, **as directed**, for **NPS 2 (DN 50)** and smaller; cast iron with interior lining complying with AWWA C550 or that is FDA approved, **as directed**, for **NPS 2-1/2 and NPS 3 (DN 65 and DN 80)**.
- h. Valves for Booster Heater Water Supply: Include integral bypass.
- i. End Connections: Threaded for **NPS 2 (DN 50)** and smaller; flanged for **NPS 2-1/2 and NPS 3 (DN 65 and DN 80)**.
- 2. Water Control Valves:
 - a. Description: Pilot-operation, diaphragm-type, single-seated main water control valve with AWWA C550 or FDA-approved, interior epoxy coating. Include small pilot control valve, restrictor device, specialty fittings, and sensor piping.
 - 1) Pressure Rating: Initial pressure of **150 psig (1035 kPa)** minimum.
 - 2) Main Valve Body: Cast- or ductile-iron body with AWWA C550 or FDA-approved, interior epoxy coating; or stainless-steel body.
 - a) Size: As directed by the manufacturer or as directed by the Owner.
 - b) Pattern: Angle **OR** Globe, **as directed**, -valve design.
 - c) Trim: Stainless steel.
 - 3) Design Flow Rate: As directed by the manufacturer or as directed by the Owner.
 - 4) Design Inlet Pressure: As directed by the manufacturer or as directed by the Owner.
 - 5) Design Outlet Pressure Setting: As directed by the manufacturer or as directed by the Owner.
 - 6) End Connections: Threaded for **NPS 2 (DN 50)** and smaller; flanged, **as directed**, for **NPS 2-1/2 (DN 65)** and larger.
- T. Relief Valves
 - 1. Air-Release Valves:
 - a. Description: Hydromechanical device to automatically release accumulated air.
 - 1) Standard: AWWA C512.
 - 2) Pressure Rating: **300 psig (2070 kPa)**, **as directed**.
 - 3) Body Material: Cast iron, **as directed**.
 - 4) Trim Material: Stainless steel, brass, or bronze, **as directed**.
 - 5) Water Inlet Size: As directed by the manufacturer or as directed by the Owner.
 - 6) Air Outlet Size: As directed by the manufacturer or as directed by the Owner.
 - 7) Orifice Size: As directed by the manufacturer or as directed by the Owner.
 - 8) Design Air-Release Capacity: As directed by the manufacturer or as directed by the Owner.
 - 2. Air/Vacuum Valves:
 - a. Description: Direct-acting, float-operated, hydromechanical device with large orifice to automatically release accumulated air or to admit air during filling of piping.
 - 1) Standard: AWWA C512.
 - 2) Pressure Rating: **300 psig (2070 kPa)**, **as directed**.
 - 3) Body Material: Cast iron, **as directed**.
 - 4) Trim Material: Stainless steel, brass, or bronze, **as directed**.
 - 5) Inlet and Outlet Size: As directed by the manufacturer or as directed by the Owner.
 - 6) Orifice Size: As directed by the manufacturer or as directed by the Owner.
 - 7) Design Air Capacity: As directed by the manufacturer or as directed by the Owner.
 - 3. Combination Air Valves:
 - a. Description: Float-operated, hydromechanical device to automatically release accumulated air or to admit air.
 - 1) Standard: AWWA C512.
 - 2) Pressure Rating: **300 psig (2070 kPa)**, **as directed**.
 - 3) Body Material: Cast iron, **as directed**.
 - 4) Trim Material: Stainless steel, brass, or bronze, **as directed**.
 - 5) Inlet and Outlet Size: As directed by the manufacturer or as directed by the Owner.
 - 6) Orifice Size: As directed by the manufacturer or as directed by the Owner.
 - 7) Design Air Capacity: As directed by the manufacturer or as directed by the Owner.

U. Vacuum Breakers

1. Pressure Vacuum Breaker Assembly:

- a. Standard: ASSE 1020.
- b. Operation: Continuous-pressure applications.
- c. Pressure Loss: **5 psig (35 kPa), as directed**, maximum, through middle 1/3 of flow range.
- d. Size: As directed by the manufacturer or as directed by the Owner.
- e. Design Flow Rate: As directed by the manufacturer or as directed by the Owner.
- f. Selected Unit Flow Range Limits: As directed by the manufacturer or as directed by the Owner.
- g. Pressure Loss at Design Flow Rate: As directed by the manufacturer or as directed by the Owner.
- h. Accessories: Ball valves on inlet and outlet.

V. Backflow Preventers

1. Reduced-Pressure-Principle Backflow Preventers:

- a. Standard: ASSE 1013 **OR** AWWA C511, **as directed**.
- b. Operation: Continuous-pressure applications.
- c. Pressure Loss: **12 psig (83 kPa), as directed**, maximum, through middle 1/3 of flow range.
- d. Size: As directed by the manufacturer or as directed by the Owner.
- e. Design Flow Rate: As directed by the manufacturer or as directed by the Owner.
- f. Selected Unit Flow Range Limits: As directed by the manufacturer or as directed by the Owner.
- g. Pressure Loss at Design Flow Rate: As directed by the manufacturer or as directed by the Owner for **NPS 2 (DN 50)** and smaller; As directed by the manufacturer or as directed by the Owner for **NPS 2-1/2 (DN 65)** and larger.
- h. Body: Bronze for **NPS 2 (DN 50)** and smaller; cast iron with interior lining complying with AWWA C550 or that is FDA approved **OR** steel with interior lining complying with AWWA C550 or that is FDA approved **OR** stainless steel, **as directed**, for **NPS 2-1/2 (DN 65)** and larger.
- i. End Connections: Threaded for **NPS 2 (DN 50)** and smaller; flanged, **as directed**, for **NPS 2-1/2 (DN 65)** and larger.
- j. Configuration: Designed for horizontal, straight through **OR** vertical inlet, horizontal center section, and vertical outlet **OR** vertical, **as directed**, flow.
- k. Accessories:
 - 1) Valves: Ball type with threaded ends on inlet and outlet of **NPS 2 (DN 50)** and smaller; OS&Y gate type with flanged ends on inlet and outlet of **NPS 2-1/2 (DN 65)** and larger.
 - 2) Air-Gap Fitting: ASME A112.1.2, matching backflow preventer connection.

2. Double-Check, Backflow-Prevention Assemblies:

- a. Standard: ASSE 1015 **OR** AWWA C510, **as directed**.
- b. Operation: Continuous-pressure applications, unless otherwise indicated.
- c. Pressure Loss: **5 psig (35 kPa), as directed**, maximum, through middle 1/3 of flow range.
- d. Size: As directed by the manufacturer or as directed by the Owner.
- e. Design Flow Rate: As directed by the manufacturer or as directed by the Owner.
- f. Selected Unit Flow Range Limits: As directed by the manufacturer or as directed by the Owner.
- g. Pressure Loss at Design Flow Rate: As directed by the manufacturer or as directed by the Owner for **NPS 2 (DN 50)** and smaller; As directed by the manufacturer or as directed by the Owner for **NPS 2-1/2 (DN 65)** and larger.
- h. Body: Bronze for **NPS 2 (DN 50)** and smaller; cast iron with interior lining complying with AWWA C550 or that is FDA approved **OR** steel with interior lining complying with AWWA C550 or that is FDA approved **OR** stainless steel, **as directed**, for **NPS 2-1/2 (DN 65)** and larger.
- i. End Connections: Threaded for **NPS 2 (DN 50)** and smaller; flanged, **as directed**, for **NPS 2-1/2 (DN 65)** and larger.

- j. Configuration: Designed for horizontal, straight through, **as directed**, flow.
- k. Accessories: Ball valves with threaded ends on inlet and outlet of **NPS 2 (DN 50)** and smaller; OS&Y gate valves with flanged ends on inlet and outlet of **NPS 2-1/2 (DN 65)** and larger.
- 3. Reduced-Pressure-Detector, Fire-Protection Backflow Preventer Assemblies:
 - a. Standards: ASSE 1047 and UL listed or FMG approved.
 - b. Operation: Continuous-pressure applications.
 - c. Pressure Loss: **12 psig (83 kPa)**, **as directed**, maximum, through middle 1/3 of flow range.
 - d. Size: As directed by the manufacturer or as directed by the Owner. Design Flow Rate: As directed by the manufacturer or as directed by the Owner.
 - e. Selected Unit Flow Range Limits: As directed by the manufacturer or as directed by the Owner.
 - f. Pressure Loss at Design Flow Rate: As directed by the manufacturer or as directed by the Owner.
 - g. Body: Cast iron with interior lining complying with AWWA C550 or that is FDA approved **OR** Steel with interior lining complying with AWWA C550 or that is FDA approved **OR** Stainless steel, **as directed**.
 - h. End Connections: Flanged.
 - i. Configuration: Designed for horizontal, straight through **OR** vertical inlet, horizontal center section, and vertical outlet **OR** vertical, **as directed**, flow.
 - j. Accessories:
 - 1) Valves: UL 262, FMG-approved, OS&Y gate type with flanged ends on inlet and outlet.
 - 2) Air-Gap Fitting: ASME A112.1.2, matching backflow preventer connection.
 - 3) Bypass: With displacement-type water meter, shutoff valves, and reduced-pressure backflow preventer.
- 4. Double-Check, Detector-Assembly Backflow Preventers:
 - a. Standards: ASSE 1048 and UL listed or FMG approved.
 - b. Operation: Continuous-pressure applications.
 - c. Pressure Loss: **5 psig (35 kPa)**, **as directed**, maximum, through middle 1/3 of flow range.
 - d. Size: As directed by the manufacturer or as directed by the Owner.
 - e. Design Flow Rate: As directed by the manufacturer or as directed by the Owner.
 - f. Selected Unit Flow Range Limits: As directed by the manufacturer or as directed by the Owner.
 - g. Pressure Loss at Design Flow Rate: As directed by the manufacturer or as directed by the Owner.
 - h. Body: Cast iron with interior lining complying with AWWA C550 or that is FDA approved **OR** Steel with interior lining complying with AWWA C550 or that is FDA approved **OR** Stainless steel, **as directed**.
 - i. End Connections: Flanged.
 - j. Configuration: Designed for horizontal, straight through **OR** vertical inlet, horizontal center section, and vertical outlet **OR** vertical, **as directed**, flow.
 - k. Accessories:
 - 1) Valves: UL 262, FMG-approved, OS&Y gate type with flanged ends on inlet and outlet.
 - 2) Bypass: With displacement-type water meter, shutoff valves, and reduced-pressure backflow preventer.
- 5. Backflow Preventer Test Kits:
 - a. Description: Factory calibrated, with gages, fittings, hoses, and carrying case with test-procedure instructions.

W. Water Meter Boxes

- 1. Description: Cast-iron body and cover for disc-type water meter, with lettering "WATER METER" in cover; and with slotted, open-bottom base section of length to fit over service piping.

- a. Option: Base section may be cast-iron, PVC, clay, or other pipe.
 2. Description: Cast-iron body and double cover for disc-type water meter, with lettering "WATER METER" in top cover; and with separate inner cover; air space between covers; and slotted, open-bottom base section of length to fit over service piping.
 3. Description: Polymer-concrete body and cover for disc-type water meter, with lettering "WATER" in cover; and with slotted, open-bottom base section of length to fit over service piping. Include vertical and lateral design loadings of **15,000 lb minimum over 10 by 10 inches (6800 kg minimum over 254 by 254 mm)** square.
 - a. Use of this meter box is permitted in walks or unpaved areas away from traffic; do not use in roadways.
- X. Concrete Vaults
 1. Description: Precast, reinforced-concrete vault, designed for A-16 load designation according to ASTM C 857 and made according to ASTM C 858.
 - a. Ladder: ASTM A 36/A 36M, steel or polyethylene-encased steel steps.
 - b. Manhole: ASTM A 48/A 48M Class No. 35A minimum tensile strength, gray-iron traffic frame and cover.
 - 1) Dimension: **24-inch (610-mm)** minimum diameter, unless otherwise indicated.
 - c. Manhole: ASTM A 536, Grade 60-40-18, ductile-iron traffic frame and cover.
 - 1) Dimension: **24-inch- (610-mm-)** minimum diameter, unless otherwise indicated.
 - d. Drain: ASME A112.6.3, cast-iron floor drain with outlet of size indicated. Include body anchor flange, light-duty cast-iron grate, bottom outlet, and integral or field-installed bronze ball or clapper-type backwater valve.
- Y. Protective Enclosures
 1. Freeze-Protection Enclosures:
 - a. Description: Insulated enclosure designed to protect aboveground water piping, equipment, or specialties from freezing and damage, with heat source to maintain minimum internal temperature of **40 deg F (4 deg C)** when external temperatures reach as low as **minus 34 deg F (minus 36 deg C)**.
 - 1) Standard: ASSE 1060.
 - 2) Class I: For equipment or devices other than pressure or atmospheric vacuum breakers.
 - 3) Class I-V: For pressure or atmospheric vacuum breaker equipment or devices. Include drain opening in housing.
 - a) Housing: Reinforced-aluminum **OR** -fiberglass, **as directed**, construction.
 - i. Size: Of dimensions indicated, but not less than those required for access and service of protected unit.
 - ii. Drain opening for units with drain connection.
 - iii. Access doors with locking devices.
 - iv. Insulation inside housing.
 - v. Anchoring devices for attaching housing to concrete base.
 - b) Electric heating cable or heater with self-limiting temperature control.
 2. Weather-Resistant Enclosures:
 - a. Description: Uninsulated enclosure designed to protect aboveground water piping, equipment, or specialties from weather and damage.
 - 1) Standard: ASSE 1060.
 - 2) Class III: For equipment or devices other than pressure or atmospheric vacuum breakers.
 - 3) Class III-V: For pressure or atmospheric vacuum breaker equipment or devices. Include drain opening in housing.
 - i. Housing: Reinforced-aluminum **OR** -fiberglass, **as directed**, construction.
 - ii. Size: Of dimensions indicated, but not less than those required for access and service of protected unit.
 - iii. Drain opening for units with drain connection.

- iv. Access doors with locking devices.
 - v. Anchoring devices for attaching housing to concrete base.
 - 3. Expanded-Metal Enclosures:
 - a. Description: Enclosure designed to protect aboveground water piping, equipment, or specialties from damage.
 - 1) Material: ASTM F 1267, expanded metal side and top panels, of weight and with reinforcement of same metal at edges as required for rigidity.
 - 2) Type: Type I, expanded **OR** II, expanded and flattened, **as directed**.
 - 3) Class: Class 1, uncoated carbon steel **OR** 2, hot-dip, zinc-coated carbon steel **OR** 3, corrosion-resisting steel, **as directed**.
 - 4) Finish: Manufacturer's enamel paint.
 - 5) Size: Of dimensions indicated, but not less than those required for access and service of protected unit.
 - 6) Locking device.
 - 7) Lugs or devices for securing enclosure to base.
 - 4. Enclosure Bases:
 - a. Description: **4-inch- (100-mm-)** **OR** **6-inch- (150-mm-)**, **as directed**, minimum thickness precast concrete, of dimensions required to extend at least **6 inches (150 mm)** beyond edges of enclosure housings. Include openings for piping.
- Z. Fire Hydrants
- 1. Dry-Barrel Fire Hydrants:
 - a. Description (for AWWA dry-barrel fire hydrants): Freestanding, with one **NPS 4-1/2 (DN 115)** and two **NPS 2-1/2 (DN 65)** outlets, **5-1/4-inch (133-mm)** main valve, drain valve, and **NPS 6 (DN 150)** mechanical-joint inlet. Include interior coating according to AWWA C550. Hydrant shall have cast-iron body, compression-type valve opening against pressure and closing with pressure.
 - 1) Standard: AWWA C502.
 - 2) Pressure Rating: **150 psig (1035 kPa)** minimum **OR** **250 psig (1725 kPa)**, **as directed**.
 - 3) Outlet Threads: NFPA 1963, with external hose thread used by local fire department. Include cast-iron caps with steel chains.
 - 4) Operating and Cap Nuts: Pentagon, **1-1/2 inches (38 mm)** point to flat.
 - 5) Direction of Opening: Open hydrant valve by turning operating nut to left or counterclockwise.
 - 6) Exterior Finish: Red alkyd-gloss enamel paint, unless otherwise indicated.
 - b. Description (for UL/FMG, dry-barrel fire hydrants): Freestanding, with one **NPS 4-1/2 (DN 115)** and two **NPS 2-1/2 (DN 65)** outlets, **5-1/4-inch (133-mm)** main valve, drain valve, and **NPS 6 (DN 150)** mechanical-joint inlet. Hydrant shall have cast-iron body, compression-type valve opening against pressure and closing with pressure.
 - 1) Standards: UL 246, FMG approved.
 - 2) Pressure Rating: **150 psig (1035 kPa)** minimum **OR** **250 psig (1725 kPa)**, **as directed**.
 - 3) Outlet Threads: NFPA 1963, with external hose thread used by local fire department. Include cast-iron caps with steel chains.
 - 4) Operating and Cap Nuts: Pentagon, **1-1/2 inches (38 mm)** point to flat.
 - 5) Direction of Opening: Open hydrant valve by turning operating nut to left or counterclockwise.
 - 6) Exterior Finish: Red alkyd-gloss enamel paint, unless otherwise indicated.
 - 2. Wet-Barrel Fire Hydrants:
 - a. Description (for AWWA wet-barrel fire hydrants): Freestanding, with one **NPS 4-1/2 (DN 115)** and two **NPS 2-1/2 (DN 65)** outlets, **NPS 6 (DN 150)** threaded or flanged inlet, and base section with **NPS 6 (DN 150)** mechanical-joint inlet. Include interior coating according to AWWA C550.
 - 1) Standard: AWWA C503.

- 2) Pressure Rating: **150 psig (1035 kPa)** minimum.
- 3) Outlet Threads: NFPA 1963, with external hose thread used by local fire department. Include cast-iron caps with steel chains.
- 4) Operating and Cap Nuts: Pentagon, **1-1/2 inches (38 mm)** point to flat.
- 5) Direction of Opening: Open hydrant valves by turning operating nut to left or counterclockwise.
- 6) Exterior Finish: Red alkyd-gloss enamel paint, unless otherwise indicated.
- b. Description (for UL/FMG, wet-barrel fire hydrants): Freestanding, with one **NPS 4-1/2 (DN 115)** and two **NPS 2-1/2 (DN 65)** outlets, **NPS 6 (DN 150)** threaded or flanged inlet, and base section with **NPS 6 (DN 150)** mechanical-joint inlet.
 - 1) Standards: UL 246 and FMG approved.
 - 2) Pressure Rating: **150 psig (1035 kPa)** minimum.
 - 3) Outlet Threads: NFPA 1963, with external hose thread used by local fire department. Include cast-iron caps with steel chains.
 - 4) Operating and Cap Nuts: Pentagon, **1-1/2 inches (38 mm)** point to flat.
 - 5) Direction of Opening: Open hydrant valves by turning operating nut to left or counterclockwise.
 - 6) Exterior Finish: Red alkyd-gloss enamel paint, unless otherwise indicated.

AA. Flushing Hydrants

1. Post-Type Flushing Hydrants:
 - a. Description: Nonfreeze and drainable, of length required for shutoff valve installation below frost line.
 - 1) Pressure Rating: **150 psig (1035 kPa)** minimum.
 - 2) Outlet: One, with horizontal discharge.
 - 3) Hose Thread: **NPS 2-1/2 (DN 65)**, with NFPA 1963 external hose thread for use by local fire department, and with cast-iron cap with brass chain.
 - 4) Barrel: Cast-iron or steel pipe with breakaway feature.
 - 5) Valve: Bronze body with bronze-ball or plunger closure, and automatic draining.
 - 6) Security: Locking device for padlock.
 - 7) Exterior Finish: Red alkyd-gloss enamel paint, unless otherwise indicated.
 - 8) Inlet: **NPS 2 (DN 50)** minimum.
 - 9) Operating Wrench: One for each unit.
2. Ground-Type Flushing Hydrants:
 - a. Description: Nonfreeze and drainable, of length required for shutoff valve installation below frost line.
 - 1) Pressure Rating: **150 psig (1035 kPa)** minimum.
 - 2) Outlet: One, with vertical **OR** angle, **as directed**, discharge.
 - 3) Hose Thread: **NPS 2-1/2 (DN 65)**, with NFPA 1963 external hose thread for use by local fire department, and with cast-iron cap with brass chain.
 - 4) Barrel: Cast-iron or steel pipe.
 - 5) Valve: Bronze body with bronze-ball or plunger closure, and automatic draining.
 - 6) Inlet: **NPS 2 (DN 50)** minimum.
 - 7) Hydrant Box: Cast iron with cover, for ground mounting.
 - 8) Operating Wrench: One for each unit.
3. Post-Type Sampling Station:
 - a. Description: Nonfreeze and drainable, of length required for shutoff valve installation below frost line.
 - 1) Pressure Rating: **100 psig (690 kPa)** minimum.
 - 2) Sampling Outlet: One unthreaded nozzle with handle.
 - 3) Valve: Bronze body with bronze-ball or plunger closure. Include operating handle.
 - 4) Drain: Tubing with separate manual vacuum pump.
 - 5) Inlet: **NPS 3/4 (DN 20)** minimum.
 - 6) Housing: Weatherproof material with locking device. Include anchor device.
 - 7) Operating Wrench: One for each unit.

BB. Fire Department Connections

1. Fire Department Connections:

- a. Description: Freestanding, with cast-bronze body, thread inlets according to NFPA 1963 and matching local fire department hose threads, and threaded bottom outlet. Include lugged caps, gaskets, and chains; lugged swivel connection and drop clapper for each hose-connection inlet; **18-inch- (460-mm-)** high brass sleeve; and round escutcheon plate.
 - 1) Standard: UL 405.
 - 2) Connections: Two **NPS 2-1/2 (DN 65)** inlets and one **NPS 4 (DN 100) OR NPS 6 (DN 150), as directed**, outlet.
 - 3) Connections: Three **OR** Four, **as directed**, **NPS 2-1/2 (DN 65)** inlets and one **NPS 6 (DN 150)** outlet.
 - 4) Connections: Six **NPS 2-1/2 (DN 65)** inlets and one **NPS 6 (DN 150) OR NPS 8 (DN 200), as directed**, outlet.
 - 5) Inlet Alignment: Inline, horizontal **OR** Square, **as directed**.
 - 6) Finish Including Sleeve: Polished chrome-plated **OR** Rough chrome-plated **OR** Polished bronze, **as directed**.
 - 7) Escutcheon Plate Marking: "AUTO SPKR" **OR** "STANDPIPE" **OR** "AUTO SPKR & STANDPIPE."

CC. Alarm Devices

1. Alarm Devices, General: UL 753 and FMG approved, of types and sizes to mate and match piping and equipment.
2. Water-Flow Indicators (can be used with wet-barrel fire hydrants): Vane-type water-flow detector, rated for **250-psig (1725-kPa)** working pressure; designed for horizontal or vertical installation; with 2 single-pole, double-throw circuit switches to provide isolated alarm and auxiliary contacts, 7 A, 125-V ac and 0.25 A, 24-V dc; complete with factory-set, field-adjustable retard element to prevent false signals and tamperproof cover that sends signal when cover is removed.
3. Supervisory Switches: Single pole, double throw; designed to signal valve in other than fully open position. Mount on stem of OS&Y gate valves and on indicator posts.
4. Pressure Switches: Single pole, double throw; designed to signal increase in pressure. Mount on barrel of dry-barrel fire hydrants.

1.3 EXECUTION

A. Earthwork

1. Refer to Division 31 Section "Earth Moving" for excavating, trenching, and backfilling.

B. Piping Applications

1. General: Use pipe, fittings, and joining methods for piping systems according to the following applications.
2. Transition couplings and special fittings with pressure ratings at least equal to piping pressure rating may be used, unless otherwise indicated.
3. Do not use flanges or unions for underground piping.
4. Flanges, unions, grooved-end-pipe couplings, and special fittings may be used, instead of joints indicated, on aboveground piping and piping in vaults.
5. Underground water-service piping **NPS 3/4 to NPS 3 (DN 20 to DN 80), as directed**, shall be selected from the following, **as directed**:
 - a. Soft copper tube, **ASTM B 88, Type K (ASTM B 88M, Type A) OR ASTM B 88, Type L (ASTM B 88M, Type B), as directed**; wrought-copper, solder-joint fittings; and brazed **OR** copper, pressure-seal fittings; and pressure-sealed, **as directed**, joints.
 - b. PE, ASTM pipe; insert fittings for PE pipe; and clamped **OR** molded PE fittings; and heat-fusion, **as directed**, joints.
 - c. PVC, Schedule 40 pipe; PVC, Schedule 40 **OR** Schedule 80 pipe; PVC, Schedule 80, **as directed**, socket fittings; and solvent-cemented joints.

- d. **NPS 1 to NPS 3 (DN 25 to DN 80)** fiberglass, AWWA RTRP, Class 150 **OR** 200 **OR** 250, **as directed**; RTRF; and bonded joints.
- e. Fiberglass, AWWA RTRP, Class 150 **OR** 200 **OR** 250, **as directed**; RTRF; and bonded joints.
6. Underground water-service piping **NPS 4 to NPS 8 (DN 100 to DN 200)**, **as directed**, shall be selected from the following, **as directed**:
 - a. Soft copper tube, **ASTM B 88, Type K (ASTM B 88M, Type A) OR ASTM B 88, Type L (ASTM B 88M, Type B)**, **as directed**; wrought-copper, solder-joint fittings; and brazed joints.
 - b. Ductile-iron, push-on-joint pipe; ductile-iron, push-on-joint fittings; and gasketed **OR** mechanical-joint pipe; ductile-iron, mechanical-joint fittings; and mechanical **OR** grooved-end pipe; ductile-iron-pipe appurtenances; and grooved, **as directed**, joints.
 - c. PE, AWWA pipe; PE, AWWA fittings; and heat-fusion joints.
 - d. PVC, Schedule 40 pipe; PVC, Schedule 40 **OR** Schedule 80 pipe; PVC, Schedule 80, **as directed**, socket fittings; and solvent-cemented joints.
 - e. **NPS 4 and NPS 6 (DN 100 and DN 150): NPS 6 (DN 150)** PVC, AWWA Class 150 pipe; PVC, AWWA Class 150 fabricated **OR** molded, **as directed**, fittings; and gasketed joints.
 - f. **NPS 8 (DN 200):** PVC, AWWA Class 200 pipe; PVC, AWWA Class 200 fabricated **OR** push-on-joint, ductile-iron **OR** mechanical-joint, ductile-iron, **as directed**, fittings; and gasketed joints.
 - g. Fiberglass, AWWA RTRP, Class 150 **OR** 200 **OR** 250, **as directed**; RTRF; and bonded joints.
7. Water Meter Box Water-Service Piping **NPS 3/4 to NPS 2 (DN 20 to DN 50)**, **as directed**, shall be same as underground water-service piping.
8. Aboveground and Vault, **as directed**, Water-Service Piping **NPS 3/4 to NPS 3 (DN 20 to DN 80)**, **as directed**, shall be selected from the following:

NOTE: Water-service piping materials listed in subparagraphs below are for potable-water service. They may not be suitable for fire-service mains.

- a. Hard copper tube, **ASTM B 88, Type K (ASTM B 88M, Type A) OR ASTM B 88, Type L (ASTM B 88M, Type B)**, **as directed**; wrought-copper, solder-joint fittings; and brazed **OR** copper, pressure-seal fittings; and pressure-sealed, **as directed**, joints.
- b. PVC, Schedule 80 pipe; PVC, Schedule 80 socket fittings; and solvent-cemented **OR** threaded fittings; and threaded, **as directed**, joints.
- c. **NPS 1 to NPS 2 (DN 25 to DN 50)** fiberglass, AWWA RTRP, Class 150 **OR** 200 **OR** 250, **as directed**; RTRF; and bonded joints.
9. Aboveground and vault, **as directed**, water-service piping **NPS 4 to NPS 8 (DN 100 to DN 200)**, **as directed**, shall be selected from the following:
 - a. Hard copper tube, **ASTM B 88, Type K (ASTM B 88M, Type A) OR ASTM B 88, Type L (ASTM B 88M, Type B)**, **as directed**; wrought-copper, solder-joint fittings; and brazed joints.
 - b. Ductile-iron, grooved-end pipe; ductile-iron, grooved-end appurtenances; and grooved joints.
 - c. PVC, Schedule 80 pipe; PVC, Schedule 80 socket fittings; and solvent-cemented **OR** threaded fittings; and threaded, **as directed**, joints.
 - d. Fiberglass, AWWA RTRP, Class 150 **OR** 200 **OR** 250, **as directed**; RTRF; and bonded joints.
10. Underground Fire-Service-Main Piping **NPS 4 to NPS 12 (DN 100 to DN 300)**, **as directed**, shall be selected from the following:

NOTE: Fire-service-main piping materials listed in subparagraphs below are for fire-protection water service. They may not be suitable for potable-water service.

- a. Ductile-iron, push-on-joint pipe; ductile-iron, push-on-joint fittings; and gasketed **OR** mechanical-joint pipe; ductile-iron, mechanical-joint fittings; and mechanical **OR** grooved-end pipe; ductile-iron-pipe appurtenances; and grooved, **as directed**, joints.
- b. PE, Class 150 **OR** 200, **as directed**, fire-service pipe; molded PE fittings; and heat-fusion joints.

- c. PVC, AWWA Class 150 pipe listed for fire-protection service; PVC Class 150 fabricated or molded fittings; and gasketed joints.
- d. PVC, AWWA Class 200 pipe listed for fire-protection service; PVC Class 200 fabricated fittings; and gasketed joints.
- e. Fiberglass, AWWA, FMG-approved RTRP, Class 150 **OR** 200, **as directed**; RTRF; and gasketed joints.
- f. Fiberglass, UL RTRP, Class 150 **OR** 200 **OR** 250, **as directed**; RTRF; and gasketed joints.
- 11. Aboveground and Vault, **as directed**, Fire-Service-Main Piping **NPS 4 to NPS 12 (DN 100 to DN 300)**, **as directed**, shall be ductile-iron, grooved-end pipe; ductile-iron-pipe appurtenances; and grooved joints.
- 12. Underground Combined Water-Service and Fire-Service-Main Piping **NPS 6 to NPS 12 (DN 150 to DN 300)**, **as directed**, shall be selected from the following:
 - a. Ductile-iron, push-on-joint pipe; ductile-iron, push-on-joint fittings; and gasketed **OR** mechanical-joint pipe; ductile-iron, mechanical-joint fittings; and mechanical **OR** grooved-end pipe; ductile-iron-pipe appurtenances; and grooved, **as directed**, joints.
 - b. PVC, AWWA Class 150 **OR** 200, **as directed**, pipe listed for fire-protection service; PVC fabricated or molded fittings of same class as pipe; and gasketed joints.
 - c. Fiberglass, AWWA, FMG-approved RTRP, Class 150 **OR** 200, **as directed**; RTRF; and gasketed joints.
- 13. Aboveground and Vault, **as directed**, Combined Water Service and Fire-Service-Main Piping **NPS 6 to NPS 12 (DN 150 to DN 300)**, **as directed**, shall be ductile-iron, grooved-end pipe; ductile-iron-pipe appurtenances; and grooved joints.

C. Valve Applications

- 1. General Application: Use mechanical-joint-end valves for **NPS 3 (DN 80)** and larger underground installation. Use threaded- or flanged-end valves for installation in vaults. Use UL/FMG, nonrising-stem gate valves for installation with indicator posts. Use corporation valves and curb valves with ends compatible with piping, for **NPS 2 (DN 50)** and smaller installation.
- 2. Drawings indicate valve types to be used. Where specific valve types are not indicated, the following requirements apply:
 - a. Underground Valves, **NPS 3 (DN 80)** and Larger: AWWA, cast-iron, nonrising-stem, metal **OR** resilient **OR** high-pressure, resilient, **as directed**, seated gate valves with valve box.
 - b. Underground Valves, **NPS 4 (DN 100)** and Larger, for Indicator Posts: UL/FMG, cast-iron, nonrising-stem gate valves with indicator post.
 - c. Use the following for valves in vaults and aboveground:
 - 1) Gate Valves, **NPS 2 (DN 50)** and Smaller: Bronze, nonrising **OR** rising, **as directed**, stem.
 - 2) Gate Valves, **NPS 3 (DN 80)** and Larger: AWWA, cast iron, OS&Y rising stem, metal seated **OR** AWWA, cast iron, OS&Y rising stem, resilient seated **OR** UL/FMG, cast iron, OS&Y rising stem, **as directed**.
 - 3) Check Valves: AWWA C508 **OR** UL/FMG, **as directed**, swing type.
 - d. Pressure-Reducing Valves: Use for water-service piping in vaults and aboveground to control water pressure.
 - e. Relief Valves: Use for water-service piping in vaults and aboveground.
 - 1) Air-Release Valves: To release accumulated air.
 - 2) Air/Vacuum Valves: To release or admit large volume of air during filling of piping.
 - 3) Combination Air Valves: To release or admit air.
 - f. Detector Check Valves: Use for water-service piping in vaults and aboveground to detect unauthorized use of water.

D. Piping Systems - Common Requirements

- 1. See Division 22 Section "Common Work Results For Plumbing" for piping-system common requirements.

E. Piping Installation

1. Water-Main Connection (if tap is made by utility company): Arrange with utility company for tap of size and in location indicated in water main.
2. Water-Main Connection (if tap is made by Contractor): Tap water main according to requirements of water utility company and of size and in location indicated.
3. Make connections larger than **NPS 2 (DN 50)** with tapping machine according to the following:
 - a. Install tapping sleeve and tapping valve according to MSS SP-60.
 - b. Install tapping sleeve on pipe to be tapped. Position flanged outlet for gate valve.
 - c. Use tapping machine compatible with valve and tapping sleeve; cut hole in main. Remove tapping machine and connect water-service piping.
 - d. Install gate valve onto tapping sleeve. Comply with MSS SP-60. Install valve with stem pointing up and with valve box.
4. Make connections **NPS 2 (DN 50)** and smaller with drilling machine according to the following:
 - a. Install service-saddle assemblies and corporation valves in size, quantity, and arrangement required by utility company standards.
 - b. Install service-saddle assemblies on water-service pipe to be tapped. Position outlets for corporation valves.
 - c. Use drilling machine compatible with service-saddle assemblies and corporation valves. Drill hole in main. Remove drilling machine and connect water-service piping.
 - d. Install corporation valves into service-saddle assemblies.
 - e. Install manifold for multiple taps in water main.
 - f. Install curb valve in water-service piping with head pointing up and with service box.
5. Comply with NFPA 24 for fire-service-main piping materials and installation.
 - a. Install PE corrosion-protection encasement according to ASTM A 674 or AWWA C105.
 - b. Install copper tube and fittings according to CDA's "Copper Tube Handbook."
6. Install ductile-iron, water-service piping according to AWWA C600 and AWWA M41.
 - a. If required, install PE corrosion-protection encasement according to ASTM A 674 or AWWA C105.
7. Install PE pipe according to ASTM D 2774 and ASTM F 645.
8. Install PVC, AWWA pipe according to ASTM F 645 and AWWA M23.
9. Install fiberglass AWWA pipe according to AWWA M45.
10. Bury piping with depth of cover over top at least **30 inches (750 mm)**, **as directed**, with top at least **12 inches (300 mm)**, **as directed**, below level of maximum frost penetration, and according to the following:
 - a. Under Driveways: With at least **36 inches (910 mm)**, **as directed**, cover over top.
 - b. Under Railroad Tracks: With at least **48 inches (1220 mm)**, **as directed**, cover over top.
 - c. In Loose Gravelly Soil and Rock: With at least **12 inches (300 mm)**, **as directed**, additional cover.
11. Install piping by tunneling or jacking, or combination of both, under streets and other obstructions that cannot be disturbed.
12. Extend water-service piping and connect to water-supply source and building-water-piping systems at outside face of building wall in locations and pipe sizes indicated.
 - a. Terminate water-service piping at building wall until building-water-piping systems are installed. Terminate piping with caps, plugs, or flanges as required for piping material. Make connections to building-water-piping systems when those systems are installed.
13. Sleeves are specified in Division 22 Section "Common Work Results For Plumbing".
14. Mechanical sleeve seals are specified in Division 22 Section "Common Work Results For Plumbing".
15. For piping with gasketed joints: Install underground piping with restrained joints at horizontal and vertical changes in direction. Use restrained-joint piping, thrust blocks, anchors, tie-rods and clamps, and other supports.
16. See Division 21 Section "Common Work Results For Fire Suppression" for fire-suppression-water piping inside the building.
17. See Division 22 Section "Common Work Results For Plumbing" for potable-water piping inside the building.

F. Joint Construction

1. See Division 22 Section "Common Work Results For Plumbing" for basic piping joint construction.
2. Make pipe joints according to the following:
 - a. Copper-Tubing, Pressure-Sealed Joints: Use proprietary crimping tool and procedure recommended by copper, pressure-seal-fitting manufacturer.
 - b. Ductile-Iron Piping, Gasketed Joints for Water-Service Piping: AWWA C600 and AWWA M41.
 - c. Ductile-Iron Piping, Gasketed Joints for Fire-Service-Main Piping: UL 194.
 - d. Ductile-Iron Piping, Grooved Joints: Cut-groove pipe. Assemble joints with grooved-end, ductile-iron-piping couplings, gaskets, lubricant, and bolts according to coupling manufacturer's written instructions.
 - e. PE Piping Insert-Fitting Joints: Use plastic insert fittings and fasteners according to fitting manufacturer's written instructions.
 - f. PVC Piping Gasketed Joints: Use joining materials according to AWWA C900. Construct joints with elastomeric seals and lubricant according to ASTM D 2774 or ASTM D 3139 and pipe manufacturer's written instructions.
 - g. Fiberglass Piping Bonded Joints: Use adhesive and procedure recommended by piping manufacturer.
 - h. Dissimilar Materials Piping Joints: Use adapters compatible with both piping materials, with OD, and with system working pressure. Refer to Division 22 Section "Common Work Results For Plumbing" for joining piping of dissimilar metals.

G. Anchorage Installation

1. Anchorage, General: Install water-distribution piping with restrained joints. Anchorages and restrained-joint types that may be used include the following:
 - a. Concrete thrust blocks.
 - b. Locking mechanical joints.
 - c. Set-screw mechanical retainer glands.
 - d. Bolted flanged joints.
 - e. Heat-fused joints.
 - f. Pipe clamps and tie rods.
2. Install anchorages for tees, plugs and caps, bends, crosses, valves, and hydrant branches. Include anchorages for the following piping systems:
 - a. Gasketed-Joint, Ductile-Iron, Water-Service Piping: According to AWWA C600.
 - b. Gasketed-Joint, PVC Water-Service Piping: According to AWWA M23.
 - c. Bonded-Joint Fiberglass, Water-Service Piping: According to AWWA M45.
 - d. Fire-Service-Main Piping: According to NFPA 24.
3. Apply full coat of asphalt or other acceptable corrosion-resistant material to surfaces of installed ferrous anchorage devices.

H. Valve Installation

1. AWWA Gate Valves: Comply with AWWA C600 and AWWA M44. Install each underground valve with stem pointing up and with valve box.
2. AWWA Valves Other Than Gate Valves: Comply with AWWA C600 and AWWA M44.
3. UL/FMG, Gate Valves: Comply with NFPA 24. Install each underground valve and valves in vaults with stem pointing up and with vertical cast-iron indicator post.
4. UL/FMG, Valves Other Than Gate Valves: Comply with NFPA 24.
5. MSS Valves: Install as component of connected piping system.
6. Corporation Valves and Curb Valves: Install each underground curb valve with head pointed up and with service box.
7. Pressure-Reducing Valves: Install in vault or aboveground between shutoff valves. Install full-size valved bypass, **as directed**.
8. Relief Valves: Comply with AWWA C512. Install aboveground with shutoff valve on inlet.

I. Detector-Check Valve Installation

1. Install in vault or aboveground.
 2. Install for proper direction of flow. Install bypass with water meter, gate valves on each side of meter, and check valve downstream from meter.
 3. Support detector check valves, meters, shutoff valves, and piping on brick or concrete piers.
- J. Water Meter Installation
1. If water meters are provided by the Contractor: Install water meters, piping, and specialties according to utility company's written instructions.
 2. Water Meters: Install displacement **OR** turbine, **as directed**, -type water meters, **NPS 2 (DN 50)** and smaller, in meter boxes with shutoff valves on water meter inlets. Include valves on water meter outlets and valved bypass around meters unless prohibited by authorities having jurisdiction.
 3. Water Meters: Install compound **OR** turbine, **as directed**, -type water meters, **NPS 3 (DN 80)** and larger, in meter vaults. Include shutoff valves on water meter inlets and outlets and valved bypass around meters. Support meters, valves, and piping on brick or concrete piers.
 4. Water Meters: Install detector-type water meters in meter vault according to AWWA M6. Include shutoff valves on water meter inlets and outlets and full-size valved bypass around meters. Support meters, valves, and piping on brick or concrete piers.
- K. Roughing-In For Water Meters
1. If Contractor is to rough-in for water meters to be installed by utility company: Rough-in piping and specialties for water meter installation according to utility company's written instructions.
- L. Vacuum Breaker Assembly Installation
1. Install pressure vacuum breaker assemblies of type, size, and capacity indicated. Include valves and test cocks. Install according to requirements of plumbing and health department and authorities having jurisdiction.
 2. Do not install pressure vacuum breaker assemblies in vault or other space subject to flooding.
- M. Backflow Preventer Installation
1. Install backflow preventers of type, size, and capacity indicated. Include valves and test cocks. Install according to requirements of plumbing and health department and authorities having jurisdiction.
 2. Do not install backflow preventers that have relief drain in vault or in other spaces subject to flooding.
 3. Do not install bypass piping around backflow preventers.
 4. Support **NPS 2-1/2 (DN 65)** and larger backflow preventers, valves, and piping near floor and on brick or concrete piers.
- N. Water Meter Box Installation
1. Install water meter boxes in paved areas flush with surface.
 2. Install water meter boxes in grass or earth areas with top **2 inches (50 mm)**, **as directed**, above surface.
- O. Concrete Vault Installation
1. Install precast concrete vaults according to ASTM C 891.
- P. Protective Enclosure Installation
1. Install concrete base level and with top approximately **2 inches (50 mm)**, **as directed**, above grade.
 2. Install protective enclosure over valves and equipment.
 3. Anchor protective enclosure to concrete base.
- Q. Fire Hydrant Installation
1. General: Install each fire hydrant with separate gate valve in supply pipe, anchor with restrained joints or thrust blocks, and support in upright position.



2. Wet-Barrel Fire Hydrants: Install with valve below frost line. Provide for drainage.
3. AWWA Fire Hydrants: Comply with AWWA M17.
4. UL/FMG Fire Hydrants: Comply with NFPA 24.

R. Flushing Hydrant Installation

1. Install post-type flushing hydrants with valve below frost line and provide for drainage. Support in upright position. Include separate gate valve or curb valve and restrained joints in supply piping.
2. Install ground-type flushing hydrants with valve below frost line and provide for drainage. Install hydrant box flush with grade. Include separate gate valve or curb valve and restrained joints in supply piping.
3. Install sampling stations with valve below frost line and provide for drainage. Attach weather-resistant housing and support in upright position. Include separate curb valve in supply piping.

S. Fire Department Connection Installation

1. Install ball drip valves at each check valve for fire department connection to mains.
2. Install protective pipe bollards on two sides of **OR** on three sides of, **as directed**, each fire department connection. Pipe bollards are specified in Division 05 Section "Metal Fabrications".

T. Alarm Device Installation

1. General: Comply with NFPA 24 for devices and methods of valve supervision. Underground valves with valve box do not require supervision.
2. Supervisory Switches: Supervise valves in open position.
 - a. Valves: Grind away portion of exposed valve stem. Bolt switch, with plunger in stem depression, to OS&Y gate-valve yoke.
 - b. Indicator Posts: Drill and thread hole in upper-barrel section at target plate. Install switch, with toggle against target plate, on barrel of indicator post.
3. Locking and Sealing: Secure unsupervised valves as follows:
 - a. Valves: Install chain and padlock on open OS&Y gate valve.
 - b. Post Indicators: Install padlock on wrench on indicator post.
4. Pressure Switches: Drill and thread hole in exposed barrel of fire hydrant. Install switch.
5. Water-Flow Indicators: Install in water-service piping in vault. Select indicator with saddle and vane matching pipe size. Drill hole in pipe, insert vane, and bolt saddle to pipe.
6. Connect alarm devices to building fire alarm system. Wiring and fire-alarm devices are specified in Division 28.

U. Connections

1. Piping installation requirements are specified in other Division 22. Drawings indicate general arrangement of piping, fittings, and specialties.
2. See Division 22 Section "Common Work Results For Plumbing" for piping connections to valves and equipment.
3. Connect water-distribution piping to utility water main **OR** existing water main, **as directed**. Use tapping sleeve and tapping valve **OR** service clamp and corporation valve, **as directed**.
4. Connect water-distribution piping to interior domestic water **OR** fire-suppression, **as directed**, piping.
5. Connect waste piping from concrete vault drains to sanitary sewerage system. See Division 22 for connection to sanitary-sewer **OR** storm-drainage system. See Division 23 for connection to storm-sewer, **as directed**, piping.
6. Ground equipment according to Division 26 Section "Grounding And Bonding For Electrical Systems".
7. Connect wiring according to Division 26 Section "Low-voltage Electrical Power Conductors And Cables".

V. Field Quality Control

1. Piping Tests: Conduct piping tests before joints are covered and after concrete thrust blocks have hardened sufficiently. Fill pipeline 24 hours before testing and apply test pressure to stabilize system. Use only potable water.
2. Hydrostatic Tests: Test at not less than one-and-one-half times working pressure for two hours.
 - a. Increase pressure in 50-psig (350-kPa) increments and inspect each joint between increments. Hold at test pressure for 1 hour; decrease to 0 psig (0 kPa). Slowly increase again to test pressure and hold for 1 more hour. Maximum allowable leakage is 2 quarts (1.89 L) per hour per 100 joints. Remake leaking joints with new materials and repeat test until leakage is within allowed limits.
3. Prepare reports of testing activities.

W. Identification

1. Install continuous underground detectable, **as directed**, warning tape during backfilling of trench for underground water-distribution piping. Locate below finished grade, directly over piping. Underground warning tapes are specified in Division 31 Section "Earth Moving".
2. Permanently attach equipment nameplate or marker indicating plastic water-service piping, on main electrical meter panel. See Division 22 Section "Common Work Results For Plumbing" for identifying devices.

NOTE: Delete paragraph above if metallic water-service piping without electrically insulated fittings will be used.

X. Cleaning

1. Clean and disinfect water-distribution piping as follows:
 - a. Purge new water-distribution piping systems and parts of existing systems that have been altered, extended, or repaired before use.
 - b. If fire-protection-water piping is not connected to potable-water supply, use purging and disinfecting procedure prescribed by authorities having jurisdiction or, if method is not prescribed by authorities having jurisdiction, use procedure described in NFPA 24 for flushing of piping. Flush piping system with clean, potable water until dirty water does not appear at points of outlet.
 - c. If fire-protection-water piping is connected to potable-water supply, use purging and disinfecting procedure prescribed by authorities having jurisdiction or, if method is not prescribed by authorities having jurisdiction, use procedure described in AWWA C651 or do as follows:
 - 1) Fill system or part of system with water/chlorine solution containing at least 50 ppm of chlorine; isolate and allow to stand for 24 hours **OR** Drain system or part of system of previous solution and refill with water/chlorine solution containing at least 200 ppm of chlorine; isolate and allow to stand for 3 hours, **as directed**.
 - 2) After standing time, flush system with clean, potable water until no chlorine remains in water coming from system.
 - 3) Submit water samples in sterile bottles to authorities having jurisdiction. Repeat procedure if biological examination shows evidence of contamination.
2. Prepare reports of purging and disinfecting activities.

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SECTION 13 34 16 13 - FIXED WOOD BLEACHERS (EXTERIOR)

1.1 GENERAL

A. Description Of Work

1. This specification covers the furnishing and installation of fixed wood bleachers (exterior). Products shall match existing materials and/or shall be as follows or as directed by the Owner. Installation procedures shall be in accordance with the product manufacturer's recommendations. Demolition and removal of materials shall be as required to support the work.

B. Submittals

1. Product Data: For each type of product indicated.

1.2 PRODUCTS

A. Hardware, Brackets, Fasteners, and Connectors

1. Zinc-coated or hot-dipped galvanized steel or aluminum. Nails, brads, staples, and spikes shall comply with ASTM F 547.

B. Lumber and Timber Members

1. Repair or replacement bleacher components shall be of the species and grades complying with National Design Specification for Wood Construction and its Fastenings (National Forest Products Association). Sizes shall comply with American Lumber Standards Committee PS20. Lumber materials shall bear a mark of recognized inspection agency identifying the species, grade, and compliance with the applicable standard. Wood preservatives shall be pressure-applied and shall comply with ASTM D 1760. Creosote or arsenate treatments shall not be used.
 - a. Seatboard Lumber shall be kiln-dried Dense No. 1 Douglas fir or Dense No. 1 Southern yellow pine boards.
 - b. Footboard Lumber shall be kiln-dried Dense No. 1 Douglas fir or Dense No. 1 Southern yellow pine boards.
 - c. Support Member and Timber shall be Dense No. 1 Douglas fir or Dense No. 1 Southern yellow pine timbers or boards.

C. Ready-Mixed Concrete

1. Comply with ASTM C 94 with compressive strength of 3,000 pounds per square inch (210.9 kgs per square cm) at 28 days and shall be protected from freezing for seven days after placement.

D. Reinforcement for Concrete

1. Comply with ASTM A 184, A 1064, or A 615 as indicated.

1.3 EXECUTION

- A. Repair or replace bleacher components using methods complying with the approved practices as referenced in American Institute of Timber Construction Timber Construction Manual.

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SECTION 13 34 16 13a - DEMOUNTABLE BLEACHERS (EXTERIOR)

1.1 GENERAL

A. Description Of Work

1. This specification covers the furnishing and installation of demountable bleachers (exterior). Products shall match existing materials and/or shall be as follows or as directed by the Owner. Installation procedures shall be in accordance with the product manufacturer's recommendations. Demolition and removal of materials shall be as required to support the work.

B. Submittals

1. Product Data: For each type of product indicated.

1.2 PRODUCTS

A. Hardware and Accessories

1. Zinc-coated or hot-dipped galvanized steel or aluminum.

B. Lumber

1. Seat-board and foot-board repair or replacement lumber shall be species and grades complying with National Forest Products Association National Design Specification for Wood Construction and Its Fastenings. Sizes shall comply with American Lumber Standards Committee PS20. Lumber materials shall bear the mark of a recognized inspection agency identifying the species, grade, and compliance with the applicable standard. Wood preservatives shall be pressure-applied and shall comply with ASTM D 1760. Creosote or arsenate treatments shall not be used.
 - a. Seat-board Lumber shall be kiln-dried Dense No. 1 Douglas fir or Dense No. 1 Southern yellow pine boards.
 - b. Foot-board Lumber shall be kiln-dried Dense No. 1 Douglas fir or Dense No. 1 Southern yellow pine boards.

C. Steel Structural Members

1. Comply with ASTM A36.

D. Aluminum Structural Members

1. Comply with ASTM B308.

1.3 EXECUTION

- #### A.
1. Repair or replace bleacher components using methods complying with the approved practices as referenced in American Institute of Timber Construction Timber Construction Manual.

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SECTION 13 34 16 13b - GRANDSTANDS AND BLEACHERS

1.1 GENERAL

A. Description Of Work

1. This specification covers the furnishing and installation of grandstands and bleachers. Products shall match existing materials and/or shall be as follows or as directed by the Owner. Installation procedures shall be in accordance with the product manufacturer's recommendations. Demolition and removal of materials shall be as required to support the work.

B. Submittals

1. Product Data: For each type of product indicated.
2. Shop Drawings: Shop Drawings submitted shall be Designed and Detailed under the direct supervision of a licensed, in house, Professional Engineer. The Professional Engineer shall be present during the time the design and detailing is completed unless all details are included on the approval drawings bearing his/her seal.

C. Warranty

1. Contractor shall warranty any and all materials or workmanship covered by these specifications for a period of one (1) year. Defects shall be corrected by the Contractor at once without charge to the Owner.

1.2 PRODUCTS

A. Design:

1. The design shall be in accordance with the generally accepted standards as published by The American Institute of Steel Construction and The Aluminum Association.
2. Design Loads:
 - a. A uniformly distributed live load of not less than 100 psf of gross horizontal projection of the grandstand.
 - b. Grandstands and bleachers shall be designed to withstand, with or without live loads, the horizontal and uplift pressures due to the wind. Wind pressures shall be derived from ANSI/ASCE 7-93, Minimum Design Loads in Buildings and Other Structures.
 - c. A horizontal swaying force applied to the seats, in a direction parallel to the length of the seats, of 24 lbs./ft.
 - d. A horizontal swaying force applied to the seats, in a direction perpendicular to the length of the seats, of 10 lb./ft.
 - e. All seat and footboard members shall be designed for live loads of not less than 120 lb. per lineal foot.
 - f. Guardrails shall be capable of sustaining a vertical load of 100 plf and a horizontal thrust of 50 plf. Acting outwardly at the top of the rail.
 - g. Under these loads, stresses shall not exceed those allowed in the "Specifications for Structural Steel Buildings, June 1, 1989" as adopted by the American Institute of Steel Construction.
3. Shop Connections: Welded and capable of carrying stress put upon them as per AWS standards.
4. Steel Members for Grandstands:
 - a. Stringers: Wide flange beams spaced at 6'-0" on center.
 - b. Columns: Wide flange beams spaced at 18'-0" on center longitudinally and transversely they will be spaced according to the size of the stand with a maximum of 24'-0" on center.
 - c. Cross Beams: Horizontal cross beams shall be wide flange beams and run "continuously" for the length of the stand.



- d. Cross-Bracing: Front to back bracing shall be structural steel angle, bolted at ends and centers. Rod bracing shall be used for side to side bracing. On columns requiring 2 or more sets of cross-bracing, the connecting strut shall run continuously for the entire length of the stand.
5. Supporting Members (Framework) for Bleachers:
 - a. Main supporting members are to be of a welded angle frame design.
 - b. Spaced at 6'-0" centers (maximum).
 - c. Constructed of a minimum 2 x 2 x 3/16" angle.
 - d. Every frame shall be laterally supported with cross-bracing to the adjacent frame.
6. Dimensions:
 - a. Length of Unit: As required to meet Project requirements.
 - b. Number of rows: As required to meet Project requirements.
 - c. Net seating capacity: As required to meet Project requirements.
 - d. Bleacher seats: As required to meet Project requirements.
 - e. Wheelchair spaces: As required to meet Project requirements, A.D.A. or Local Codes
 - f. Front Walkways: 66 inches clear width
 - g. Seat Height:
 - 1) Grandstands: 17 to 18 inches.
 - 2) Bleachers: 17 inches.
 - h. Walkway Elevation:
 - 1) Grandstands: 42 to 49 inches.
 - 2) Bleachers: 30 to 42 inches.
 - i. Aisle Width: 48" minimum clear width, unless directed otherwise.
7. Typical Stands:
 - a. Grandstands:
 - 1) 8" Rise or 10" Rise with a 24" **OR** 28", **as directed**, row spacing.
 - 2) 12" Rise with 30" row spacing (Min. required for backrest).
 - b. Bleachers: Standard 8: Rise with a 24" row depth
8. Deck Arrangements:
 - a. Walkways: Six 2 x 12 planks.
 - b. Seats: Standard 2 x 10, unless directed otherwise.
 - c. Aisle Steps: Standard 2 x 12 plank **OR** 2 x 12 plank with 1" contrasting nosing to delineate the leading edge, **as directed**.
 - d. Footboard and Riser plank arrangement: Semi-closed (SC), Fully Closed Deck Plank Arrangement (CD), and Interlocked Deck (IL).
9. Guardrails:
 - a. Furnished on sides of the bleacher including stairs, ramps, portals and landings.
 - b. All pipes shall be 1 5/8" O.D. anodized aluminum pipe with end plugs and elbows at corners. Secured to angle rail posts with galvanized fasteners.
 - c. Rails not less than 42" vertically above the center of the seatboard surface shall be provided at the back and sides of the bleacher.
 - d. Rails are not to be less than 42" above the elevated front footrests.
 - e. Included on all sides of the bleacher shall be 2" x 9 gauge galvanized chain link fencing fastened in place with aluminum ties and galvanized tension bars and aluminum rail clamps.
10. Stairs: Per applicable codes and/or drawings.
 - a. 2 x 12 aluminum plank with a maximum rise of 7".
 - b. Stairs shall have a multi-pipe rail system that conforms to the 4" ball rule. Top rail shall be 42" above the leading edge of the treads.
11. Mudills: 2 x 4 pressure treated wood shall be provided on all frames.
12. Handicap Provisions:
 - a. Wheelchair pockets inset into the front rows of seating shall be provided to comply with local codes and ADA for wheelchair accessibility.
 - b. Handicapped seating will be enclosed on all three sides with no exposed vertical rise allowed.

- c. Front platform shall be accessible from a ramp with a maximum gradient of 1:12.
 - d. Ramp width shall be minimum 5'-0" for two-way traffic.
 - e. Ramp shall have a 3-pipe rail system consisting of 1 5/8" O.D. anodized aluminum pipe with 2 x 9 gauge galvanized fence. Top rail will be 42" above the ramp surface.
 - f. A handrail 36" above the ramp surface shall be provided.
13. Pressbox
- a. Grandstands: Pressbox Support Structure will be independently supported but connected to the rear of the grandstand.
 - b. Bleachers: Pressbox Support Structure will be independently supported on its own poured concrete piers and connected to bleacher by means of stairs off bleacher aisle.
 - c. Support Structure to be 8'-0" wide and in increments of 6'-0" in length.
 - d. Pressbox specifications as required to meet Project requirements.

B. Materials

1. Steel: ASTM A572 (Hot-Dipped Galvanized), ASTM A586 (Weathering Steel).
2. Aluminum: Extruded alloy 6063-T6.
3. Ready-Mixed Concrete shall comply with ASTM C94 with compressive strength of **3,000 pounds per square inch (210.9 kgs per square cm)** at 28 days and shall be protected from freezing for seven days after placement.
4. Reinforcement for Concrete shall comply with ASTM A184, A1064, or A615 as indicated.
5. Accessories:
 - a. High Strength Bolts and Nuts - ASTM A325 steel.
 - b. Ordinary Bolts and Nuts - ASTM A307.
 - c. Hold-Down Clip Assemblies - Aluminum alloy 6063-T6.
 - d. End Caps - Channel aluminum alloy 6063-T6.

C. Finishes

1. Steel: Galvanized Steel and Weathering Steel.
2. Aluminum:
 - a. Anodized: Seat planks, backrest, stanchions and also risers if requested clear anodized 204R1, AA-M10C22A31, Class II.
 - b. Mill Finish: Footboards and riser boards (6063-T6).
 - c. Paint: Electrostatically applied, baked-on siliconized acrylic or siliconized polyester enamel.

1.3 EXECUTION

A. Installation

1. All work will be performed by factory-trained technicians experienced in bleacher seating installation.
2. Complete installation as per approved shop drawings and manufacturers instructions.
3. Bleachers shall be sufficiently anchored to the ground to withstand the wind loads for their particular areas.
4. After installation, unit shall be inspected for proper alignment and function.

B. Foundations/Piers

1. Piers for the pressbox shall be designed to provide sufficient bearing area to support the total live and dead loads of the pressbox without exceeding the allowable soil bearing pressure.
2. Footings for the grandstand shall be designed to provide sufficient bearing area to support the total live and dead loads of the grandstand without exceeding the allowable soil bearing pressure.
3. Design and depth of footings shall be determined from the Owner supplied geotechnical report indicating local soil conditions.
4. Hot-Dipped galvanized anchor bolts shall be used, secured in the concrete footings.
5. Concrete shall attain a working strength of 3,000 psi.



END OF SECTION 13 34 16 13b

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SECTION 13 34 19 00 - METAL BUILDING SYSTEMS

1.1 GENERAL

A. Description Of Work

1. This specification covers the furnishing and installation of materials for metal building systems. Products shall be as follows or as directed by the Owner. Installation procedures shall be in accordance with the product manufacturer's recommendations. Demolition and removal of materials shall be as required to support the work.

B. Summary

1. Section Includes:
 - a. Structural-steel framing.
 - b. Metal roof panels.
 - c. Metal wall panels.
 - d. Foam-insulation-core metal wall panels.
 - e. Translucent panels.
 - f. Metal soffit panels.
 - g. Thermal insulation.
 - h. Doors and frames.
 - i. Windows.
 - j. Accessories.

C. Definitions

1. Terminology Standard: See MBMA's "Metal Building Systems Manual" for definitions of terms for metal building system construction not otherwise defined in this Section or in referenced standards.

D. Submittals

1. Product Data: For each type of metal building system component. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for the following:
 - a. Structural-steel-framing system.
 - b. Metal roof panels.
 - c. Metal wall panels.
 - d. Metal liner panels.
 - e. Translucent panels.
 - f. Insulation and vapor retarder facings.
 - g. Flashing and trim.
 - h. Doors.
 - i. Windows.
 - j. Accessories.
2. LEED Submittals:
 - a. Product Test Reports for Credit SS 7.2: For roof panels, documentation indicating that panels comply with Solar Reflectance Index requirement.
 - b. Product Data for Credit MR 4.1 and Credit MR 4.2, **as directed**: For products having recycled content, documentation indicating percentages by weight of postconsumer and preconsumer recycled content. Include statement indicating costs for each product having recycled content.
3. Shop Drawings: For the following metal building system components. Include plans, elevations, sections, details, and attachments to other work.
 - a. Anchor-Bolt Plans: Submit anchor-bolt plans and templates before foundation work begins. Include location, diameter, and projection of anchor bolts required to attach metal building to foundation. Indicate column reactions at each location.

- b. Structural-Framing Drawings: Show complete fabrication of primary and secondary framing; include provisions for openings. Indicate welds and bolted connections, distinguishing between shop and field applications. Include transverse cross-sections.
 - 1) Show provisions for attaching roof curbs, service walkways, platforms and pipe racks.
 - c. Metal Roof and Wall Panel Layout Drawings: Show layouts of metal panels including methods of support. Include details of edge conditions, joints, panel profiles, corners, anchorages, trim, flashings, closures, and special details. Distinguish between factory- and field-assembled work; show locations of exposed fasteners.
 - 1) Show roof-mounted items including roof hatches, equipment supports, pipe supports and penetrations, lighting fixtures, and items mounted on roof curbs.
 - 2) Show wall-mounted items including doors, windows, louvers, and lighting fixtures.
 - 3) Show translucent panels.
4. Samples: For each type of exposed finish required, prepared on Samples of sizes indicated below:
 - a. Metal Panels: Nominal 12 inches (300 mm) long by actual panel width. Include fasteners, closures, and other exposed panel accessories.
 - b. Translucent Panels: Nominal 12 inches (300 mm) long by actual panel width.
 - c. Flashing and Trim: Nominal 12 inches (300 mm) long. Include fasteners and other exposed accessories.
 - d. Vapor-Retarder Facings: Nominal 6-inch- (150-mm-) square Samples.
 - e. Windows: Full-size, nominal 12-inch- (300-mm-) long frame Samples showing typical profile.
 - f. Accessories: Nominal 12-inch- (300-mm-) long Samples for each type of accessory.
5. Door Schedule: For doors and frames. Use same designations indicated on Drawings. Include details of reinforcement.
 - a. Door Hardware Schedule: Include details of fabrication and assembly of door hardware. Organize schedule into door hardware sets indicating complete designations of every item required for each door or opening.
 - b. Keying Schedule: Detail the Owner's final keying instructions for locks. Include schematic keying diagram and index each key set to unique door designations.
6. Delegated-Design Submittal: For metal building systems indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
7. Qualification Data: For qualified erector, manufacturer, professional engineer, land surveyor and testing agency.
8. Welding certificates.
9. Metal Building System Certificates: For each type of metal building system, from manufacturer.
 - a. Letter of Design Certification: Signed and sealed by a qualified professional engineer. Include the following:
 - 1) Name and location of Project.
 - 2) Order number.
 - 3) Name of manufacturer.
 - 4) Name of Contractor.
 - 5) Building dimensions including width, length, height, and roof slope.
 - 6) Indicate compliance with AISC standards for hot-rolled steel and AISI standards for cold-rolled steel, including edition dates of each standard.
 - 7) Governing building code and year of edition.
 - 8) Design Loads: Include dead load, roof live load, collateral loads, roof snow load, deflection, wind loads/speeds and exposure, seismic design category or effective peak velocity-related acceleration/peak acceleration, and auxiliary loads (cranes).
 - 9) Load Combinations: Indicate that loads were applied acting simultaneously with concentrated loads, according to governing building code.
 - 10) Building-Use Category: Indicate category of building use and its effect on load importance factors.

- 11) AISC Certification for Category MB: Include statement that metal building system and components were designed and produced in an AISC-Certified Facility by an AISC-Certified Manufacturer.
 10. Erector Certificates: For each product, from manufacturer.
 11. Manufacturer Certificates: For each product, from manufacturer.
 12. Material Test Reports: For each of the following products:
 - a. Structural steel including chemical and physical properties.
 - b. Bolts, nuts, and washers including mechanical properties and chemical analysis.
 - c. Tension-control, high-strength, bolt-nut-washer assemblies.
 - d. Shop primers.
 - e. Nonshrink grout.
 13. Product Test Reports: Based on evaluation of comprehensive tests performed by manufacturer and witnessed by a qualified testing agency, for insulation and vapor-retarder facings. Include reports for thermal resistance, fire-test-response characteristics, water-vapor transmission, and water absorption.
 14. Source quality-control reports.
 15. Field quality-control reports.
 16. Surveys: Show final elevations and locations of major members. Indicate discrepancies between actual installation and the Contract Documents. Have surveyor who performed surveys certify their accuracy.
 17. Maintenance Data: For metal panel finishes and door hardware to include in maintenance manuals.
 18. Warranties: Sample of special warranties.
- E. Quality Assurance
1. Manufacturer Qualifications: A qualified manufacturer and member of MBMA.
 - a. AISC Certification for Category MB: An AISC-Certified Manufacturer that designs and produces metal building systems and components in an AISC-Certified Facility.
 - b. Engineering Responsibility: Preparation of Shop Drawings and comprehensive engineering analysis by a qualified professional engineer.
 2. Land Surveyor Qualifications: A professional land surveyor who practices in jurisdiction where Project is located and who is experienced in providing surveying services of the kind indicated.
 3. Erector Qualifications: An experienced erector who specializes in erecting and installing work similar in material, design, and extent to that indicated for this Project and who is acceptable to manufacturer.
 4. Testing Agency Qualifications: Qualified according to ASTM E 329 for testing indicated.
 5. Source Limitations: Obtain metal building system components, including primary and secondary framing and metal panel assemblies, from single source from single manufacturer.
 6. Welding Qualifications: Qualify procedures and personnel according to the following:
 - a. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
 - b. AWS D1.3, "Structural Welding Code - Sheet Steel."
 7. Structural Steel: Comply with AISC 360, "Specification for Structural Steel Buildings," for design requirements and allowable stresses.
 8. Cold-Formed Steel: Comply with AISI's "North American Specification for the Design of Cold-Formed Steel Structural Members" for design requirements and allowable stresses.
 9. Fire-Resistance Ratings: Where indicated, provide metal panel assemblies identical to those of assemblies tested for fire resistance per ASTM E 119 by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
 - a. Indicate design designations from UL's "Fire Resistance Directory" or from the listings of another qualified testing agency.
 - b. Combustion Characteristics: ASTM E 136.
 10. Fire-Rated Door Assemblies: Assemblies complying with NFPA 80 that are listed and labeled by a qualified testing agency, for fire-protection ratings indicated, based on testing at positive pressure according to NFPA 252 or UL 10C.



- a. Oversize Fire-Rated Door Assemblies: For units exceeding sizes of tested assemblies, provide certification by a qualified testing agency that doors comply with standard construction requirements for tested and labeled fire-rated door assemblies except for size.
11. Preinstallation Conference: Conduct conference at Project site.
- F. Delivery, Storage, And Handling
 1. Deliver components, sheets, panels, and other manufactured items so as not to be damaged or deformed. Package metal panels for protection during transportation and handling.
 2. Unload, store, and erect metal panels in a manner to prevent bending, warping, twisting, and surface damage.
 3. Stack metal panels horizontally on platforms or pallets, covered with suitable weathertight and ventilated covering. Store metal panels to ensure dryness, with positive slope for drainage of water. Do not store metal panels in contact with other materials that might cause staining, denting, or other surface damage.
 4. Protect foam-plastic insulation as follows:
 - a. Do not expose to sunlight, except to extent necessary for period of installation and concealment.
 - b. Protect against ignition at all times. Do not deliver foam-plastic insulation materials to Project site before installation time.
 - c. Complete installation and concealment of foam-plastic materials as rapidly as possible in each area of construction.
- G. Project Conditions
 1. Weather Limitations: Proceed with installation only when weather conditions permit metal panels to be installed according to manufacturers' written instructions and warranty requirements.
 2. Field Measurements:
 - a. Established Dimensions for Foundations: Comply with established dimensions on approved anchor-bolt plans, establishing foundation dimensions and proceeding with fabricating structural framing without field measurements. Coordinate anchor-bolt installation to ensure that actual anchorage dimensions correspond to established dimensions.
 - b. Established Dimensions for Metal Panels: Where field measurements cannot be made without delaying the Work, either establish framing and opening dimensions and proceed with fabricating metal panels without field measurements, or allow for field trimming metal panels. Coordinate construction to ensure that actual building dimensions, locations of structural members, and openings correspond to established dimensions.
- H. Coordination
 1. Coordinate sizes and locations of concrete foundations and casting of anchor-bolt inserts into foundation walls and footings. Concrete, reinforcement, and formwork requirements are specified in Division 03 Section "Cast-in-place Concrete".
 2. Coordinate installation of roof curbs, equipment supports and roof penetrations, which are specified in Division 07 Section "Roof Accessories".
 3. Coordinate metal panel assemblies with rain drainage work, flashing, trim, and construction of supports and other adjoining work to provide a leakproof, secure, and noncorrosive installation.
- I. Warranty
 1. Special Warranty on Metal Panel Finishes: Manufacturer's standard form in which manufacturer agrees to repair finish or replace metal panels that show evidence of deterioration of factory-applied finishes within specified warranty period.
 - a. Exposed Panel Finish: Deterioration includes, but is not limited to, the following:
 - 1) Color fading more than 5 Hunter units when tested according to ASTM D 2244.
 - 2) Chalking in excess of a No. 8 rating when tested according to ASTM D 4214.
 - 3) Cracking, checking, peeling, or failure of paint to adhere to bare metal.
 - b. Finish Warranty Period: 20 **OR** 10, **as directed**, years from date of Final Completion.

2. Special Weathertightness Warranty for Standing-Seam Metal Roof Panels: Manufacturer's standard form in which manufacturer agrees to repair or replace standing-seam metal roof panel assemblies that leak or otherwise fail to remain weathertight within specified warranty period.
 - a. Warranty Period: 20 years from date of Final Completion.

1.2 PRODUCTS

A. Metal Building Systems

1. Description: Provide a complete, integrated set of metal building system manufacturer's standard mutually dependent components and assemblies that form a metal building system capable of withstanding structural and other loads, thermally induced movement, and exposure to weather without failure or infiltration of water into building interior.
 - a. Provide metal building system of size and with bay spacings, roof slopes, and spans indicated.
2. Primary-Frame Type:
 - a. Rigid Clear Span: Solid-member, structural-framing system without interior columns.
 - b. Rigid Modular: Solid-member, structural-framing system with interior columns.
 - c. Truss-Frame Clear Span: Truss-member, structural-framing system without interior columns.
 - d. Truss-Frame Modular: Truss-member, structural-framing system with interior columns.
 - e. Lean to: Solid- or truss-member, structural-framing system without interior columns, designed to be partially supported by another structure.
3. End-Wall Framing: Manufacturer's standard, for buildings not required to be expandable, consisting of primary frame, capable of supporting one-half of a bay design load, and end-wall columns **OR** load-bearing end-wall and corner columns and rafters, **as directed**.
OR
 End-Wall Framing: Engineer end walls to be expandable. Provide primary frame, capable of supporting full-bay design loads, and end-wall columns.
4. Secondary-Frame Type: Manufacturer's standard purlins and joists and flush-framed **OR** partially inset-framed **OR** exterior-framed (bypass), **as directed**, girts.
5. Eave Height: **16 feet (4.9 m) OR 20 feet (6.1 m) OR 24 feet (7.3 m) OR 28 feet (8.5 m) OR** Manufacturer's standard height, as indicated by nominal height on Drawings, **as directed**.
6. Bay Spacing: **20 feet (6.1 m) OR 25 feet (7.6 m) OR 30 feet (9.1 m) OR** As determined by manufacturer, **as directed**.
7. Roof Slope: **1/4 inch per 12 inches (1:48) OR 1/2 inch per 12 inches (1:24) OR 1 inch per 12 inches (1:12) OR 4 inches per 12 inches (1:3) OR** Manufacturer's standard for frame type required, **as directed**.
8. Roof System: Manufacturer's standard vertical-rib, standing-seam **OR** trapezoidal-rib, standing-seam **OR** lap-seam, **as directed**, metal roof panels with field-installed insulation, **as directed**.
9. Exterior Wall System: Manufacturer's standard tapered-rib, exposed-fastener **OR** reverse-rib, exposed-fastener **OR** concealed-fastener, **as directed**, metal wall panels with field-installed insulation, **as directed**.
OR
 Exterior Wall System: Manufacturer's standard foam-insulation-core metal wall panels.

B. Metal Building System Performance

1. Delegated Design: Design metal building system, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.
 2. Structural Performance: Metal building systems shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated according to procedures in MBMA's "Metal Building Systems Manual."
 - a. Design Loads: As indicated on Drawings.
- OR**

- Design Loads: As required by MBMA's "Metal Building Systems Manual" **OR** ASCE/SEI 7, **as directed**.
- b. Deflection Limits: Design metal building system assemblies to withstand design loads with deflections no greater than the following:
 - 1) Purlins and Rafters: Vertical deflection of 1/180 **OR** 1/240, **as directed**, of the span.
 - 2) Girts: Horizontal deflection of 1/180 **OR** 1/240, **as directed**, of the span.
 - 3) Metal Roof Panels: Vertical deflection of 1/180 **OR** 1/240, **as directed**, of the span.
 - 4) Metal Wall Panels: Horizontal deflection of 1/180 **OR** 1/240, **as directed**, of the span.
 - 5) Design secondary-framing system to accommodate deflection of primary framing and construction tolerances, and to maintain clearances at openings.
 - c. Drift Limits: Engineer building structure to withstand design loads with drift limits no greater than the following:
 - 1) Lateral Drift: Maximum of 1/200 **OR** 1/400, **as directed**, of the building height.
 - d. Metal panel assemblies shall withstand the effects of gravity loads and loads and stresses within limits and under conditions indicated according to ASTM E 1592.
 3. Seismic Performance: Metal building systems shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.
 4. Thermal Movements: Allow for thermal movements resulting from the following maximum change (range) in ambient and surface temperatures by preventing buckling, opening of joints, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Base engineering calculations on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.
 - a. Temperature Change (Range): 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.
 5. Air Infiltration for Metal Roof Panels: Air leakage through assembly of not more than 0.06 cfm/sq. ft. (0.3 L/s per sq. m) of roof area when tested according to ASTM E 1680 at negative test-pressure difference of 1.57 lbf/sq. ft. (75 Pa).
 6. Air Infiltration for Metal Wall Panels: Air leakage through assembly of not more than 0.06 cfm/sq. ft. (0.3 L/s per sq. m) of wall area when tested according to ASTM E 283 at static-air-pressure difference of 1.57 lbf/sq. ft. (75 Pa).
 7. Water Penetration for Metal Roof Panels: No water penetration when tested according to ASTM E 1646 at test-pressure difference of 2.86 lbf/sq. ft. (137 Pa).
 8. Water Penetration for Metal Wall Panels: No water penetration when tested according to ASTM E 331 at a wind-load design pressure of not less than 2.86 lbf/sq. ft. (137 Pa).
 9. Wind-Uplift Resistance: Provide metal roof panel assemblies that comply with UL 580 for Class 30 **OR** Class 60 **OR** Class 90, **as directed**.
 10. Thermal Performance: Provide insulated metal panel assemblies with the following maximum U-factors and minimum R-values for opaque elements when tested according to ASTM C 1363 or ASTM C 518:
 - a. Metal Roof Panel Assemblies:
 - 1) U-Factor: as directed by the Owner.
 - 2) R-Value: as directed by the Owner.
 - b. Metal Wall Panel Assemblies:
 - 1) U-Factor: as directed by the Owner.
 - 2) R-Value: as directed by the Owner.
 11. Energy Performance (for LEED-NC Credit SS 7.2): Provide roof panels with Solar Reflectance Index not less than 78 **OR** 29, **as directed**, when calculated according to ASTM E 1980 based on testing identical products by a qualified testing agency.
 12. Energy Performance (for ENERGY STAR requirements): Provide roof panels that are listed on the DOE's ENERGY STAR Roof Products Qualified Product List for low **OR** steep, **as directed**, -slope roof products.
 13. Energy Performance (for roofs that must comply with CEC-Title 24): Provide roof panels with initial solar reflectance not less than 0.70 and emissivity not less than 0.75 when tested according to CRRC.

C. Structural-Steel Framing

1. Primary Framing: Manufacturer's standard primary-framing system, designed to withstand required loads and specified requirements. Primary framing includes transverse and lean-to frames; rafter, rake, and canopy beams; sidewall, intermediate, end-wall, and corner columns; and wind bracing.
 - a. General: Provide frames with attachment plates, bearing plates, and splice members. Factory drill for field-bolted assembly. Provide frame span and spacing indicated.
 - 1) Slight variations in span and spacing may be acceptable if necessary to comply with manufacturer's standard, as approved by the Owner.
 - b. Rigid Clear-Span Frames: I-shaped frame sections fabricated from shop-welded, built-up steel plates or structural-steel shapes. Interior columns are not permitted.
 - c. Rigid Modular Frames: I-shaped frame sections fabricated from shop-welded, built-up steel plates or structural-steel shapes. Provide interior columns fabricated from round steel pipes or tubes, or shop-welded, built-up steel plates.
 - d. Truss-Frame, Clear-Span Frames: Rafter frames fabricated from joist girders, and I-shaped column sections fabricated from shop-welded, built-up steel plates or structural-steel shapes.
 - e. Truss-Frame Modular Frames: Rafter frames fabricated from joist girders, and I-shaped column sections fabricated from shop-welded, built-up steel plates or structural-steel shapes. Provide interior columns fabricated from round steel pipes or tubes, or shop-welded, built-up steel plates.
 - f. Long-Bay Frames: I-shaped frame sections fabricated from shop-welded, built-up steel plates or structural-steel shapes. Provide interior columns fabricated from round steel pipes or tubes, or shop-welded, built-up steel plates.
 - g. Frame Configuration: Single gable **OR** One-directional sloped **OR** Lean to, with high side connected to and supported by another structure **OR** Multiple gable **OR** Load-bearing-wall type **OR** Multistory, **as directed**.
 - h. Exterior Column Type: Uniform depth **OR** Tapered, **as directed**.
 - i. Rafter Type: Uniform depth **OR** Tapered, **as directed**.
2. End-Wall Framing: Manufacturer's standard primary end-wall framing fabricated for field-bolted assembly to comply with the following:
 - a. End-Wall and Corner Columns: I-shaped sections fabricated from structural-steel shapes; shop-welded, built-up steel plates; or C-shaped, cold-formed, structural-steel sheet.
 - b. End-Wall Rafters: C-shaped, cold-formed, structural-steel sheet; or I-shaped sections fabricated from shop-welded, built-up steel plates or structural-steel shapes.
3. Secondary Framing: Manufacturer's standard secondary framing, including purlins, girts, eave struts, flange bracing, base members, gable angles, clips, headers, jambs, and other miscellaneous structural members. Unless otherwise indicated, fabricate framing from either cold-formed, structural-steel sheet or roll-formed, metallic-coated steel sheet, prepainted with coil coating, to comply with the following:
 - a. Purlins: C- or Z-shaped sections; fabricated from built-up steel plates, steel sheet, or structural-steel shapes; minimum **2-1/2-inch- (64-mm-)** wide flanges.
 - 1) Depth: As indicated **OR** As needed to comply with system performance requirements, **as directed**.

OR

Purlins: Steel joists of depths indicated.
 - b. Girts: C- or Z-shaped sections; fabricated from built-up steel plates, steel sheet, or structural-steel shapes. Form ends of Z-sections with stiffening lips angled 40 to 50 degrees from flange, with minimum **2-1/2-inch- (64-mm-)** wide flanges.
 - 1) Depth: As indicated **OR** As required to comply with system performance requirements, **as directed**.
 - c. Eave Struts: Unequal-flange, C-shaped sections; fabricated from built-up steel plates, steel sheet, or structural-steel shapes; to provide adequate backup for metal panels.
 - d. Flange Bracing: Minimum **2-by-2-by-1/8-inch (51-by-51-by-3-mm)** structural-steel angles or **1-inch (- (25-mm-))** diameter, cold-formed structural tubing to stiffen primary-frame flanges.

- e. Sag Bracing: Minimum **1-by-1-by-1/8-inch (25-by-25-by-3-mm)** structural-steel angles.
 - f. Base or Sill Angles: Minimum **3-by-2-inch (76-by-51-mm)** zinc-coated (galvanized) steel sheet.
 - g. Purlin and Girt Clips: Manufacturer's standard clips fabricated from steel sheet. Provide galvanized clips where clips are connected to galvanized framing members.
 - h. Secondary End-Wall Framing: Manufacturer's standard sections fabricated from zinc-coated (galvanized) steel sheet **OR** structural-steel sheet, **as directed**.
 - i. Framing for Openings: Channel shapes; fabricated from cold-formed, structural-steel sheet or structural-steel shapes. Frame head and jamb of door openings and head, jamb, and sill of other openings.
 - j. Miscellaneous Structural Members: Manufacturer's standard sections fabricated from cold-formed, structural-steel sheet; built-up steel plates; or zinc-coated (galvanized) steel sheet; designed to withstand required loads.
4. Canopy Framing: Manufacturer's standard structural-framing system, designed to withstand required loads; fabricated from shop-welded, built-up steel plates or structural-steel shapes. Provide frames with attachment plates and splice members, factory drilled for field-bolted assembly.
- a. Type: Straight-beam, eave type **OR** Purlin-extension type **OR** Tapered-beam, below-eave type **OR** As indicated, **as directed**.
5. Bracing: Provide adjustable wind bracing as follows:
- a. Rods: ASTM A 36/A 36M; ASTM A 572/A 572M, Grade **50 (345)**; or ASTM A 529/A 529M, Grade **50 (345)**; minimum **1/2-inch- (13-mm-)** diameter steel; threaded full length or threaded a minimum of **6 inches (152 mm)** at each end.
 - b. Cable: ASTM A 475, **1/4-inch- (6-mm-)** diameter, extra-high-strength grade, Class B, zinc-coated, seven-strand steel; with threaded end anchors.
 - c. Angles: Fabricated from structural-steel shapes to match primary framing, of size required to withstand design loads.
 - d. Rigid Portal Frames: Fabricated from shop-welded, built-up steel plates or structural-steel shapes to match primary framing; of size required to withstand design loads.
 - e. Fixed-Base Columns: Fabricated from shop-welded, built-up steel plates or structural-steel shapes to match primary framing; of size required to withstand design loads.
 - f. Diaphragm Action of Metal Panels: Design metal building to resist wind forces through diaphragm action of metal panels.
 - g. Bracing: Provide wind bracing using any method specified above, at manufacturer's option.
6. Bolts: Provide plain-finish bolts for structural-framing components that are primed or finish painted. Provide zinc-plated or hot-dip galvanized bolts for structural-framing components that are galvanized.
7. Materials:
- a. W-Shapes: ASTM A 992/A 992M; ASTM A 572/A 572M, Grade **50 or 55 (345 or 380)**; or ASTM A 529/A 529M, Grade **50 or 55 (345 or 380)**.
 - b. Channels, Angles, M-Shapes, and S-Shapes: ASTM A 36/A 36M; ASTM A 572/A 572M, Grade **50 or 55 (345 or 380)**; or ASTM A 529/A 529M, Grade **50 or 55 (345 or 380)**.
 - c. Plate and Bar: ASTM A 36/A 36M; ASTM A 572/A 572M, Grade **50 or 55 (345 or 380)**; or ASTM A 529/A 529M, Grade **50 or 55 (345 or 380)**.
 - d. Steel Pipe: ASTM A 53/A 53M, Type E or S, Grade B.
 - e. Cold-Formed Hollow Structural Sections: ASTM A 500, Grade B or C, structural tubing.
 - f. Structural-Steel Sheet: Hot-rolled, ASTM A 1011/A 1011M, Structural Steel (SS), Grades **30 through 55 (205 through 380)**, or High-Strength Low-Alloy Steel (HSLAS), Grades **45 through 70 (310 through 480)**; or cold-rolled, ASTM A 1008/A 1008M, Structural Steel (SS), Grades **25 through 80 (170 through 550)**, or High-Strength Low-Alloy Steel (HSLAS), Grades **45 through 70 (310 through 480)**.
 - g. Metallic-Coated Steel Sheet: ASTM A 653/A 653M, Structural Steel (SS), Grades **33 through 80 (230 through 550)**, or High-Strength Low-Alloy Steel (HSLAS), Grades **50 through 80 (340 through 550)**; with **G60 (Z180)** coating designation; mill phosphatized.

- h. Metallic-Coated Steel Sheet Prepainted with Coil Coating: Steel sheet, metallic coated by the hot-dip process and prepainted by the coil-coating process to comply with ASTM A 755/A 755M.
 - 1) Zinc-Coated (Galvanized) Steel Sheet: ASTM A 653/A 653M, Structural Steel (SS), Grades **33 through 80 (230 through 550)**, or High-Strength Low-Alloy Steel (HSLAS), Grades **50 through 80 (340 through 550)**; with **G90 (Z275)** coating designation.
 - 2) Aluminum-Zinc Alloy-Coated Steel Sheet: ASTM A 792/A 792M, Structural Steel (SS), Grade **50 or 80 (340 or 550)**; with Class **AZ50 (AZM150)** coating.
- i. Joist Girders: Manufactured according to "Standard Specifications for Joist Girders," in SJI's "Standard Specifications and Load Tables for Steel Joists and Joist Girders"; with steel-angle, top- and bottom-chord members, and end- and top-chord arrangements as indicated and required for primary framing.
- j. Steel Joists: Manufactured according to "Standard Specifications for Open Web Steel Joists, K-Series," in SJI's "Standard Specifications and Load Tables for Steel Joists and Joist Girders"; with steel-angle, top- and bottom-chord members, and end- and top-chord arrangements as indicated and required for secondary framing.
- k. Non-High-Strength Bolts, Nuts, and Washers: **ASTM A 307, Grade A (ASTM F 568M, Property Class 4.6)**, carbon-steel, hex-head bolts; **ASTM A 563 (ASTM A 563M)** carbon-steel hex nuts; and ASTM F 844 plain (flat) steel washers.
 - 1) Finish: Plain **OR** Hot-dip zinc coating, ASTM A 153/A 153M, Class C **OR** Mechanically deposited zinc coating, ASTM B 695, Class 50, **as directed**.
- l. High-Strength Bolts, Nuts, and Washers: **ASTM A 325 (ASTM A 325M)**, Type 1, heavy-hex steel structural bolts; **ASTM A 563 (ASTM A 563M)** heavy-hex carbon-steel nuts; and **ASTM F 436 (ASTM F 436M)** hardened carbon-steel washers.
 - 1) Finish: Plain **OR** Hot-dip zinc coating, ASTM A 153/A 153M, Class C **OR** Mechanically deposited zinc coating, ASTM B 695, Class 50, **as directed**.
- m. High-Strength Bolts, Nuts, and Washers: **ASTM A 490 (ASTM A 490M)**, Type 1, heavy-hex steel structural bolts or tension-control, bolt-nut-washer assemblies with spline ends; **ASTM A 563 (ASTM A 563M)** heavy-hex carbon-steel nuts; and **ASTM F 436 (ASTM F 436M)** hardened carbon-steel washers, plain.
- n. Tension-Control, High-Strength Bolt-Nut-Washer Assemblies: ASTM F 1852, Type 1, heavy-hex-head steel structural bolts with spline ends.
 - 1) Finish: Plain **OR** Mechanically deposited zinc coating, ASTM B 695, Class 50 **OR** Mechanically deposited zinc coating, ASTM B 695, Class 50, baked-epoxy coated, **as directed**.
- o. Unheaded Anchor Rods: ASTM F 1554, Grade 36 **OR** ASTM A 572/A 572M, Grade **50 (345) OR** ASTM A 36/A 36M **OR** **ASTM A 307, Grade A (ASTM F 568M, Property Class 4.6)**, **as directed**.
 - 1) Configuration: Straight.
 - 2) Nuts: **ASTM A 563 (ASTM A 563M)** hex **OR** heavy-hex, **as directed**, carbon steel.
 - 3) Plate Washers: ASTM A 36/A 36M carbon steel.
 - 4) Washers: **ASTM F 436 (ASTM F 436M)** hardened carbon steel.
 - 5) Finish: Plain **OR** Hot-dip zinc coating, ASTM A 153/A 153M, Class C **OR** Mechanically deposited zinc coating, ASTM B 695, Class 50, **as directed**.
- p. Headed Anchor Rods: ASTM F 1554, Grade 36 **OR** **ASTM A 307, Grade A (ASTM F 568M, Property Class 4.6)**, **as directed**.
 - 1) Configuration: Straight.
 - 2) Nuts: **ASTM A 563 (ASTM A 563M)** hex **OR** heavy-hex, **as directed**, carbon steel.
 - 3) Plate Washers: ASTM A 36/A 36M carbon steel.
 - 4) Washers: **ASTM F 436 (ASTM F 436M)** hardened carbon steel.
 - 5) Finish: Plain **OR** Hot-dip zinc coating, ASTM A 153/A 153M, Class C **OR** Mechanically deposited zinc coating, ASTM B 695, Class 50, **as directed**.
- q. Threaded Rods: ASTM A 193/A 193M **OR** ASTM A 572/A 572M, Grade **50 (345) OR** ASTM A 36/A 36M **OR** **ASTM A 307, Grade A (ASTM F 568M, Property Class 4.6)**, **as directed**.

- 1) Nuts: **ASTM A 563 (ASTM A 563M)** hex **OR** heavy-hex, **as directed**, carbon steel.
- 2) Washers: **ASTM F 436 (ASTM F 436M)** hardened **OR** ASTM A 36/A 36M, **as directed**, carbon steel.
- 3) Finish: Plain **OR** Hot-dip zinc coating, ASTM A 153/A 153M, Class C **OR** Mechanically deposited zinc coating, ASTM B 695, Class 50, **as directed**.
- r. Recycled Content of Steel Products: Provide steel products with an average recycled content so postconsumer recycled content plus one-half of preconsumer recycled content is not less than 25 percent.
8. Finish: Factory primed. Apply specified primer immediately after cleaning and pretreating.
 - a. Apply primer to primary and secondary framing to a minimum dry film thickness of **1 mil (0.025 mm)**.
 - 1) Prime secondary framing formed from uncoated steel sheet to a minimum dry film thickness of **0.5 mil (0.013 mm)** on each side.
 - b. Prime galvanized members with specified primer after phosphoric acid pretreatment.
 - c. Primer: SSPC-Paint 15, Type I, red oxide.

D. Metal Roof Panels

1. Vertical-Rib, Standing-Seam Metal Roof Panels: Formed with vertical ribs at panel edges and intermediate stiffening ribs symmetrically spaced **OR** flat pan, **as directed**, between ribs; designed for sequential installation by mechanically attaching panels to supports using concealed clips located under one side of panels and engaging opposite edge of adjacent panels.
 - a. Material: Zinc-coated (galvanized) **OR** Aluminum-zinc alloy-coated, **as directed**, steel sheet, **0.022-inch (0.56-mm) OR 0.028-inch (0.71-mm) OR 0.034-inch (0.86-mm)**, **as directed**, nominal thickness.
 - 1) Exterior Finish: Fluoropolymer **OR** Siliconized polyester, **as directed**.
 - 2) Color: As indicated by manufacturer's designations **OR** As selected from manufacturer's full range, **as directed**.
 - b. Clips: Manufacturer's standard, fixed type **OR** floating type to accommodate thermal movement, **as directed**; fabricated from zinc-coated (galvanized) steel **OR** aluminum-zinc alloy-coated steel **OR** stainless-steel, **as directed**, sheet.
 - c. Joint Type: Panels snapped together.
OR
Joint Type: Mechanically seamed, single folded **OR** double folded **OR** folded according to manufacturer's standard, **as directed**.
 - d. Panel Coverage: **16 inches (406 mm)**.
 - e. Panel Height: **2 inches (51 mm)**.
 - f. Uplift Rating: UL 30 **OR** UL 60 **OR** UL 90, **as directed**.
2. Trapezoidal-Rib, Standing-Seam Metal Roof Panels: Formed with raised trapezoidal ribs at panel edges and intermediate stiffening ribs symmetrically spaced **OR** flat pan, **as directed**, between ribs; designed for sequential installation by mechanically attaching panels to supports using concealed clips located under one side of panels and engaging opposite edge of adjacent panels.
 - a. Material: Zinc-coated (galvanized) **OR** Aluminum-zinc alloy-coated, **as directed**, steel sheet, **0.022-inch (0.56-mm) OR 0.028-inch (0.71-mm) OR 0.034-inch (0.86-mm)**, **as directed**, nominal thickness.
 - 1) Exterior Finish: Fluoropolymer **OR** Siliconized polyester, **as directed**.
 - 2) Color: As indicated by manufacturer's designations **OR** As selected from manufacturer's full range, **as directed**.
 - b. Clips: Manufacturer's standard, fixed type **OR** floating type to accommodate thermal movement, **as directed**; fabricated from zinc-coated (galvanized) steel **OR** aluminum-zinc alloy-coated steel **OR** stainless-steel, **as directed**, sheet.
 - c. Joint Type: Panels snapped together.
OR
Joint Type: Mechanically seamed, single folded **OR** double folded **OR** folded according to manufacturer's standard, **as directed**.
 - d. Panel Coverage: **24 inches (610 mm)**.

- e. Panel Height: **3 inches (76 mm)**.
- f. Uplift Rating: UL 30 **OR** UL 60 **OR** UL 90, **as directed**.
3. Tapered-Rib-Profile, Lap-Seam Metal Roof Panels: Formed with raised, trapezoidal major ribs and intermediate stiffening ribs symmetrically spaced **OR** flat pan, **as directed**, between major ribs; designed to be installed by lapping side edges of adjacent panels and mechanically attaching panels to supports using exposed fasteners in side laps.
 - a. Material: Zinc-coated (galvanized) **OR** Aluminum-zinc alloy-coated, **as directed**, steel sheet, **0.022-inch (0.56-mm) OR 0.028-inch (0.71-mm) OR 0.034-inch (0.86-mm)**, **as directed**, nominal thickness.
 - 1) Exterior Finish: Fluoropolymer **OR** Siliconized polyester, **as directed**.
 - 2) Color: As indicated by manufacturer's designations **OR** As selected from manufacturer's full range, **as directed**.
 - b. Major-Rib Spacing: **6 inches (152 mm) OR 12 inches (305 mm)**, **as directed**, o.c.
 - c. Panel Coverage: **36 inches (914 mm)**.
 - d. Panel Height: **0.75 inch (19 mm) OR 1.125 inches (29 mm) OR 1.188 inches (30 mm) OR 1.25 inches (32 mm) OR 1.5 inches (38 mm)**, **as directed**.
4. Tapered-Rib-Profile, Metal Liner Panels: Formed with raised, trapezoidal major ribs and intermediate stiffening ribs symmetrically spaced **OR** flat pan, **as directed**, between major ribs; designed to be installed by lapping side edges of adjacent panels and mechanically attaching panels to supports using exposed fasteners in side laps.
 - a. Material: Zinc-coated (galvanized) **OR** Aluminum-zinc alloy-coated, **as directed**, steel sheet, **0.022-inch (0.56-mm) OR 0.028-inch (0.71-mm) OR 0.034-inch (0.86-mm)**, **as directed**, nominal thickness.
 - 1) Exterior Finish: Fluoropolymer **OR** Siliconized polyester, **as directed**.
 - 2) Color: As indicated by manufacturer's designations **OR** As selected from manufacturer's full range, **as directed**.
 - b. Major-Rib Spacing: **6 inches (152 mm) OR 12 inches (305 mm)**, **as directed**, o.c.
 - c. Panel Coverage: **36 inches (914 mm)**.
 - d. Panel Height: **1.25 inches (32 mm) OR 1.5 inches (38 mm)**, **as directed**.
5. Materials:
 - a. Metallic-Coated Steel Sheet: Restricted-flatness steel sheet, metallic coated by the hot-dip process and prepainted by the coil-coating process to comply with ASTM A 755/A 755M.
 - 1) Zinc-Coated (Galvanized) Steel Sheet: ASTM A 653/A 653M, **G90 (Z275)** coating designation; structural quality.
 - 2) Aluminum-Zinc Alloy-Coated Steel Sheet: ASTM A 792/A 792M, **Class AZ50 coating designation, Grade 40 (Class AZM150 coating designation, Grade 275)**; structural quality.
 - 3) Surface: Smooth, flat **OR** Embossed, **as directed**, finish.
6. Finishes:
 - a. Exposed Coil-Coated Finish:
 - 1) Two-Coat Fluoropolymer: AAMA 621. Fluoropolymer finish containing not less than 70 percent PVDF resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
 - 2) Three-Coat Fluoropolymer: AAMA 621. Fluoropolymer finish containing not less than 70 percent PVDF resin by weight in both color coat and clear topcoat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
 - 3) Siliconized Polyester: Epoxy primer and silicone-modified, polyester-enamel topcoat; with a dry film thickness of not less than **0.2 mil (0.005 mm)** for primer and **0.8 mil (0.02 mm)** for topcoat.
 - b. Concealed Finish: Apply pretreatment and manufacturer's standard white or light-colored acrylic or polyester backer finish, consisting of prime coat and wash coat with a minimum total dry film thickness of **0.5 mil (0.013 mm)**.

E. Metal Wall Panels

1. Tapered-Rib-Profile, Exposed-Fastener Metal Wall Panels: Formed with raised, trapezoidal major ribs and intermediate stiffening ribs symmetrically spaced **OR** flat pan, **as directed**, between major ribs; designed to be installed by lapping side edges of adjacent panels and mechanically attaching panels to supports using exposed fasteners in side laps.
 - a. Material: Zinc-coated (galvanized) **OR** Aluminum-zinc alloy-coated, **as directed**, steel sheet, **0.022-inch (0.56-mm) OR 0.028-inch (0.71-mm) OR 0.034-inch (0.86-mm)**, **as directed**, nominal thickness.
 - 1) Exterior Finish: Fluoropolymer **OR** Siliconized polyester, **as directed**.
 - 2) Color: As indicated by manufacturer's designations **OR** As selected from manufacturer's full range, **as directed**.
 - b. Major-Rib Spacing: **6 inches (152 mm) OR 12 inches (305 mm)**, **as directed**, o.c.
 - c. Panel Coverage: **36 inches (914 mm)**.
 - d. Panel Height: **0.75 inch (19 mm) OR 1.125 inches (29 mm) OR 1.188 inches (30 mm) OR 1.25 inches (32 mm) OR 1.5 inches (38 mm)**, **as directed**.
2. Reverse-Rib-Profile, Exposed-Fastener Metal Wall Panels: Formed with recessed, trapezoidal major valleys and intermediate stiffening valleys symmetrically spaced **OR** flat pan, **as directed**, between major valleys; designed to be installed by lapping side edges of adjacent panels and mechanically attaching panels to supports using exposed fasteners in side laps.
 - a. Material: Zinc-coated (galvanized) **OR** Aluminum-zinc alloy-coated, **as directed**, steel sheet, **0.022-inch (0.56-mm) OR 0.028-inch (0.71-mm) OR 0.034-inch (0.86-mm)**, **as directed**, nominal thickness.
 - 1) Exterior Finish: Fluoropolymer **OR** Siliconized polyester, **as directed**.
 - 2) Color: As indicated by manufacturer's designations **OR** As selected from manufacturer's full range, **as directed**.
 - b. Major-Rib Spacing: **12 inches (305 mm)** o.c.
 - c. Panel Coverage: **36 inches (914 mm)**.
 - d. Panel Height: **1.125 inches (29 mm) OR 1.188 inches (30 mm) OR 1.25 inches (32 mm) OR 1.5 inches (38 mm)**, **as directed**.
3. Concealed-Fastener Metal Wall Panels: Formed with vertical panel edges and a single wide recess, centered between panel edges **OR** flush surface, **as directed**; with flush joint between panels; with **1-inch- (25-mm-)** wide flange for attaching interior finish; designed to be installed by lapping and interconnecting side edges of adjacent panels and mechanically attaching through panel to supports using concealed fasteners and factory-applied sealant, **as directed**, in side laps.
 - a. Material: Zinc-coated (galvanized) **OR** Aluminum-zinc alloy-coated, **as directed**, steel sheet, **0.028-inch (0.71-mm) OR 0.034-inch (0.86-mm)**, **as directed**, nominal thickness.
 - 1) Exterior Finish: Fluoropolymer **OR** Siliconized polyester, **as directed**.
 - 2) Color: As indicated by manufacturer's designations **OR** As selected from manufacturer's full range, **as directed**.
 - b. Panel Coverage: **16 inches (406 mm)**.
 - c. Panel Height: **3 inches (76 mm)**.
4. Tapered-Rib-Profile, Metal Liner Panels: Formed with raised, trapezoidal major ribs and intermediate stiffening ribs symmetrically spaced **OR** flat pan, **as directed**, between major ribs; designed to be installed by lapping side edges of adjacent panels and mechanically attaching panels to supports using exposed fasteners in side laps.
 - a. Material: Zinc-coated (galvanized) **OR** Aluminum-zinc alloy-coated, **as directed**, steel sheet, **0.022-inch (0.56-mm) OR 0.028-inch (0.71-mm) OR 0.034-inch (0.86-mm)**, **as directed**, nominal thickness.
 - 1) Exterior Finish: Siliconized polyester **OR** Acrylic enamel, **as directed**.
 - 2) Color: As indicated by manufacturer's designations **OR** As selected from manufacturer's full range, **as directed**.
 - b. Major-Rib Spacing: **6 inches (152 mm) OR 12 inches (305 mm)**, **as directed** o.c.
 - c. Panel Coverage: **36 inches (914 mm)**.
 - d. Panel Height: **1.25 inches (32 mm) OR 1.5 inches (38 mm)**, **as directed**.

5. Flush-Profile, Metal Liner Panels: Solid **OR** Perforated, **as directed**, panels formed with vertical panel edges and intermediate stiffening ribs symmetrically spaced **OR** flat pan, **as directed**, between panel edges; with flush joint between panels; designed for interior side of metal wall panel assemblies and installed by lapping and interconnecting side edges of adjacent panels and mechanically attaching through panel to supports using concealed fasteners and factory-applied sealant, **as directed**, in side laps.
 - a. Material: Zinc-coated (galvanized) **OR** Aluminum-zinc alloy-coated, **as directed**, steel sheet, **0.028-inch (0.71-mm) OR 0.034-inch (0.86-mm)**, **as directed**, nominal thickness.
 - 1) Exterior Finish: Siliconized polyester **OR** Polyester **OR** Acrylic enamel, **as directed**.
 - 2) Color: As indicated by manufacturer's designations **OR** As selected from manufacturer's full range, **as directed**.
 - b. Sound Absorption: NRC not less than 0.65 **OR** 0.85 **OR** 1.00, **as directed** when tested according to ASTM C 423.
 - c. Panel Coverage: **12 inches (305 mm)**.
 - d. Panel Height: **1.5 inches (38 mm)**.
6. Materials:
 - a. Metallic-Coated Steel Sheet: Restricted-flatness steel sheet, metallic coated by the hot-dip process and prepainted by the coil-coating process to comply with ASTM A 755/A 755M.
 - 1) Zinc-Coated (Galvanized) Steel Sheet: ASTM A 653/A 653M, **G90 (Z275)** coating designation; structural quality.
 - 2) Aluminum-Zinc Alloy-Coated Steel Sheet: ASTM A 792/A 792M, **Class AZ50 coating designation, Grade 40 (Class AZM150 coating designation, Grade 275)**; structural quality.
 - 3) Surface: Smooth, flat **OR** Embossed, **as directed**, finish.
7. Finishes:
 - a. Exposed Coil-Coated Finish:
 - 1) Two-Coat Fluoropolymer: AAMA 621. Fluoropolymer finish containing not less than 70 percent PVDF resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
 - 2) Three-Coat Fluoropolymer: AAMA 621. Fluoropolymer finish containing not less than 70 percent PVDF resin by weight in both color coat and clear topcoat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
 - 3) Siliconized Polyester: Epoxy primer and silicone-modified, polyester-enamel topcoat; with a dry film thickness of not less than **0.2 mil (0.005 mm)** for primer and **0.8 mil (0.02 mm)** for topcoat.
 - b. Concealed Finish: Apply pretreatment and manufacturer's standard white or light-colored acrylic or polyester backer finish, consisting of prime coat and wash coat with a minimum total dry film thickness of **0.5 mil (0.013 mm)**.
- F. Foam-Insulation-Core Metal Wall Panels
 1. Description: Provide factory-formed and -assembled, metal wall panels fabricated from two metal facing sheets and an insulation core foamed in place during fabrication, with joints between panels designed to form weathertight seals. Include accessories required for weathertight installation.
 - a. Concealed-Fastener, Foam-Insulation-Core Metal Wall Panels: Formed with tongue-and-groove panel edges; designed for sequential installation by interlocking panel edges and mechanically attaching panels to supports using concealed clips or fasteners.
 - 1) Facings: Fabricate panel with exterior and interior facings of same material and thickness.
 - 2) Exterior Surface: Smooth, flat **OR** Striated **OR** Shallow ribs **OR** Shallow V grooves, **as directed**.
 - 3) Panel Coverage: **36 inches (914 mm) OR 42 inches (1067 mm)**, **as directed**, nominal.

- 4) Panel Thickness: **2 inches (51 mm) OR 2.5 inches (64 mm) OR 3 inches (76 mm) OR 4 inches (102 mm) OR 5 inches (127 mm) OR 6 inches (152 mm), as directed.**
 - 5) Thermal-Resistance Value (R-Value): as directed by the Owner.
2. Panel Performance:
- a. Flatwise Tensile Strength: **30 psi (200 kPa)** when tested according to ASTM C 297/C 297M.
 - b. Humid Aging: Volume increase not greater than 6.0 percent and no delamination or metal corrosion when tested for seven days at **140 deg F (60 deg C)** and 100 percent relative humidity according to ASTM D 2126.
 - c. Heat Aging: Volume increase not greater than 2.0 percent and no delamination, surface blistering, or permanent bowing when tested for seven days at **200 deg F (93 deg C)** according to ASTM D 2126.
 - d. Cold Aging: Volume decrease not more than 1.0 percent and no delamination, surface blistering, or permanent bowing when tested for seven days at minus **20 deg F (29 deg C)** according to ASTM D 2126.
 - e. Fatigue: No evidence of delamination, core cracking, or permanent bowing when tested to a **20-lbf/sq. ft. (958-kPa)** positive and negative wind load and with deflection of L/180 for two million cycles.
 - f. Autoclave: No delamination when exposed to **2-psi (13.8-kPa)** pressure at a temperature of **212 deg F (100 deg C)** for 2-1/2 hours.
 - g. Fire-Test-Response Characteristics: Class A according to ASTM E 108.
3. Polyisocyanurate Insulation-Core Performance:
- a. Density: **2.0 to 2.6 lb/cu. ft. (32 to 42 kg/cu. m)** when tested according to ASTM D 1622.
 - b. Compressive Strength: Minimum **20 psi (140 kPa)** when tested according to ASTM D 1621.
 - c. Shear Strength: **26 psi (179 kPa)** when tested according to ASTM C 273/C 273M.
4. Materials:
- a. Polyisocyanurate Insulation: Modified polyisocyanurate foam using a non-CFC blowing agent, foamed-in-place or board type as indicated, with maximum flame-spread and smoke-developed indexes of 25 and 450, respectively.
 - 1) Closed-Cell Content: 90 percent when tested according to ASTM D 6226.
 - b. Metallic-Coated Steel Sheet: Restricted-flatness steel sheet, metallic coated by the hot-dip process and prepainted by the coil-coating process to comply with ASTM A 755/A 755M.
 - 1) Zinc-Coated (Galvanized) Steel Sheet: ASTM A 653/A 653M, **G90 (Z275)** coating designation; structural quality.
 - 2) Aluminum-Zinc Alloy-Coated Steel Sheet: ASTM A 792/A 792M, **Class AZ50 coating designation, Grade 40 (Class AZM150 coating designation, Grade 275)**; structural quality.
 - 3) Surface: Smooth, flat **OR Embossed, as directed**, finish.
5. Finishes:
- a. Exposed Coil-Coated Finish:
 - 1) Two-Coat Fluoropolymer: AAMA 621. Fluoropolymer finish containing not less than 70 percent PVDF resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
 - 2) Three-Coat Fluoropolymer: AAMA 621. Fluoropolymer finish containing not less than 70 percent PVDF resin by weight in both color coat and clear topcoat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
 - 3) Siliconized Polyester: Epoxy primer and silicone-modified, polyester-enamel topcoat; with a dry film thickness of not less than **0.2 mil (0.005 mm)** for primer and **0.8 mil (0.02 mm)** for topcoat.
 - b. Concealed Finish: Apply pretreatment and manufacturer's standard white or light-colored acrylic or polyester backer finish, consisting of prime coat and wash coat with a minimum total dry film thickness of **0.5 mil (0.013 mm)**.

G. Translucent Panels

1. Uninsulated Translucent Panels: Glass-fiber-reinforced polyester, translucent plastic; complying with ASTM D 3841, Type CC2 (general purpose) **OR** Type CC1 (limited flammability), **as directed**, Grade 1 (weather resistant); smooth finish on both sides. Match profile of adjacent metal panels.
 - a. Roof Panel Weight: Not less than 8 oz./sq. ft. (2441 g/sq. m).
 - b. Wall Panel Weight: Not less than 6 oz./sq. ft. (1831 g/sq. m).
 - c. Light Transmittance: Not less than 55 percent according to ASTM D 1494.
 - d. Metal Edge: Fabricate full length of each side of panel with metal edge for seaming into standing-seam roof panel joint.
 - e. Color: White.
2. Insulated Translucent Panels: Fabricate insulating units of two sheets of glass-fiber-reinforced polyester, translucent plastic separated by an air space; complying with ASTM D 3841, Type CC1 (limited flammability), Grade 1 (weather resistant); smooth finish on both sides. Match profile of adjacent metal panels.
 - a. Exterior Panel Weight: Not less than 8 oz./sq. ft. (2441 g/sq. m) **OR** 6 oz./sq. ft. (1831 g/sq. m), **as directed**.
 - b. Interior Panel Weight: Not less than 8 oz./sq. ft. (2441 g/sq. m) **OR** 6 oz./sq. ft. (1831 g/sq. m) **OR** 4 oz./sq. ft. (1221 g/sq. m), **as directed**.
 - c. Light Transmittance: Not less than 42 percent according to ASTM D 1494.
 - d. Metal Edge: Fabricate full length of each side of panel with metal edge for seaming into standing-seam roof panel joint.
 - e. Color: White.
3. Mastic for Translucent Panels: Nonstaining, saturated vinyl polymer as recommended by translucent panel manufacturer for sealing laps.
4. Performance:
 - a. Surface-Burning Characteristics: As determined by testing identical products according to ASTM E 84 by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
 - 1) Flame-Spread Index: 25 or less.
 - 2) Smoke-Developed Index: 450 or less.

H. Metal Soffit Panels

1. General: Provide factory-formed metal soffit panels designed to be installed by lapping and interconnecting side edges of adjacent panels and mechanically attaching through panel to supports using concealed fasteners and factory-applied sealant, **as directed**, in side laps. Include accessories required for weathertight installation.
2. Metal Soffit Panels: Match profile and material of metal roof **OR** wall, **as directed**, panels.
 - a. Finish: Match finish and color of metal roof panels **OR** Match finish and color of metal wall panels **OR** As indicated on Drawings, **as directed**.
3. Tapered-Rib-Profile, Exposed-Fastener Metal Soffit Panels: Formed with raised, trapezoidal major ribs and intermediate stiffening ribs symmetrically spaced **OR** flat pan, **as directed**, between major ribs; designed to be installed by lapping side edges of adjacent panels and mechanically attaching panels to supports using exposed fasteners in side laps.
 - a. Material: Zinc-coated (galvanized) **OR** Aluminum-zinc alloy-coated, **as directed**, steel sheet, 0.022-inch (0.56-mm) **OR** 0.028-inch (0.71-mm) **OR** 0.034-inch (0.86-mm), **as directed**, nominal thickness.
 - 1) Exterior Finish: Fluoropolymer **OR** Siliconized polyester, **as directed**.
 - 2) Color: As indicated by manufacturer's designations **OR** As selected from manufacturer's full range, **as directed**.
 - b. Major-Rib Spacing: 6 inches (152 mm) **OR** 12 inches (305 mm), **as directed**, o.c.
 - c. Panel Coverage: 36 inches (914 mm).
 - d. Panel Height: 0.75 inch (19 mm) **OR** 1.125 inches (29 mm) **OR** 1.188 inches (30 mm) **OR** 1.25 inches (32 mm) **OR** 1.5 inches (38 mm), **as directed**.
4. Concealed-Fastener Metal Soffit Panels: Formed with vertical panel edges and a single wide recess, centered between panel edges **OR** flush surface, **as directed**; with flush joint between

panels; with **1-inch- (25-mm-)** wide flange for attaching interior finish; designed to be installed by lapping and interconnecting side edges of adjacent panels and mechanically attaching through panel to supports using concealed fasteners and factory-applied sealant, **as directed**, in side laps.

- a. Material: Zinc-coated (galvanized) **OR** Aluminum-zinc alloy-coated, **as directed**, steel sheet, **0.028-inch (0.71-mm) OR 0.034-inch (0.86-mm)**, **as directed**, nominal thickness.
 - 1) Exterior Finish: Fluoropolymer **OR** Siliconized polyester, **as directed**.
 - 2) Color: As indicated by manufacturer's designations **OR** As selected from manufacturer's full range, **as directed**.
- b. Panel Coverage: **12 inches (305 mm) OR 16 inches (406 mm)**, **as directed**.
- c. Panel Height: **1 inch (25 mm) OR 1.5 inches (38 mm)**, **as directed**.

I. Thermal Insulation

1. Faced Metal Building Insulation: ASTM C 991, Type II, glass-fiber-blanket insulation; **0.5-lb/cu. ft. (8-kg/cu. m)** density; **2-inch- (51-mm-)** wide, continuous, vapor-tight edge tabs; with a flame-spread index of 25 or less.
2. Unfaced Metal Building Insulation: ASTM C 991, Type I, or NAIMA 202, glass-fiber-blanket insulation; **0.5-lb/cu. ft. (8-kg/cu. m)** density; **2-inch- (51-mm-)** wide, continuous, vapor-tight edge tabs; with a flame-spread index of 25 or less.
 - a. Vapor-Retarder Facing: ASTM C 1136, with permeance not greater than **0.02 perm (1.15 ng/Pa x s x sq. m)** when tested according to ASTM E 96/E 96M, Desiccant Method.
 - 1) Composition: White metallized-polypropylene film facing, fiberglass scrim reinforcement, and kraft-paper backing.
OR
Composition: Aluminum foil facing, elastomeric barrier coating, fiberglass scrim reinforcement, and kraft-paper backing.
OR
Composition: White polypropylene **OR** vinyl, **as directed**, film facing, fiberglass scrim reinforcement, and metallized-polyester film backing.
OR
Composition: White polypropylene film facing and fiberglass-polyester-blend fabric backing.
3. Mineral-Fiber-Blanket Insulation: ASTM C 665, type indicated below; consisting of fibers manufactured from glass, slag wool, or rock wool.
 - a. Nonreflective Faced: Type II (blankets with nonreflective membrane covering), Category 1 (membrane is a vapor retarder), Class A (membrane-faced surface with a flame-spread index of 25 or less).
 - b. Reflective Faced: Type III (blankets with reflective membrane covering), Category 1 (membrane is a vapor retarder), Class A (membrane-faced surface with a flame-spread index of 25 or less).
 - c. Unfaced: Type I (blankets without membrane covering), passing ASTM E 136 for combustion characteristics.
 - d. Vapor-Retarder Facing: ASTM C 1136, with permeance not greater than **0.02 perm (1.15 ng/Pa x s x sq. m)** when tested according to ASTM E 96/E 96M, Desiccant Method.
 - 1) Composition: White metallized-polypropylene film facing, fiberglass scrim reinforcement, and kraft-paper backing.
 - 2) Composition: Aluminum foil facing, elastomeric barrier coating, fiberglass scrim reinforcement, and kraft-paper backing.
 - 3) Composition: White polypropylene **OR** vinyl, **as directed**, film facing, fiberglass scrim reinforcement, and metallized-polyester film backing.
 - 4) Composition: White polypropylene film facing and fiberglass-polyester blend fabric backing.
4. Faced, Polyisocyanurate Board Insulation: ASTM C 1289, Type I (foil facing), Class 2, with maximum flame-spread and smoke-developed indexes of 75 and 450, respectively, based on

tests performed on unfaced core. Provide units tested for interior exposure without an approved thermal barrier.

5. Retainer Strips: **0.025-inch (0.64-mm)** nominal-thickness, formed, metallic-coated steel or PVC retainer clips colored to match insulation facing.
6. Vapor-Retarder Tape: Pressure-sensitive tape of type recommended by vapor-retarder manufacturer for sealing joints and penetrations in vapor retarder.

J. Doors And Frames

1. Swinging Personnel Doors and Frames: As specified in Division 08 Section "Hollow Metal Doors And Frames".

OR

Swinging Personnel Doors and Frames: Metal building system manufacturer's standard doors and frames; prepared and reinforced at strike and at hinges to receive factory- and field-applied hardware according to BHMA A156 Series.

- a. Steel Doors: **1-3/4 inches (44 mm)** thick; fabricated from **0.040-inch (1.02-mm)** nominal-thickness, metallic-coated steel face sheets; of seamed **OR** seamless, **as directed**, hollow-metal construction; with **0.064-inch (1.63-mm)** nominal-thickness, inverted metallic-coated steel channels welded to face sheets at top and bottom of door.
 - 1) Design: Flush panel **OR** As indicated, **as directed**.
 - 2) Core: Kraft honeycomb with U-factor rating of at least **0.47 Btu/sq. ft. x h x deg F (2.67 W/sq. m x K)**.
OR
Core: Polystyrene foam with U-factor rating of at least **0.16 Btu/sq. ft. x h x deg F (0.91 W/sq. m x K)**.
OR
Core: Polyurethane foam with U-factor rating of at least **0.07 Btu/sq. ft. x h x deg F (0.40 W/sq. m x K)**.
 - 3) Glazing Frames: Steel frames to receive field-installed glass.
 - 4) Glazing: As specified in Division 08 Section "Glazing".
- b. Steel Frames: Fabricate **2-inch- (51-mm-)** wide face frames from **0.064-inch (1.63-mm)** nominal-thickness, metallic-coated steel sheet.
 - 1) Type: Knocked down for field assembly **OR** Factory welded, **as directed**.
- c. Fabricate concealed stiffeners, reinforcement, edge channels, and moldings from either cold- or hot-rolled steel sheet.
- d. Hardware:
 - 1) Provide hardware for each door leaf, as follows:
 - a) Hinges: BHMA A156.1. Three plain **OR** antifriction, **as directed**, bearing, standard-weight, full-mortise, stainless-steel or bronze, template-type hinges; **4-1/2 by 4-1/2 inches (114 by 114 mm)**, with nonremovable pin.
 - b) Lockset: BHMA A156.2. Key-in-lever cylindrical **OR** Mortise, with lever handle, **as directed**, type.
 - c) Exit Device: BHMA A156.3. Touch- or push-bar type.
 - d) Threshold: BHMA A156.21. Extruded aluminum.
 - e) Silencers: Pneumatic rubber; three silencers on strike jambs of single door frames and two silencers on heads of double door frames.
 - f) Closer: BHMA A156.4. Surface-applied, standard-duty hydraulic type.
 - g) Weather Stripping: Vinyl applied to head and jambs, with vinyl sweep at sill.
 - 2) Provide each pair of double doors with the following hardware in addition to that specified for each leaf:
 - a) Astragal: Removable type.
 - b) Surface Bolts: Top and bottom of inactive door.
- e. Anchors and Accessories: Manufacturer's standard units, galvanized according to ASTM A 123/A 123M.
- f. Fabrication: Fabricate doors and frames to be rigid; neat in appearance; and free from defects, warp, or buckle. Provide continuous welds on exposed joints; grind, dress, and make welds smooth, flush, and invisible.

2. Horizontal-Sliding Doors: Manufacturer's standard horizontal-sliding door assembly including structural frame, door panels, brackets, guides, tracks, hardware, and installation accessories.
 - a. Door Frames: Channels and zeeks; fabricated from minimum **0.064-inch (1.63-mm)** nominal-thickness, metallic-coated steel sheet or structural-steel shapes.
 - b. Door Panels: Same material and finish as metal wall panels.
 - c. Hardware: Manufacturer's standard metallic-coated steel track, bottom guides, lock angles for side closure, and brackets. Support each door leaf by two four-wheel trolleys. Provide metallic-coated steel handle for each leaf, and slide bolt or padlock hasp. Flash top of track with metallic-coated steel sheet hood.
3. Materials:
 - a. Cold-Rolled Steel Sheet: ASTM A 1008/A 1008M, Commercial Steel (CS), Type B, suitable for exposed applications.
 - b. Hot-Rolled Steel Sheet: ASTM A 1011/A 1011M, Commercial Steel (CS), Type B; free of scale, pitting, or surface defects; pickled and oiled.
 - c. Metallic-Coated Steel Sheet: ASTM A 653/A 653M, Commercial Steel (CS), Type B; with **G60 (Z180)** zinc (galvanized) or **A60 (ZF180)** zinc-iron-alloy (galvannealed) coating designation.
4. Finishes for Personnel Doors and Frames:
 - a. Prime Finish: Factory-apply manufacturer's standard primer immediately after cleaning and pretreating.
 - 1) Shop Primer: Manufacturer's standard, fast-curing, lead- and chromate-free primer complying with SDI A250.10 acceptance criteria; recommended by primer manufacturer for substrate; compatible with substrate and field-applied coatings despite prolonged exposure.
 - b. Factory-Applied Paint Finish: Manufacturer's standard, complying with SDI A250.3 for performance and acceptance criteria.
 - 1) Color and Gloss: As indicated by manufacturer's designations **OR** As selected from manufacturer's full range, **as directed**.

K. Windows

1. Aluminum Windows: As specified in Division 08 Section "Aluminum Windows".
OR
Aluminum Windows: Metal building system manufacturer's standard, with self-flashing mounting fins, and as follows:
 - a. Type, Performance Class, and Performance Grade: Comply with AAMA/WDMA/CSA 101/I.S.2/A440 and as follows:
 - 1) Horizontal-Sliding Units: HS-LC25 **OR** HS-C30, **as directed**.
 - 2) Single-Hung Units: H-LC25 **OR** H-C30, **as directed**.
 - 3) Fixed Units: F-LC25 **OR** F-C30, **as directed**.
 - b. Aluminum Extrusions: **ASTM B 221 (ASTM B 221M)**, alloy and temper recommended by manufacturer for strength, corrosion resistance, and application of required finish, but not less than **0.064-inch (1.63-mm)** thickness at any location for main frame and sash members.
 - 1) Thermally Improved Construction: Fabricate window units with an integral, concealed, low-conductance thermal barrier; located between exterior materials and window members exposed on interior side; in a manner that eliminates direct metal-to-metal contact.
 - c. Mullions: Between adjacent windows, fabricated of extruded aluminum matching finish of window units.
 - d. Fasteners, Anchors, and Clips: Nonmagnetic stainless steel, aluminum, or other noncorrosive material, compatible with aluminum window members, trim, hardware, anchors, and other components of window units. Fasteners shall not be exposed, except for attaching hardware.
 - 1) Reinforcement: Where fasteners screw-anchor into aluminum less than **0.128 inch (3.26 mm)** thick, reinforce interior with aluminum or nonmagnetic stainless steel to

- receive screw threads, or provide standard, noncorrosive, pressed-in, spline grommet nuts.
- e. Hardware: Manufacturer's standard; of aluminum, stainless steel, die-cast steel, malleable iron, or bronze; including the following:
 - 1) Cam-action sweep sash lock and keeper at meeting rails.
 - 2) Spring-loaded, snap-type lock at jambs.
 - 3) Pole-operated, cam-action locking device on meeting rail where rail is more than **72 inches (1830 mm)** above floor.
 - 4) Lift handles for single-hung units.
 - 5) Nylon sash rollers for horizontal-sliding units.
 - 6) Steel or bronze operating arms.
 - f. Sliding-Type Weather Stripping: Woven-pile weather stripping of wool, polypropylene, or nylon pile and resin-impregnated backing fabric; complying with AAMA 701/702.
 - g. Insect Screens: Provide removable insect screen on each operable exterior sash, with screen frame finished to match window unit, and as follows:
 - 1) Aluminum Wire Fabric: **18-by-18 (1.1-by-1.1-mm)**, **18-by-16 (1.1-by-1.3-mm)**, or **18-by-14 (1.1-by-1.5-mm)** mesh of **0.013-inch- (0.3-mm-)** diameter, coated aluminum wire; complying with FS RR-W-365, Type VII.
OR
Glass-Fiber Mesh Fabric: **18-by-16 (1.1-by-1.3-mm)** or **18-by-14 (1.1-by-1.5-mm)** mesh of PVC-coated, glass-fiber threads, woven and fused to form a fabric mesh; complying with ASTM D 3656.
OR
Fabric: Manufacturer's standard aluminum wire fabric or glass-fiber mesh fabric.
2. Glazing: Comply with requirements specified in Division 08 Section "Glazing".
OR
Glazing:
- a. Float Glass: ASTM C 1036, Type I, Quality-Q3, Class I (clear), 3 mm thick.
 - b. Heat-Treated Float Glass: ASTM C 1048, Type I, Quality-Q3, Class I (clear), Condition A, 3 mm thick.
 - c. Tinted Float Glass: ASTM C 1036, Type I, Quality-Q3, Class 2, 3 mm thick.
 - 1) Tint Color: Blue **OR** Blue-green **OR** Bronze **OR** Green **OR** Gray **OR** Manufacturer's standard color, **as directed**.
 - d. Patterned Glass: ASTM C 1036, Type II, Quality-Q6, Class 1 (clear), Form 3, Pattern P3 (random), 3 mm thick.
 - e. Insulating-Glass Units: Factory-assembled units consisting of sealed lites of 2.5-mm-thick clear float glass separated by a dehydrated interspace, qualified according to ASTM E 2190.
 - f. Safety Glass: Category II materials complying with testing requirements in 16 CFR 1201.
 - 1) Provide safety glazing labeling.
 - g. Glazing Stops: Screw-applied or snap-on glazing stops coordinated with Division 08 Section "Glazing" and with glazing system indicated. Match material and finish of window frames.
 - h. Factory-Glazed Fabrication: Glaze window units in the factory to greatest extent possible and practical for applications indicated. Comply with requirements in Division 08 Section "Glazing".
3. Finish:
- a. Mill finish.
 - b. Baked-Enamel Finish: Organic Coating: Thermosetting, modified-acrylic enamel primer/topcoat system complying with AAMA 2603 except with a minimum dry film thickness of **0.7 mil (0.02 mm)**, medium gloss.
 - 1) Color: As indicated by manufacturer's designations **OR** As selected from manufacturer's full range, **as directed**.

L. Accessories

1. General: Provide accessories as standard with metal building system manufacturer and as specified. Fabricate and finish accessories at the factory to greatest extent possible, by manufacturer's standard procedures and processes. Comply with indicated profiles and with dimensional and structural requirements.
 - a. Form exposed sheet metal accessories that are without excessive oil-canning, buckling, and tool marks and that are true to line and levels indicated, with exposed edges folded back to form hems.
2. Roof Panel Accessories: Provide components required for a complete metal roof panel assembly including copings, fasciae, corner units, ridge closures, clips, sealants, gaskets, fillers, closure strips, and similar items. Match material and finish of metal roof panels unless otherwise indicated.
 - a. Closures: Provide closures at eaves and ridges, fabricated of same material as metal roof panels.
 - b. Clips: Manufacturer's standard, formed from steel **OR** stainless-steel, **as directed**, sheet, designed to withstand negative-load requirements.
 - c. Cleats: Manufacturer's standard, mechanically seamed cleats formed from steel **OR** stainless-steel sheet or nylon-coated aluminum, **as directed**, sheet.
 - d. Backing Plates: Provide metal backing plates at panel end splices, fabricated from material recommended by manufacturer.
 - e. Closure Strips: Closed-cell, expanded, cellular, rubber or crosslinked, polyolefin-foam or closed-cell laminated polyethylene; minimum **1-inch- (25-mm-)** thick, flexible closure strips; cut or premolded to match metal roof panel profile. Provide closure strips where indicated or necessary to ensure weathertight construction.
 - f. Thermal Spacer Blocks: Where metal panels attach directly to purlins, provide thermal spacer blocks of thickness required to provide **1-inch (25-mm)** standoff; fabricated from extruded polystyrene.
3. Wall Panel Accessories: Provide components required for a complete metal wall panel assembly including copings, fasciae, mullions, sills, corner units, clips, sealants, gaskets, fillers, closure strips, and similar items. Match material and finish of metal wall panels unless otherwise indicated.
 - a. Closures: Provide closures at eaves and rakes, fabricated of same material as metal wall panels.
 - b. Backing Plates: Provide metal backing plates at panel end splices, fabricated from material recommended by manufacturer.
 - c. Closure Strips: Closed-cell, expanded, cellular, rubber or crosslinked, polyolefin-foam or closed-cell laminated polyethylene; minimum **1-inch- (25-mm-)** thick, flexible closure strips; cut or premolded to match metal wall panel profile. Provide closure strips where indicated or necessary to ensure weathertight construction.
4. Flashing and Trim: Formed from **0.022-inch (0.56-mm)** nominal-thickness, metallic-coated steel sheet or aluminum-zinc alloy-coated steel sheet prepainted with coil coating; finished to match adjacent metal panels.
 - a. Provide flashing and trim as required to seal against weather and to provide finished appearance. Locations include, but are not limited to, eaves, rakes, corners, bases, framed openings, ridges, fasciae, and fillers.
 - b. Opening Trim: Formed from **0.022-inch (0.56-mm)** **OR** **0.034-inch (0.86-mm)**, **as directed**, nominal-thickness, metallic-coated steel sheet or aluminum-zinc alloy-coated steel sheet prepainted with coil coating. Trim head and jamb of door openings, and head, jamb, and sill of other openings.
5. Gutters: Formed from **0.022-inch (0.56-mm)** nominal-thickness, metallic-coated steel sheet or aluminum-zinc alloy-coated steel sheet prepainted with coil coating; finished to match roof fascia and rake trim. Match profile of gable trim, complete with end pieces, outlet tubes, and other special pieces as required. Fabricate in minimum **96-inch- (2438-mm-)** long sections, sized according to SMACNA's "Architectural Sheet Metal Manual."
 - a. Gutter Supports: Fabricated from same material and finish as gutters.
 - b. Strainers: Bronze, copper, or aluminum wire ball type at outlets.

6. Downspouts: Formed from 0.022-inch (0.56-mm) nominal-thickness, zinc-coated (galvanized) steel sheet or aluminum-zinc alloy-coated steel sheet prepainted with coil coating; finished to match metal wall panels. Fabricate in minimum 10-foot- (3-m-) long sections, complete with formed elbows and offsets.
 - a. Mounting Straps: Fabricated from same material and finish as gutters.
7. Roof Ventilators: Gravity type, complete with hardware, flashing, closures, and fittings.
 - a. Circular-Revolving Type: Minimum 20-inch- (508-mm-) diameter throat opening; fabricated from 0.028-inch (0.71-mm) nominal-thickness, metallic-coated steel sheet or aluminum-zinc alloy-coated steel sheet prepainted with coil coating; finished to match metal roof panels; with matching base and rain cap.
 - 1) Type: Directional **OR** Stationary, **as directed**, revolving.
 - 2) Bird Screening: Galvanized steel, 1/2-inch- (13-mm-) square mesh, 0.041-inch (1.04-mm) wire; or aluminum, 1/2-inch- (13-mm-) square mesh, 0.063-inch (1.6-mm) wire.
 - 3) Dampers: Spring-loaded, butterfly type; pull-chain operation; with pull chain of length required to reach within 36 inches (914 mm) of floor.
 - 4) Reinforce and brace units, with joints properly formed and edges beaded to be watertight under normal positive-pressure conditions.
 - 5) Mount ventilators on square-to-round bases for ridge or on-slope mounting, designed to match roof pitch and roll formed to match metal roof panel profile.
 - b. Continuous or Sectional-Ridge Type: Factory-engineered and -fabricated, continuous unit; fabricated from 0.022-inch (0.56-mm) nominal-thickness, metallic-coated steel sheet or aluminum-zinc alloy-coated steel sheet prepainted with coil coating; finished to match metal roof panels. Fabricated in minimum 10-foot- (3-m-) long sections. Provide throat size and total length indicated, complete with side baffles, ventilator assembly, end caps, splice plates, and reinforcing diaphragms.
 - 1) Bird Screening: Galvanized steel, 1/2-inch- (13-mm-) square mesh, 0.041-inch (1.04-mm) wire; or aluminum, 1/2-inch- (13-mm-) square mesh, 0.063-inch (1.6-mm) wire.
 - 2) Dampers: Manually operated, spring-loaded, vertically rising type; chain and worm gear operator; with pull chain of length required to reach within 36 inches (914 mm) of floor.
 - 3) Throat Size: 9 inches (229 mm) **OR** 12 inches (305 mm), **as directed**.
8. Louvers: Size and design indicated; self-framing and self-flashing. Fabricate welded frames from minimum 0.052-inch (1.32-mm) nominal-thickness, metallic-coated steel sheet; finished to match metal wall panels. Form blades from 0.040-inch (1.02-mm) nominal-thickness, metallic-coated steel sheet; folded or beaded at edges, set at an angle that excludes driving rains, and secured to frames by riveting or welding. Fabricate louvers with equal blade spacing to produce uniform appearance.
 - a. Blades: Fixed.
OR
Blades: Adjustable type, with weather-stripped edges, and manually operated by hand crank or pull chain.
 - b. Free Area: Not less than 7.0 sq. ft. (0.65 sq. m) for 48-inch- (1220-mm-) wide by 48-inch- (1220-mm-) high louver.
 - c. Bird Screening: Galvanized steel, 1/2-inch- (13-mm-) square mesh, 0.041-inch (1.04-mm) wire; with rewirable frames, removable and secured with clips; fabricated of same kind and form of metal and with same finish as louvers.
 - 1) Mounting: Interior **OR** Exterior, **as directed**, face of louvers.
 - d. Vertical Mullions: Provide mullions at spacings recommended by manufacturer, or 72 inches (1830 mm) o.c., whichever is less.
9. Roof Curbs: Fabricated from minimum 0.052-inch (1.32-mm) nominal-thickness, metallic-coated steel sheet or aluminum-zinc alloy-coated steel sheet prepainted with coil coating; finished to match metal roof panels; with welded top box and bottom skirt, and integral full-length cricket; capable of withstanding loads of size and height indicated.

- a. Curb Subframing: Fabricated from 0.064-inch (1.63-mm) nominal-thickness, angle-, C-, or Z-shaped metallic-coated steel sheet.
- b. Insulation: 1-inch- (25-mm-) thick, rigid type.
- 10. Service Walkways: Fabricated from 0.052-inch (1.32-mm) nominal-thickness, metallic-coated steel plank grating; with slip-resistant pattern; 18-inch (457-mm) OR 24-inch (610-mm) OR 36-inch (914-mm), **as directed**, overall width. Support walkways on framing system anchored to metal roof panels without penetrating panels; with predrilled holes and clamps or hooks for anchoring.
- 11. Pipe Flashing: Premolded, EPDM pipe collar with flexible aluminum ring bonded to base.
- 12. Materials:
 - a. Fasteners: Self-tapping screws, bolts, nuts, self-locking rivets and bolts, end-welded studs, and other suitable fasteners designed to withstand design loads. Provide fasteners with heads matching color of materials being fastened by means of plastic caps or factory-applied coating.
 - 1) Fasteners for Metal Roof Panels: Self-drilling or self-tapping, zinc-plated, hex-head carbon-steel screws, with a stainless-steel cap or zinc-aluminum-alloy head and EPDM sealing washer.
OR
Fasteners for Metal Roof Panels: Self-drilling, Type 410 stainless-steel or self-tapping, Type 304 stainless-steel or zinc-alloy-steel hex washer head, with EPDM washer under heads of fasteners bearing on weather side of metal panels.
 - 2) Fasteners for Metal Wall Panels: Self-drilling or self-tapping, zinc-plated, hex-head carbon-steel screws, with EPDM sealing washers bearing on weather side of metal panels, **as directed**.
OR
Fasteners for Metal Wall Panels: Self-drilling, Type 410 stainless-steel or self-tapping, Type 304 stainless-steel or zinc-alloy-steel hex washer head, with EPDM sealing washers bearing on weather side of metal panels, **as directed**.
 - 3) Fasteners for Flashing and Trim: Blind fasteners or self-drilling screws with hex washer head.
 - 4) Blind Fasteners: High-strength aluminum or stainless-steel rivets.
 - b. Corrosion-Resistant Coating: Cold-applied asphalt mastic, compounded for 15-mil (0.4-mm) dry film thickness per coat. Provide inert-type noncorrosive compound free of asbestos fibers, sulfur components, and other deleterious impurities.
 - c. Nonmetallic, Shrinkage-Resistant Grout: ASTM C 1107, factory-packaged, nonmetallic aggregate grout, noncorrosive, nonstaining, mixed with water to consistency suitable for application and a 30-minute working time.
 - d. Metal Panel Sealants:
 - 1) Sealant Tape: Pressure-sensitive, 100 percent solids, gray polyisobutylene-compound sealant tape with release-paper backing. Provide permanently elastic, nonsag, nontoxic, nonstaining tape of manufacturer's standard size.
 - 2) Joint Sealant: ASTM C 920; one-part elastomeric polyurethane or polysulfide; of type, grade, class, and use classifications required to seal joints in metal panels and remain weathertight; and as recommended by metal building system manufacturer.

M. Source Quality Control

- 1. Testing Agency (if required): Engage a qualified testing agency to evaluate product.
- 2. Special Inspector (if required by local code): Engage a qualified special inspector to perform the following tests and inspections and to submit reports. Special inspector will verify that manufacturer maintains detailed fabrication and quality-control procedures and will review the completeness and adequacy of those procedures to perform the Work.
 - a. Special inspections will not be required if fabrication is performed by manufacturer registered and approved by authorities having jurisdiction to perform such Work without special inspection.

- 1) After fabrication, submit copy of certificate of compliance to authorities having jurisdiction, certifying that Work was performed according to Contract requirements.
3. Testing: Test and inspect shop connections for metal buildings according to the following:
 - a. Bolted Connections: Shop-bolted connections shall be tested and inspected according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."
 - b. Welded Connections: In addition to visual inspection, shop-welded connections shall be tested and inspected according to AWS D1.1/D1.1M and the following inspection procedures, at inspector's option:
 - 1) Liquid Penetrant Inspection: ASTM E 165.
 - 2) Magnetic Particle Inspection: ASTM E 709; performed on root pass and on finished weld. Cracks or zones of incomplete fusion or penetration will not be accepted.
 - 3) Ultrasonic Inspection: ASTM E 164.
 - 4) Radiographic Inspection: ASTM E 94.
4. Product will be considered defective if it does not pass tests and inspections.
5. Prepare test and inspection reports.

N. Fabrication

1. General: Design components and field connections required for erection to permit easy assembly.
 - a. Mark each piece and part of the assembly to correspond with previously prepared erection drawings, diagrams, and instruction manuals.
 - b. Fabricate structural framing to produce clean, smooth cuts and bends. Punch holes of proper size, shape, and location. Members shall be free of cracks, tears, and ruptures.
2. Tolerances: Comply with MBMA's "Metal Building Systems Manual" for fabrication and erection tolerances.
3. Primary Framing: Shop fabricate framing components to indicated size and section, with baseplates, bearing plates, stiffeners, and other items required for erection welded into place. Cut, form, punch, drill, and weld framing for bolted field assembly.
 - a. Make shop connections by welding or by using high-strength bolts.
 - b. Join flanges to webs of built-up members by a continuous, submerged arc-welding process.
 - c. Brace compression flange of primary framing with steel angles or cold-formed structural tubing between frame web and purlin web or girt web, so flange compressive strength is within allowable limits for any combination of loadings.
 - d. Weld clips to frames for attaching secondary framing.
 - e. Shop Priming: Prepare surfaces for shop priming according to SSPC-SP 2. Shop prime primary framing with specified primer after fabrication.
4. Secondary Framing: Shop fabricate framing components to indicated size and section by roll-forming or break-forming, with baseplates, bearing plates, stiffeners, and other plates required for erection welded into place. Cut, form, punch, drill, and weld secondary framing for bolted field connections to primary framing.
 - a. Make shop connections by welding or by using non-high-strength bolts.
 - b. Shop Priming: Prepare uncoated surfaces for shop priming according to SSPC-SP 2. Shop prime uncoated secondary framing with specified primer after fabrication.
5. Metal Panels: Fabricate and finish metal panels at the factory to greatest extent possible, by manufacturer's standard procedures and processes, as necessary to fulfill indicated performance requirements. Comply with indicated profiles and with dimensional and structural requirements.
 - a. Provide panel profile, including major ribs and intermediate stiffening ribs, if any, for full length of metal panel.

1.3 EXECUTION

A. Examination

1. Examine substrates, areas, and conditions, with erector present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

2. Before erection proceeds, survey elevations and locations of concrete- and masonry-bearing surfaces and locations of anchor rods, bearing plates, and other embedments to receive structural framing, with erector present, for compliance with requirements and metal building system manufacturer's tolerances.
 - a. Engage land surveyor to perform surveying.
3. Proceed with erection only after unsatisfactory conditions have been corrected.

B. Preparation

1. Clean and prepare surfaces to be painted according to manufacturer's written instructions for each particular substrate condition.
2. Provide temporary shores, guys, braces, and other supports during erection to keep structural framing secure, plumb, and in alignment against temporary construction loads and loads equal in intensity to design loads. Remove temporary supports when permanent structural framing, connections, and bracing are in place unless otherwise indicated.

C. Erection Of Structural Framing

1. Erect metal building system according to manufacturer's written erection instructions and erection drawings.
2. Do not field cut, drill, or alter structural members without written approval from metal building system manufacturer's professional engineer.
3. Set structural framing accurately in locations and to elevations indicated, according to AISI specifications referenced in this Section. Maintain structural stability of frame during erection.
4. Base and Bearing Plates: Clean concrete- and masonry-bearing surfaces of bond-reducing materials, and roughen surfaces prior to setting plates. Clean bottom surface of plates.
 - a. Set plates for structural members on wedges, shims, or setting nuts as required.
 - b. Tighten anchor rods after supported members have been positioned and plumbed. Do not remove wedges or shims but, if protruding, cut off flush with edge of plate before packing with grout.
 - c. Promptly pack grout solidly between bearing surfaces and plates so no voids remain. Neatly finish exposed surfaces; protect grout and allow to cure. Comply with manufacturer's written installation instructions for shrinkage-resistant grouts.
5. Align and adjust structural framing before permanently fastening. Before assembly, clean bearing surfaces and other surfaces that will be in permanent contact with framing. Perform necessary adjustments to compensate for discrepancies in elevations and alignment.
 - a. Level and plumb individual members of structure.
 - b. Make allowances for difference between temperature at time of erection and mean temperature when structure will be completed and in service.
6. Primary Framing and End Walls: Erect framing level, plumb, rigid, secure, and true to line. Level baseplates to a true even plane with full bearing to supporting structures, set with double-nutted anchor bolts. Use grout to obtain uniform bearing and to maintain a level base-line elevation. Moist-cure grout for not less than seven days after placement.
 - a. Make field connections using high-strength bolts installed according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts" for bolt type and joint type specified.
 - 1) Joint Type: Snug tightened or pretensioned.
7. Secondary Framing: Erect framing level, plumb, rigid, secure, and true to line. Field bolt secondary framing to clips attached to primary framing.
 - a. Provide rake or gable purlins with tight-fitting closure channels and fasciae.
 - b. Locate and space wall girts to suit openings such as doors and windows.
 - c. Locate canopy framing as indicated.
 - d. Provide supplemental framing at entire perimeter of openings, including doors, windows, louvers, ventilators, and other penetrations of roof and walls.
8. Steel Joists and Joist Girders: Install joists, girders, and accessories plumb, square, and true to line; securely fasten to supporting construction according to SJI's "Standard Specifications and

Load Tables for Steel Joists and Joist Girders," joist manufacturer's written instructions, and requirements in this Section.

- a. Before installation, splice joists delivered to Project site in more than one piece.
- b. Space, adjust, and align joists accurately in location before permanently fastening.
- c. Install temporary bracing and erection bridging, connections, and anchors to ensure that joists are stabilized during construction.
- d. Bolt joists to supporting steel framework using carbon-steel bolts unless otherwise indicated.

OR

Bolt joists to supporting steel framework using high-strength structural bolts unless otherwise indicated. Comply with RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts" for high-strength structural bolt installation and tightening requirements.

- e. Install and connect bridging concurrently with joist erection, before construction loads are applied. Anchor ends of bridging lines at top and bottom chords if terminating at walls or beams.
9. Bracing: Install bracing in roof and sidewalls where indicated on erection drawings.
 - a. Tighten rod and cable bracing to avoid sag.
 - b. Locate interior end-bay bracing only where indicated.
10. Framing for Openings: Provide shapes of proper design and size to reinforce openings and to carry loads and vibrations imposed, including equipment furnished under mechanical and electrical work. Securely attach to structural framing.
11. Erection Tolerances: Maintain erection tolerances of structural framing within AISC 303.

D. Metal Panel Installation, General

1. Examination: Examine primary and secondary framing to verify that structural-panel support members and anchorages have been installed within alignment tolerances required by manufacturer.
 - a. Examine roughing-in for components and systems penetrating metal panels, to verify actual locations of penetrations relative to seams before metal panel installation.
2. General: Anchor metal panels and other components of the Work securely in place, with provisions for thermal and structural movement.
 - a. Field cut metal panels as required for doors, windows, and other openings. Cut openings as small as possible, neatly to size required, and without damage to adjacent metal panel finishes.
 - 1) Field cutting of metal panels by torch is not permitted unless approved in writing by manufacturer.
 - b. Install metal panels perpendicular to structural supports unless otherwise indicated.
 - c. Flash and seal metal panels with weather closures at perimeter of openings and similar elements. Fasten with self-tapping screws.
 - d. Locate and space fastenings in uniform vertical and horizontal alignment.
 - e. Locate metal panel splices over, but not attached to, structural supports with end laps in alignment.
 - f. Lap metal flashing over metal panels to allow moisture to run over and off the material.
3. Lap-Seam Metal Panels: Install screw fasteners using power tools with controlled torque adjusted to compress EPDM washers tightly without damage to washers, screw threads, or metal panels. Install screws in predrilled holes.
 - a. Arrange and nest side-lap joints so prevailing winds blow over, not into, lapped joints. Lap ribbed or fluted sheets one full rib corrugation. Apply metal panels and associated items for neat and weathertight enclosure. Avoid "panel creep" or application not true to line.
4. Metal Protection: Where dissimilar metals contact each other or corrosive substrates, protect against galvanic action by painting contact surfaces with corrosion-resistant coating, by applying rubberized-asphalt underlayment to each contact surface, or by other permanent separation as recommended by metal roof panel manufacturer.

5. Joint Sealers: Install gaskets, joint fillers, and sealants where indicated and where required for weatherproof performance of metal panel assemblies. Provide types of gaskets, fillers, and sealants indicated; or, if not indicated, provide types recommended by metal panel manufacturer.
 - a. Seal metal panel end laps with double beads of tape or sealant the full width of panel. Seal side joints where recommended by metal panel manufacturer.
 - b. Prepare joints and apply sealants to comply with requirements in Division 07 Section "Joint Sealants".

E. Metal Roof Panel Installation

1. General: Provide metal roof panels of full length from eave to ridge unless otherwise indicated or restricted by shipping limitations.
 - a. Install ridge and hip caps as metal roof panel work proceeds.
 - b. Flash and seal metal roof panels with weather closures at eaves and rakes. Fasten with self-tapping screws.
2. Standing-Seam Metal Roof Panels: Fasten metal roof panels to supports with concealed clips at each standing-seam joint, at location and spacing and with fasteners recommended by manufacturer.
 - a. Install clips to supports with self-drilling or self-tapping fasteners.
 - b. Install pressure plates at locations indicated in manufacturer's written installation instructions.
 - c. Snap Joint: Nest standing seams and fasten together by interlocking and completely engaging factory-applied sealant.
OR
Seamed Joint: Crimp standing seams with manufacturer-approved motorized seamer tool so that clip, metal roof panel, and factory-applied sealant are completely engaged.
 - d. Rigidly fasten eave end of metal roof panels and allow ridge end free movement due to thermal expansion and contraction. Predrill panels for fasteners.
 - e. Provide metal closures at peaks, rake edges, rake walls and each side of ridge and hip caps.
3. Lap-Seam Metal Roof Panels: Fasten metal roof panels to supports with exposed fasteners at each lapped joint, at location and spacing recommended by manufacturer.
 - a. Provide metal-backed sealing washers under heads of exposed fasteners bearing on weather side of metal roof panels.
 - b. Provide sealant tape at lapped joints of metal roof panels and between panels and protruding equipment, vents, and accessories.
 - c. Apply a continuous ribbon of sealant tape to weather-side surface of fastenings on end laps and on side laps of nesting-type metal panels, on side laps of ribbed or fluted metal panels, and elsewhere as needed to make metal panels weatherproof to driving rains.
 - d. At metal panel splices, nest panels with minimum **6-inch (152-mm)** end lap, sealed with butyl-rubber sealant and fastened together by interlocking clamping plates.
4. Metal Fascia Panels: Align bottom of metal panels and fasten with blind rivets, bolts, or self-drilling or self-tapping screws. Flash and seal metal panels with weather closures where fasciae meet soffits, along lower panel edges, and at perimeter of all openings.
5. Metal Roof Panel Installation Tolerances: Shim and align metal roof panels within installed tolerance of **1/4 inch in 20 feet (6 mm in 6 m)** on slope and location lines as indicated and within **1/8-inch (3-mm)** offset of adjoining faces and of alignment of matching profiles.

F. Metal Wall Panel Installation

1. General: Install metal wall panels in orientation, sizes, and locations indicated on Drawings. Install panels perpendicular to girts, extending full height of building, unless otherwise indicated. Anchor metal wall panels and other components of the Work securely in place, with provisions for thermal and structural movement.
 - a. Unless otherwise indicated, begin metal panel installation at corners with center of rib lined up with line of framing.
 - b. Shim or otherwise plumb substrates receiving metal wall panels.

- c. When two rows of metal panels are required, lap panels **4 inches (102 mm)** minimum.
 - d. When building height requires two rows of metal panels at gable ends, align lap of gable panels over metal wall panels at eave height.
 - e. Rigidly fasten base end of metal wall panels and allow eave end free movement due to thermal expansion and contraction. Predrill panels.
 - f. Flash and seal metal wall panels with weather closures at eaves, rakes, and at perimeter of all openings. Fasten with self-tapping screws.
 - g. Install screw fasteners in predrilled holes.
 - h. Install flashing and trim as metal wall panel work proceeds.
 - i. Apply elastomeric sealant continuously between metal base channel (sill angle) and concrete, and elsewhere as indicated; or, if not indicated, as necessary for waterproofing.
 - j. Align bottom of metal wall panels and fasten with blind rivets, bolts, or self-drilling or self-tapping screws.
 - k. Provide weatherproof escutcheons for pipe and conduit penetrating exterior walls.
 2. Metal Wall Panels: Install metal wall panels on exterior side of girts. Attach metal wall panels to supports with fasteners as recommended by manufacturer.
 3. Insulated Metal Wall Panels: Install insulated metal wall panels on exterior side of girts. Attach panels to supports at each panel joint using concealed clip and fasteners at maximum **42 inches (1067 mm)** o.c., spaced not more than manufacturer's recommendation. Fully engage tongue and groove of adjacent insulated metal wall panels.
 - a. Install clips to supports with self-tapping fasteners.
 - b. Apply continuous ribbon of sealant to panel joint on concealed side of insulated metal wall panels as vapor seal; apply sealant to panel joint on exposed side of panels as weather seal.
 4. Installation Tolerances (for highly finished metal wall panel assemblies): Shim and align metal wall panels within installed tolerance of **1/4 inch in 20 feet (6 mm in 6 m)**, nonaccumulative, on level, plumb, and on location lines as indicated, and within **1/8-inch (3-mm)** offset of adjoining faces and of alignment of matching profiles.
- G. Translucent Panel Installation
1. Translucent Panels: Attach translucent panels to structural framing with fasteners according to manufacturer's written instructions. Install panels perpendicular to supports unless otherwise indicated. Anchor translucent panels securely in place, with provisions for thermal and structural movement.
 - a. Provide end laps of not less than **6 inches (152 mm)** and side laps of not less than **1-1/2-inch (38-mm)** corrugations for metal roof panels.
 - b. Provide end laps of not less than **4 inches (102 mm)** and side laps of not less than **1-1/2-inch (38-mm)** corrugations for metal wall panels.
 - c. Align horizontal laps with adjacent metal panels.
 - d. Seal intermediate end laps and side laps of translucent panels with translucent mastic.
- H. Metal Soffit Panel Installation
1. Provide metal soffit panels the full width of soffits. Install panels perpendicular to support framing.
 2. Flash and seal metal soffit panels with weather closures where panels meet walls and at perimeter of all openings.
- I. Thermal Insulation Installation
1. General: Install insulation concurrently with metal panel installation, in thickness indicated to cover entire surface, according to manufacturer's written instructions.
 - a. Set vapor-retarder-faced units with vapor retarder toward warm side of construction unless otherwise indicated. Do not obstruct ventilation spaces except for firestopping.
 - b. Tape joints and ruptures in vapor retarder, and seal each continuous area of insulation to the surrounding construction to ensure airtight installation.
 - c. Install factory-laminated, vapor-retarder-faced blankets straight and true in one-piece lengths, with both sets of facing tabs sealed, to provide a complete vapor retarder.
- OR**

- Install blankets straight and true in one-piece lengths. Install vapor retarder over insulation, with both sets of facing tabs sealed, to provide a complete vapor retarder.
2. Blanket Roof Insulation: Comply with the following installation method:
 - a. Over-Framing Installation: Extend insulation and vapor retarder over and perpendicular to top flange of secondary framing. Hold in place by metal roof panels fastened to secondary framing.
 - b. Between-Purlin Installation: Extend insulation and vapor retarder between purlins. Carry vapor-retarder-facing tabs up and over purlin, overlapping adjoining facing of next insulation course and maintaining continuity of retarder. Hold in place with bands and crossbands below insulation.
 - c. Over-Purlin-with-Spacer-Block Installation: Extend insulation and vapor retarder over and perpendicular to top flange of secondary framing. Install layer of filler insulation over first layer to fill space formed by metal roof panel standoffs. Hold in place by panels fastened to standoffs.
 - 1) Thermal Spacer Blocks: Where metal roof panels attach directly to purlins, install thermal spacer blocks.
 - d. Two-Layers-between-Purlin-with-Spacer-Block Installation: Extend insulation and vapor retarder between purlins. Carry vapor-retarder-facing tabs up and over purlin, overlapping adjoining facing of next insulation course and maintaining continuity of retarder. Install layer of filler insulation over first layer to fill space between purlins formed by thermal spacer blocks. Hold in place with bands and crossbands below insulation.
 - 1) Thermal Spacer Blocks: Where metal roof panels attach directly to purlins, install thermal spacer blocks.
 - e. Retainer Strips: Install retainer strips at each longitudinal insulation joint, straight and taut, nesting with secondary framing to hold insulation in place.
 3. Blanket Wall Insulation: Extend insulation and vapor retarder over and perpendicular to top flange of secondary framing. Hold in place by metal wall panels fastened to secondary framing.
 - a. Retainer Strips: Install retainer strips at each longitudinal insulation joint, straight and taut, nesting with secondary framing to hold insulation in place.
 - b. Sound-Absorption Insulation: Where sound-absorption requirement is indicated for metal liner panels, cover insulation with polyethylene film and provide inserts of wire mesh to form acoustical spacer grid.
 4. Board Wall Insulation: Extend board insulation in thickness indicated to cover entire wall. Hold in place by metal wall panels fastened to secondary framing. Comply with manufacturers' written instructions.
 - a. Retainer Strips: Install retainer strips at each longitudinal insulation joint, straight and taut, nesting with secondary framing to hold insulation in place.
- J. Door And Frame Installation
1. General: Install doors and frames plumb, rigid, properly aligned, and securely fastened in place according to manufacturers' written instructions. Coordinate installation with wall flashings and other components. Seal perimeter of each door frame with elastomeric sealant used for metal wall panels.
 2. Personnel Doors and Frames: Install doors and frames according to SDI A250.8. Fit non-fire-rated doors accurately in their respective frames, with the following clearances:
 - a. Between Doors and Frames at Jambs and Head: 1/8 inch (3 mm).
 - b. Between Edges of Pairs of Doors: 1/8 inch (3 mm).
 - c. At Door Sills with Threshold: 3/8 inch (9.5 mm).
 - d. At Door Sills without Threshold: 3/4 inch (19.1 mm).
 - e. At fire-rated openings, install frames according to, and doors with clearances specified in, NFPA 80.
 3. Sliding Service Doors: Bolt support angles to opening head members through factory-punched holes. Bolt door tracks to support angles at maximum 24 inches (610 mm) o.c. Set doors and operating equipment with necessary hardware, jamb and head mold stops, continuous hood flashing, anchors, inserts, hangers, and equipment supports.

4. Field Glazing: Comply with installation requirements in Division 8 Section "Glazing."
 5. Door Hardware: Mount units at heights indicated in DHI's "Recommended Locations for Architectural Hardware for Standard Steel Doors and Frames."
 - a. Install surface-mounted items after finishes have been completed on substrates involved.
 - b. Set units level, plumb, and true to line and location. Adjust and reinforce attachment substrates as necessary for proper installation and operation.
 - c. Drill and countersink units that are not factory prepared for anchorage fasteners. Space fasteners and anchors according to industry standards.
 - d. Set thresholds for exterior doors in full bed of butyl-rubber sealant complying with requirements specified in Division 07 Section "Joint Sealants".
- K. Window Installation
1. General: Install windows plumb, rigid, properly aligned, without warp or rack of frames or sash, and securely fasten in place according to manufacturer's written instructions. Coordinate installation with wall flashings and other components. Seal perimeter of each window frame with elastomeric sealant used for metal wall panels.
 - a. Separate dissimilar materials from sources of corrosion or electrolytic action at points of contact with other materials by complying with requirements specified in AAMA/WDMA/CSA 101/I.S.2/A440.
 2. Set sill members in bed of sealant or with gaskets, as indicated, for weathertight construction.
 3. Install windows and components to drain condensation, water penetrating joints, and moisture migrating within windows to the exterior.
 4. Mount screens directly to frames with tapped screw clips.
 5. Field Glazing: Comply with installation requirements in Division 08 Section "Glazing".
- L. Accessory Installation
1. General: Install accessories with positive anchorage to building and weathertight mounting, and provide for thermal expansion. Coordinate installation with flashings and other components.
 - a. Install components required for a complete metal roof panel assembly, including trim, copings, ridge closures, seam covers, flashings, sealants, gaskets, fillers, closure strips, and similar items.
 - b. Install components for a complete metal wall panel assembly, including trim, copings, corners, seam covers, flashings, sealants, gaskets, fillers, closure strips, and similar items.
 - c. Where dissimilar metals contact each other or corrosive substrates, protect against galvanic action by painting contact surfaces with corrosion-resistant coating, by applying rubberized-asphalt underlayment to each contact surface, or by other permanent separation as recommended by manufacturer.
 2. Flashing and Trim: Comply with performance requirements, manufacturer's written installation instructions, and SMACNA's "Architectural Sheet Metal Manual." Provide concealed fasteners where possible, and set units true to line and level as indicated. Install work with laps, joints, and seams that will be permanently watertight and weather resistant.
 - a. Install exposed flashing and trim that is without excessive oil-canning, buckling, and tool marks and that is true to line and levels indicated, with exposed edges folded back to form hems. Install sheet metal flashing and trim to fit substrates and to result in waterproof and weather-resistant performance.
 - b. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim. Space movement joints at a maximum of **10 feet (3 m)** with no joints allowed within **24 inches (600 mm)** of corner or intersection. Where lapped or bayonet-type expansion provisions cannot be used or would not be sufficiently weather resistant and waterproof, form expansion joints of intermeshing hooked flanges, not less than **1 inch (25 mm)** deep, filled with mastic sealant (concealed within joints).
 3. Gutters: Join sections with riveted-and-soldered or lapped-and-sealed joints. Attach gutters to eave with gutter hangers spaced as required for gutter size, but not more than **36 inches (914 mm)** o.c. using manufacturer's standard fasteners. Provide end closures and seal watertight with sealant. Provide for thermal expansion.



4. Downspouts: Join sections with **1-1/2-inch (38-mm)** telescoping joints. Provide fasteners designed to hold downspouts securely **1 inch (25 mm)** away from walls; locate fasteners at top and bottom and at approximately **60 inches (1524 mm)** o.c. in between.
 - a. Provide elbows at base of downspouts to direct water away from building.

OR

Tie downspouts to underground drainage system indicated.
5. Circular Roof Ventilators: Set ventilators complete with necessary hardware, anchors, dampers, weather guards, rain caps, and equipment supports. Mount ventilators on flat level base. Install preformed filler strips at base to seal ventilator to metal roof panels.
6. Continuous Roof Ventilators: Set ventilators complete with necessary hardware, anchors, dampers, weather guards, rain caps, and equipment supports. Join sections with splice plates and end-cap skirt assemblies where required to achieve indicated length. Install preformed filler strips at base to seal ventilator to metal roof panels.
7. Louvers: Locate and place louver units level, plumb, and at indicated alignment with adjacent work.
 - a. Use concealed anchorages where possible. Provide brass or lead washers fitted to screws where required to protect metal surfaces and to make a weathertight connection.
 - b. Provide perimeter reveals and openings of uniform width for sealants and joint fillers.
 - c. Protect galvanized- and nonferrous-metal surfaces from corrosion or galvanic action by applying a heavy coating of corrosion-resistant paint on surfaces that will be in contact with concrete, masonry, or dissimilar metals.
 - d. Install concealed gaskets, flashings, joint fillers, and insulation as louver installation progresses, where weathertight louver joints are required. Comply with Division 07 Section "Joint Sealants" for sealants applied during louver installation.
8. Roof Curbs: Install curbs at locations indicated on Drawings. Install flashing around bases where they meet metal roof panels.
9. Pipe Flashing: Form flashing around pipe penetration and metal roof panels. Fasten and seal to panel as recommended by manufacturer.

M. Field Quality Control

1. Special Inspections: Engage, **as directed**, a qualified special inspector to perform the following special inspections:
 - a. Inspection of fabricators.
 - b. Steel construction.
2. Testing Agency: Engage, **as directed**, a qualified testing agency to perform tests and inspections.
3. Tests and Inspections:
 - a. High-Strength, Field-Bolted Connections: Connections shall be tested and inspected during installation according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."
 - b. Welded Connections: In addition to visual inspection, field-welded connections shall be tested and inspected according to AWS D1.1/D1.1M and the following inspection procedures, at inspector's option:
 - 1) Liquid Penetrant Inspection: ASTM E 165.
 - 2) Magnetic Particle Inspection: ASTM E 709; performed on root pass and on finished weld. Cracks or zones of incomplete fusion or penetration will not be accepted.
 - 3) Ultrasonic Inspection: ASTM E 164.
 - 4) Radiographic Inspection: ASTM E 94.
4. Product will be considered defective if it does not pass tests and inspections.
5. Prepare test and inspection reports.

N. Adjusting

1. Doors: After completing installation, test and adjust doors to operate easily, free of warp, twist, or distortion.

2. Door Hardware: Adjust and check each operating item of door hardware and each door to ensure proper operation and function of every unit. Replace units that cannot be adjusted to operate as intended.
 3. Windows: Adjust operating sashes and ventilators, screens, hardware, and accessories for a tight fit at contact points and at weather stripping to ensure smooth operation and weathertight closure. Lubricate hardware and moving parts.
 4. Roof Ventilators and Adjustable Louvers: After completing installation, including work by other trades, lubricate, test, and adjust units to operate easily and be free of warp, twist, or distortion as needed to provide fully functioning units.
 - a. Adjust louver blades to be weathertight when in closed position.
- O. Cleaning And Protection
1. Repair damaged galvanized coatings on galvanized items with galvanized repair paint according to ASTM A 780 and manufacturer's written instructions.
 2. Remove and replace glass that has been broken, chipped, cracked, abraded, or damaged during construction period.
 3. Touchup Painting: After erection, promptly clean, prepare, and prime or reprime field connections, rust spots, and abraded surfaces of prime-painted structural framing, bearing plates, and accessories.
 - a. Clean and prepare surfaces by SSPC-SP 2, "Hand Tool Cleaning," or by SSPC-SP 3, "Power Tool Cleaning."
 - b. Apply a compatible primer of same type as shop primer used on adjacent surfaces.
- OR**
- Touchup Painting: Cleaning and touchup painting are specified in Division 9 painting Sections.
4. Metal Panels: Remove temporary protective coverings and strippable films, if any, as metal panels are installed. On completion of metal panel installation, clean finished surfaces as recommended by metal panel manufacturer. Maintain in a clean condition during construction.
 - a. Replace metal panels that have been damaged or have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.
 5. Doors and Frames: Immediately after installation, sand rusted or damaged areas of prime coat until smooth and apply touchup of compatible air-drying primer.
 - a. Immediately before final inspection, remove protective wrappings from doors and frames.
 6. Windows: Clean metal surfaces immediately after installing windows. Avoid damaging protective coatings and finishes. Remove excess sealants, glazing materials, dirt, and other substances. Clean factory-glazed glass immediately after installing windows.
 7. Louvers: Clean exposed surfaces that are not protected by temporary covering, to remove fingerprints and soil during construction period. Do not let soil accumulate until final cleaning.
 - a. Restore louvers damaged during installation and construction period so no evidence remains of corrective work. If results of restoration are unsuccessful, as determined by the Owner, remove damaged units and replace with new units.
 - 1) Touch up minor abrasions in finishes with air-dried coating that matches color and gloss of, and is compatible with, factory-applied finish coating.

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Task	Specification	Specification Description
13 34 19 00	01 22 16 00	No Specification Required
13 34 23 13	13 34 19 00	Metal Building Systems
13 34 23 16	11 12 16 00	Parking Control Equipment
13 34 23 16	11 12 16 00a	Prefabricated Control Booths
13 34 23 31	13 34 19 00	Metal Building Systems

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SECTION 13 42 63 16 - SECURITY CEILING SYSTEMS

1.1 GENERAL

A. Description Of Work

1. This specification covers the furnishing and installation of material for security ceiling systems. Products shall be as follows or as directed by the Owner. Installation procedures shall be in accordance with the products manufacturer's recommendations. Demolition and removal of materials shall be as required to support the work.

B. Summary

1. Section Includes:
 - a. Downward-locking-panel security ceiling systems.
 - b. Security-plank security ceiling systems.

C. Performance Requirements

1. General Performance: Security ceiling systems shall withstand normal thermal movement and structural loads without failure, including permanent deformation of security ceiling system components including pans and suspension system; noise or metal fatigue caused by vibration, deflection, and displacement of security ceiling units; and permanent damage to fasteners and anchors.
2. Acoustical Performance: Provide security ceiling systems with acoustical ratings indicated, as determined according to ASTM E 1264 and the following:
 - a. Noise Reduction Coefficient: ASTM C 423 and ASTM E 795 in Type E-400 mounting.
 - b. Ceiling Attenuation Class: ASTM E 1414.
3. Structural Performance: Security ceiling systems shall withstand the effects of gravity loads and loads and stresses within limits and under conditions indicated:

D. Submittals

1. Product Data: For each type of product indicated.
2. LEED Submittals:
 - a. Product Data for Credit MR 4.1 and MR 4.2, **as directed**: For products having recycled content, documentation indicating percentages by weight of postconsumer and preconsumer recycled content.
 - 1) Include statement indicating costs for each product having recycled content.
 - b. Product Data for Credit EQ 4.1: For sealants, including printed statement of VOC content.
3. Coordination Drawings: Reflected ceiling plans.
4. Welding certificates.
5. Product test reports.
6. Research/evaluation reports.
7. Field quality-control reports documenting inspections of installed products.
8. Field quality-control certification signed by Contractor and Detention Specialist.

E. Quality Assurance

1. Installer Qualifications: An employer of workers trained and approved by manufacturer.
2. Source Limitations: Obtain each security ceiling system from single source from single manufacturer.
3. Welding Qualifications: Qualify procedures and personnel according to the following:
 - a. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
 - b. AWS D1.2/D1.2M, "Structural Welding Code - Aluminum."
 - c. AWS D1.3, "Structural Welding Code - Sheet Steel."
 - d. AWS D1.6, "Structural Welding Code - Stainless Steel."
4. Seismic Standard: Provide ceilings designed and installed to withstand the effects of earthquake motions according to the following:

- a. Standard for Ceiling Suspension Systems Requiring Seismic Restraint: Comply with ASTM E 580.
 - b. Cisca's Recommendations for Acoustical Ceilings: Comply with Cisca's "Recommendations for Direct-Hung Acoustical Tile and Lay-in Panel Ceilings - Seismic Zones 0-2."
 - c. Cisca's Guidelines for Systems Requiring Seismic Restraint: Comply with Cisca's "Guidelines for Seismic Restraint of Direct-Hung Suspended Ceiling Assemblies - Seismic Zones 3 & 4."
 - d. IBC Standard for Metal Suspension Systems for Acoustical Tile and for Lay-in Panel Ceilings.
 - e. SEI/ASCE 7, "Minimum Design Loads for Buildings and Other Structures": Section 9, "Earthquake Loads."
5. Preinstallation Conference: Conduct conference at Project site.

F. Delivery, Storage, And Handling

1. Deliver acoustical metal panels, suspension system components, and accessories to Project site in original, unopened packages and store them in a fully enclosed, conditioned space where they will be protected against damage from moisture, humidity, temperature extremes, direct sunlight, surface contamination, and other causes.
2. Handle acoustical metal panels, suspension system components, and accessories carefully to avoid damaging units and finishes in any way.

1.2 PRODUCTS

A. Materials

1. Recycled Content: Provide products made from steel with average recycled content such that postconsumer recycled content plus one-half of preconsumer recycled content is not less than 25 percent.
2. Steel Sheet: Uncoated or electrolytic zinc-coated, ASTM A 591/A 591M with cold-rolled steel sheet substrate complying with ASTM A 1008/A 1008M, Commercial Steel (CS), exposed.
3. Metallic-Coated Steel Sheet: ASTM A 653/A 653M, CS (Commercial Steel), Type B; with **G60 (Z180)** zinc (galvanized) or **A60 (ZF180)** zinc-iron-alloy (galvannealed) coating designation.
4. Steel Tubing: ASTM A 513, Type B.
5. Stainless-Steel Sheet: ASTM A 666, Type 302 or 304.
6. Aluminum Sheet: **ASTM B 209 (ASTM B 209M)**, alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated, as standard with manufacturer.
7. Concealed Bolts: ASTM A 307, Grade A, unless otherwise indicated.
8. Welding Rods and Bare Electrodes: Select according to AWS specifications for metal alloy welded.
9. Attachment Devices: Size for 5 times the design load indicated in ASTM C 635, Table 1, Direct Hung, unless otherwise indicated.
 - a. Cast-in-Place and Postinstalled Expansion Anchors in Concrete: Anchors of type and material indicated below, with holes or loops for attaching hangers of type indicated and with capability to sustain, without failure, a load equal to 5 times the load imposed by security ceiling construction, as determined by testing per ASTM E 488, conducted by a qualified testing agency.
 - 1) Type: Cast-in-place **OR** Postinstalled expansion **OR** Chemical, **as directed**, anchors.
 - 2) Corrosion Protection: Carbon-steel components zinc plated to comply with ASTM B 633, Class Fe/Zn 5 (0.005 mm) for Class SC service condition (mild).
 - 3) Corrosion Protection: Stainless-steel components complying with **ASTM F 593 and ASTM F 594, Alloy Group 1 or 2 (ASTM F 738M and ASTM F 836M, Alloy Group 1 or 4)** for bolts and nuts; ASTM A 666 or ASTM A 276, Type 304 or 316, for anchors.

- 4) Corrosion Protection: Components fabricated from nickel-copper-alloy rods complying with ASTM B 164 for UNS No. N04400 alloy.
 - b. Powder-Actuated Fasteners in Concrete: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with clips or other accessory devices for attaching hangers of type indicated and with capability to sustain, without failure, a load equal to 10 times the load imposed by security ceiling construction, as determined by testing per ASTM E 1190, conducted by a qualified testing and inspecting agency.
- B. Downward-Locking-Panel Security Ceiling System
1. Provide a complete, integrated system, including security ceiling panels, exposed suspension system, perimeter supports, and accessories.
 2. Panels: Fabricated from a single sheet of metal, with formed upturned edges on all four sides designed to continuously engage with and lock under rectangular bulb of suspension system.
 - a. Steel Panels: Cold-rolled **OR** Electrolytic zinc-coated **OR** Metallic-coated, **as directed**, steel with minimum uncoated sheet thickness of **0.043 inch (1.09 mm) OR 0.033 inch (0.84 mm) OR 0.021 inch (0.53 mm), as directed.**
 - 1) Finish: Factory-applied, baked enamel **OR** powder coating, **as directed.**
 - b. Aluminum Panels: Nominal sheet thickness of **0.040 inch (1.0 mm).**
 - 1) Finish: Factory-applied, baked enamel **OR** powder coating, **as directed.**
 - c. Stainless-Steel Panels: Nominal sheet thickness of **0.050 inch (1.27 mm) OR 0.025 inch (0.65 mm), as directed.**
 - 1) Finish: No. 2b **OR** 4, **as directed.**
 - d. Panel Size: **12 by 24 inches (305 by 610 mm) OR 12 by 48 inches (305 by 1220 mm) OR 24 by 24 inches (610 by 610 mm) OR 24 by 48 inches (610 by 1220 mm), as directed.**
 - e. Perforation Pattern: Perforated **OR** Unperforated, **as directed.**
 - f. Noise Reduction Coefficient (NRC): NRC 0.70 **OR** NRC 0.80 **OR** NRC 0.85 **OR** NRC 0.90 **OR** NRC 0.95 **OR** NRC 1.00, **as directed.**
 3. Sound-Absorptive Pads: Provide sound-absorptive pads for placement over ceiling panels.
 - a. Spacer Grids: Metallic-coated-steel **OR** Aluminum, **as directed**, grid units that provide an air cushion between security ceiling panels and sound-absorptive pads and that act to improve sound absorption.
 - b. Support Clips: Metal clips designed to hold sound-absorptive pads above bottom face sheet.
 4. Backer Plates: Unperforated units formed from metallic-coated steel **OR** aluminum, **as directed**, sheet that reduces travel of sound through panel and that makes panel assembly comply with the following performance:
 - a. Ceiling Attenuation Class (CAC): CAC 40 **OR** CAC 45, **as directed.**
 - b. Sound-Absorptive Pads: Provide secondary sound-absorptive pads, same as specified for primary pads, for placement over backer plates to reduce plenum sound.
 5. Access Panels: Material, perforation pattern, and finish same as security ceiling panels; designed to be accessible by high-security locks with keyways coordinated to building master key system **OR** removal of security fasteners, **as directed.**
 - a. Size: **24 by 24 inches (610 by 610 mm) OR 24 by 48 inches (610 by 1220 mm) OR** As indicated, **as directed.**
 6. Suspension System: ASTM C 635, heavy-duty exposed system consisting of snap-in main runners supported by hangers attached to building structure.
 - a. Provide system complete with main runners, splice plates, connector and alignment clips, hangers, trim, seismic- and wind-load clips and struts, and other suspension components required to support security ceiling units and other security ceiling-supported construction.
 - b. Main Runners and Cross Tees: Formed from metal sheet, **1-1/2 inches (38 mm)** high, with **15/16-inch (23.8-mm)** flange width and with oversized rectangular bulb for engaging panels.
 - 1) Material: Galvanized steel, **G90 (Z275)** zinc coating **OR** Electrolytic zinc-coated steel, **40Z (12G)** zinc coating **OR** Aluminum **OR** Stainless steel, **as directed.**

- c. Wire Hangers, Braces, and Ties: Zinc-coated carbon-steel wire, ASTM A 641/A 641M, Class 1 zinc coating, soft temper.
 - 1) Size: Select wire diameter so its stress at 3 times the hanger design load (ASTM C 635, Table 1, Direct Hung) will be less than yield stress of wire, but provide not less than **0.106-inch- (2.69-mm-)** diameter wire.
- d. Hanger Rods: Mild steel, zinc coated or protected with rust-inhibitive paint.
- e. Flat Hangers: Mild steel, zinc coated or protected with rust-inhibitive paint.
- f. Angle Hangers: Angles with legs not less than **7/8 inch (22 mm)** wide, formed with **0.04-inch- (1.0-mm-)** thick, galvanized-steel sheet, **G90 (Z275)** zinc coating, with bolted connections and **5/16-inch- (8-mm-)** diameter bolts.
- g. Compression Struts: Fabricated from **3/4-inch- (19-mm-)** diameter steel tubing, designed to fit over rectangular bulb of suspension system.
- h. Security Clips: Steel wire, designed to slip over suspension system and through holes in flanges of panel to prevent panel removal.
- 7. Perimeter Supports: Wall-mounted channel moldings and wall angles; fabricated from **0.042-inch- (1.06-mm-)** thick galvanized steel **OR 0.016-inch- (0.4-mm-)** thick galvanized steel **OR 0.040-inch- (1.0-mm-)** thick aluminum, **as directed**; finished to match suspension system.
- 8. Exposed Edge Moldings and Trim: Provide exposed members as indicated or required for edges of security ceiling, fixture trim, beams, fasciae at changes in security ceiling height, and other conditions; of metal and finish matching security ceiling panels.

C. Security-Plank Security Ceiling System

- 1. Single-Configuration Panels: Fabricated from a single sheet of metal, with a self-locking male/female lap joint for joining panels.
 - a. Steel Panels: Cold-rolled **OR** Electrolytic zinc-coated **OR** Metallic-coated, **as directed**, steel with minimum uncoated sheet thickness of **0.097 inch (2.45 mm) OR 0.068 inch (1.72 mm) OR 0.053 inch (1.34 mm) OR 0.043 inch (1.09 mm) OR 0.033 inch (0.84 mm)**, **as directed**.
 - 1) Finish: Factory-applied, baked enamel **OR** powder coating, **as directed**.
 - b. Aluminum Panels: Nominal sheet thickness of **0.125 inch (3.2 mm) OR 0.100 inch (2.5 mm) OR 0.080 inch (2.0 mm) OR 0.063 inch (1.6 mm) OR 0.050 inch (1.2 mm) OR 0.040 inch (1.0 mm)**, **as directed**.
 - 1) Finish: Factory-applied, baked enamel **OR** powder coating, **as directed**.
 - c. Stainless-Steel Panels: Nominal sheet thickness of **0.109 inch (2.78 mm) OR 0.078 inch (1.98 mm) OR 0.062 inch (1.59 mm) OR 0.050 inch (1.27 mm)**, **as directed**.
 - 1) Finish: No. 2b **OR** 4, **as directed**.
 - d. Panel Width: **12 inches (305 mm) OR 18 inches (457 mm) OR 24 inches (610 mm)**, **as directed**.
 - e. Panel Length: Minimum **8 feet (2.4 m) OR Minimum 10 feet (3.0 m) OR Minimum 12 feet (3.7 m)** **OR** Custom lengths to fit areas indicated, **as directed**.
 - f. Perforation Pattern: Perforated **OR** Unperforated, **as directed**.
 - g. Noise Reduction Coefficient (NRC): NRC 0.70 **OR** NRC 0.80 **OR** NRC 0.85 **OR** NRC 0.90 **OR** NRC 0.95 **OR** NRC 1.00, **as directed**.
- 2. Double-Configuration Panels: Factory-assembled units with cold-rolled steel top face sheet and metallic-coated steel bottom face sheet, welded to a truss core. Fabricate panels with a self-locking male/female lap joint for joining panels.
 - a. Panel Width: **12 inches (305 mm) OR 18 inches (457 mm) OR 24 inches (610 mm)**, **as directed**, wide by length indicated.
 - b. Overall Panel Thickness: As required by indicated spans **OR** indicated on Drawings, **as directed**.
 - c. Minimum Uncoated Top Face Sheet Thickness: **0.068 inch (1.72 mm) OR 0.053 inch (1.34 mm) OR 0.043 inch (1.09 mm) OR 0.033 inch (0.84 mm)**, **as directed**.
 - d. Minimum Uncoated Bottom Face Sheet Thickness: **0.068 inch (1.72 mm) OR 0.053 inch (1.34 mm) OR 0.043 inch (1.09 mm) OR 0.033 inch (0.84 mm)**, **as directed**.

- e. Truss Core: Fabricated from **0.015-inch- (0.38-mm-)** thick, cold-rolled steel sheet bent into corrugated shape; welded to top and bottom face sheets at even spacings across and along length of panel.
- f. Perforation Pattern for Bottom Face Sheet: Perforated **OR** Unperforated, **as directed**.
- g. Noise Reduction Coefficient (NRC): NRC 0.65 **OR** NRC 0.90 **OR** NRC 1.00, **as directed**.
- h. Finish of Bottom Face: Factory-applied prime paint.
3. Sound-Absorptive Pads: Provide sound-absorptive pads for placement over ceiling planks.
 - a. Spacer Grids: Metallic-coated-steel **OR** Aluminum, **as directed**, grid units that provide an air cushion between security ceiling panels and sound-absorptive pads and that act to improve sound absorption.
 - b. Support Clips: Metal clips designed to hold sound-absorptive pads above bottom face sheet.
4. Backer Plates: Unperforated units formed from metallic-coated steel **OR** aluminum, **as directed**, sheet that reduces travel of sound through panel and that makes panel assembly comply with the following performance:
 - a. Ceiling Attenuation Class (CAC): CAC 40 **OR** CAC 45, **as directed**.
 - b. Sound-Absorptive Pads: Provide secondary sound-absorptive pads, same as specified for primary pads, for placement over backer plates to reduce plenum sound.
5. Access Panels: Material, perforation pattern, and finish same as security ceiling panels; designed to be held in place by high-security locks with keyways coordinated to building master key system **OR** security fasteners screwed through suspension system, **as directed**.
 - a. Size: **24 by 24 inches (610 by 610 mm)** **OR** **24 by 48 inches (610 by 1220 mm)** **OR** As indicated, **as directed**.
6. Closures: Fabricated from minimum **0.053-inch- (1.34-mm-)** thick steel sheet, finished to match security ceiling panels. Fasten with security fasteners or by welding.
7. Suspension System: Heavy-duty exposed system consisting of intermediate carriers supported by secondary support system attached to building structure.
 - a. Intermediate Carriers: Formed from tees with a nominal **4-inch- (102-mm-)** wide exposed face or built up from back-to-back angles or channels each with a nominal **2-inch- (51-mm-)** wide exposed face; fabricated from **0.068-inch- (1.72-mm-)** **OR** **0.053-inch- (1.34-mm-)**, **as directed**, thick, cold-rolled steel sheet.
 - 1) Finish: Match security ceiling panels.
 - b. Secondary Support System:
 - 1) Hanger Rods: Mild steel, zinc coated or protected with rust-inhibitive paint.
 - 2) Angle Hangers: **1-1/2-by-1-1/2-inch (38-by-38-mm)** galvanized-steel angles, **G90 (Z275)** zinc coating, bolted to intermediate carriers and building structure.
8. Perimeter Supports: Wall-mounted angles, tees, and bearing plates; fabricated from minimum **0.068-inch- (1.72-mm-)** thick, cold-rolled steel sheet; finished to match security ceiling panels.
9. Exposed Edge Moldings and Trim: Provide exposed members as indicated or required for edges of security ceiling, fixture trim, beams, fasciae at changes in security ceiling height, and other conditions, of metal and finish matching security ceiling panels.
- D. Sound-Absorptive Pads
 1. Plastic-Sheet-Wrapped, Mineral-Fiber Insulation: Pads consisting of nonrigid, vinyl chloride plastic sheet encapsulating unfaced mineral-fiber insulation.
 - a. Plastic Sheet: Not less than **0.003 inch (0.076 mm)** thick; flat black.
 - b. Mineral Fiber: Glass fiber or fiber made from slag (mineral wool), complying with ASTM C 553, Type I, II, or III.
 - 1) Thickness: **1 inch (25 mm)** **OR** **1-1/2 inches (38 mm)** **OR** **2 inches (51 mm)** **OR** **4 inches (102 mm)** **OR** As required to meet NRC rating, **as directed**.
 - c. Mineral-Fiber Density: **1.0 lb/cu. ft. (16 kg/cu. m)** **OR** **1.5 lb/cu. ft. (24 kg/cu. m)** **OR** As required to meet NRC rating, **as directed**.
 - d. Surface-Burning Characteristics: As determined by testing identical products according to ASTM E 84 by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
 - 1) Flame-Spread Index: 25 or less.

- 2) Smoke-Developed Index: 50 **OR** 450, **as directed**, or less..

E. Sealants

1. Acoustical Sealant for Exposed and Concealed Joints: Manufacturer's standard nonsag, paintable, nonstaining latex sealant, with a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24), complying with ASTM C 834 and effective in reducing airborne sound transmission through perimeter joints and openings in building construction, as demonstrated by testing representative assemblies according to ASTM E 90.
2. Acoustical Sealant for Concealed Joints: Manufacturer's standard nondrying, nonhardening, nonskinning, nonstaining, gunnable, synthetic-rubber sealant, with a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24), recommended for sealing interior concealed joints to reduce airborne sound transmission.
3. Security Sealant: Manufacturer's standard, high-modulus, nonsag, two-part, pick-proof, epoxy sealant, with a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24), recommended for sealing nonmoving interior joints in security applications.

F. Security Fasteners

1. Security Fasteners: Operable only by tools produced for use on specific type of fastener by fastener manufacturer or other licensed fabricator.
2. Drive-System Type, Head Style, Material, and Protective Coating: Provide as required for assembly, installation, and strength, and as follows:
 - a. Drive-System Types: Pinned Torx-Plus **OR** Pinned Torx, **as directed**.
 - b. Fastener Strength: **Grade 8 (Class 10.9)**.
 - c. Socket Button Head Fasteners:
 - 1) Heat-treated alloy steel, **ASTM F 835 (ASTM F 835M)**.
 - 2) Stainless steel, **ASTM F 879 (ASTM F 879M)**, Group 1 CW.
 - d. Socket Flat Countersunk Head Fasteners:
 - 1) Heat-treated alloy steel, **ASTM F 835 (ASTM F 835M)**.
 - 2) Stainless steel, **ASTM F 879 (ASTM F 879M)**, Group 1 CW.
 - e. Socket Head Cap Fasteners:
 - 1) Heat-treated alloy steel, **ASTM A 574 (ASTM A 574M)**.
 - 2) Stainless steel, **ASTM F 837 (ASTM F 837M)**, Group 1 CW.
 - f. Protective Coatings for Heat-Treated Alloy Steel:
 - 1) Zinc and clear trivalent chromium, for exterior applications and interior applications where indicated.
 - 2) Zinc phosphate with oil, ASTM F 1137, Grade I, or black oxide unless otherwise indicated.

G. Fabrication

1. Panels: Form metal panels from sheet metals selected for their surface flatness, smoothness, and freedom from surface blemishes where exposed to view in finished unit. Do not use materials whose exposed surfaces exhibit pitting, seam marks, roller marks, or variations in flatness exceeding those permitted by referenced standards for stretcher-leveled metal sheet.
 - a. Factory fabricate double-configuration security planks and join top and bottom face sheets by welding.

H. General Finish Requirements

1. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
2. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
3. Appearance of Finished Work: Noticeable variations in the same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

- I. Aluminum Finishes
 - 1. Color-Coated Finish: Manufacturer's standard powder-coat, **as directed**, baked paint complying with coating manufacturer's written instructions for surface preparation, pretreatment, application, baking, and minimum dry film thickness.
- J. Steel Sheet Finishes
 - 1. Color-Coated Finish: Manufacturer's standard powder-coat, **as directed**, baked paint complying with coating manufacturer's written instructions for surface preparation, pretreatment, application, baking, and minimum dry film thickness.
- K. Stainless-Steel Finishes
 - 1. Surface Preparation: Remove tool and die marks and stretch lines, or blend into finish.
 - 2. Polished Finishes: Grind and polish surfaces to produce uniform finish, free of cross scratches.
 - a. Run grain of directional finishes with long dimension of each piece.
 - b. When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.

1.3 EXECUTION

- A. Preparation
 - 1. Coordination: Furnish layouts for cast-in-place anchors, clips, and other security ceiling anchors whose installation is specified in other Sections.
 - a. Furnish cast-in-place anchors and similar devices to other trades for installation well in advance of time needed for coordinating other work.
 - 2. Measure each security ceiling area and establish layout of security ceiling panels to balance border widths at opposite edges of each security ceiling. Avoid using less-than-half-width panels at borders and comply with layout shown on reflected ceiling plans and Coordination Drawings.
- B. General Installation
 - 1. Comply with Cisca's "Ceiling Systems Handbook" for installation of security ceiling systems.
 - 2. Install perimeter supports around perimeter of security ceiling area.
 - a. Apply acoustical **OR** security, **as directed**, sealant in a continuous ribbon concealed on back of vertical legs of supports before they are installed.
 - b. Attach supports with anchor bolts or expansion anchors spaced not more than **12 inches (305 mm)** o.c. and not more than **3 inches (76 mm)** from ends. Miter corners accurately.
 - 1) Level perimeter supports with suspension system to a tolerance of **1/8 inch in 12 feet (3 mm in 3.7 m)**.
 - c. Do not use exposed fasteners, including pop rivets, on moldings and trim. If exposed fasteners are unavoidable, obtain approval from the Owner for their use and use security fasteners.
 - 3. Install accessories where indicated and as required to comply with performance requirements.
 - a. Sound-Absorptive Pads: For security ceiling panels indicated, provide sound-absorptive pads of width and length to completely fill inside of each security ceiling panel.
 - 1) Install sound-absorptive pads over metal spacer grids **OR** with support clips, **as directed**.
 - b. Backer Plates: Install plates in areas indicated on reflected ceiling plans or in room finish schedules. Lay backer plates directly on security ceiling system in manner indicated and close major openings to form complete coverage in required areas. Lay second sound-absorptive pad on backer plate, **as directed**.
- C. Downward-Locking-Panel Security Ceiling System Installation
 - 1. Comply with ASTM C 636 **OR** IBC Standard, **as directed**, and seismic requirements indicated, per manufacturer's written instructions and Cisca's "Ceiling Systems Handbook."
 - 2. Ceiling Hangers: Suspend from building's structural members and as follows:

- a. Install hangers plumb and free from contact with insulation or other objects within security ceiling plenum that are not part of supporting structure or of security ceiling suspension system.
 - b. Splay hangers only where required to avoid obstructions; offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.
 - c. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with location of hangers at spacings required to support standard suspension system members, install supplemental suspension members and hangers in form of trapezes or equivalent devices.
 - d. Secure wire hangers to security ceiling suspension members and to supports above with a minimum of three tight turns. Connect hangers directly either to structures or to inserts, eye screws, or other devices that are secure and appropriate for substrate and that will not deteriorate or otherwise fail due to age, corrosion, or elevated temperatures.
- OR**
- Secure flat, angle, channel, and rod hangers to structure, including intermediate framing members, by attaching to inserts, eye screws, or other devices that are secure and appropriate for both structure to which hangers are attached and type of hanger involved. Install hangers in a manner that will not cause them to deteriorate or fail due to age, corrosion, or elevated temperatures.
- e. Do not support security ceilings directly from permanent metal forms or floor deck. Fasten hangers to cast-in-place hanger inserts, postinstalled mechanical or adhesive anchors, or power-actuated fasteners that extend through forms into concrete.
 - f. When steel framing does not permit installation of hanger wires at spacing required, install carrying channels or other supplemental support for attachment of hanger wires.
 - g. Do not attach hangers to steel deck tabs.
 - h. Do not attach hangers to steel roof deck. Attach hangers to structural members.
 - i. Space hangers not more than **48 inches (1220 mm)** o.c. along each member supported directly from hangers, unless otherwise indicated; provide hangers not more than **8 inches (200 mm)** from ends of each member.
 - j. Install suspension system runners so they are square and securely interlocked with one another. Remove and replace dented, bent, or kinked members.
 - k. Install compression struts extending from main runners to structure above and spaced at **48 inches (1220 mm)** o.c.
3. Install suspension system runners so they are square and securely interlocked with one another. Remove and replace dented, bent, or kinked members.
 4. Panel Installation: Install panels to continuously engage with and lock under rectangular bulb of suspension system. Attach panels to perimeter supports with security fasteners not more than **3 inches (76 mm)** from edges of panel. Fasten through exposed face of supports into panel.
 - a. Align joints in adjacent courses to form uniform, straight joints parallel to room axis in both directions unless otherwise indicated.
 - b. Fit adjoining units to form flush, tight joints. Scribe and cut units for accurate fit at borders and around construction penetrating security ceiling.
 - c. Install directionally patterned panels in directions indicated.
 - d. Scribe and cut security ceiling panels for accurate fit at borders and at interruptions and penetrations by other work through security ceilings. Stiffen edges of cut panels as required to eliminate evidence of buckling or variations in flatness.
 5. Install each access panel within one security ceiling panel and attach with security fasteners **OR** by continuously welding access panel frame to security ceiling panel, **as directed**.
- D. Security-Plank Security Ceiling System Installation**
1. Install security planks with long edges continuously interlocked. Adjust security planks to final position before permanently fastening. Provide minimum **1-1/2-inch (38-mm)** end bearing.
 - a. Attach adjacent security planks to each other with security fasteners spaced not more than **12 inches (305 mm)** o.c. and not more than **6 inches (152 mm)** from ends.

- b. Continuously weld ends of security planks to perimeter supports. Remove exposed projecting burrs, edges, and rough spots resulting from welding operations by grinding smooth.
OR
Attach ends of security planks to perimeter supports with security fasteners not more than **3 inches (76 mm)** from edges of security plank. Fasten through exposed face of supports into security planks.
 - c. Provide intermediate carriers for ends of security planks that are not supported by perimeter supports. To attach security planks to intermediate carriers, use same method as that used for attaching security planks to perimeter supports.
 - 1) Support intermediate carriers from structure above by secondary support system spaced at **48 inches (1220 mm)** o.c. and bolted to carriers.
 2. Install each access panels within one security plank and attach with security fasteners **OR** by continuously welding access panel frame to security plank, **as directed**.
 3. Provide steel angle reinforcement on each side of openings that exceed **12 inches (305 mm)** in any direction.
- E. Field Quality Control
1. Detention Specialist shall inspect **OR** Inspect, **as directed**, installed products to verify compliance with requirements. Prepare inspection reports and indicate compliance with and deviations from the Contract Documents.
 2. Remove and replace security ceiling systems where inspections indicate that work does not comply with specified requirements.
 3. Perform additional inspections to determine compliance of replaced or additional work. Prepare inspection reports.
 4. Prepare field quality-control certification that states installed products and their installation comply with requirements in the Contract Documents.
 5. Field Quality-Control Testing: Engage a qualified independent testing agency to perform field quality-control testing.
 6. Extent and Testing Frequency: Testing will take place in successive stages in areas described below. Proceed with installation of security ceiling systems only after test results for previously installed hangers comply with requirements.
 - a. Extent of Each Test Area: When installation of security ceiling suspension systems on each floor has reached 20 percent completion but no security panel units have been installed.
 - b. Within each test area, testing agency will select 1 of every 10 powder-actuated fasteners and postinstalled anchors used to attach hangers to concrete and will test them for **200 lbf (890 N)** of tension; it will also select 1 of every 2 postinstalled anchors used to attach bracing wires to concrete and will test them for **440 lbf (1957 N)** of tension.
 - c. When testing discovers fasteners and anchors that do not comply with requirements, testing agency will test those fasteners and anchors not previously tested until 20 consecutively pass and then will resume initial testing frequency.
 7. Fasteners and anchors will be considered defective if they do not pass tests and inspections.
 8. Prepare test and inspection reports.
 9. Additional Testing: Where fasteners and anchors are removed and replaced, additional testing will be performed to determine compliance with specified requirements.
- F. Cleaning
1. Remove and replace work that cannot be successfully cleaned and repaired to permanently eliminate evidence of damage, including dented and bent units.
 2. Touchup Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas of shop paint, and paint exposed areas with same material as that used for shop painting; comply with SSPC-PA 1 for touching up shop-painted surfaces.
 - a. Apply by brush or spray to provide a minimum dry film thickness of **2 mils (0.05 mm)**.
 3. Metallic-Coated Steel Surfaces: Clean field welds, bolted connections, and abraded areas and repair zinc or zinc-iron coating to comply with ASTM A 780.



END OF SECTION 13 42 63 16

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Task	Specification	Specification Description
13 42 63 16	11 98 12 00	Detention Enclosures
13 42 63 16	10 86 00 00	Detention Furniture

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SECTION 13 47 13 13 - CATHODIC PROTECTION

1.1 GENERAL

A. Description Of Work

1. This specification covers the furnishing and installation of materials for cathodic protection. Products shall be as follows or as directed by the Owner. Installation procedures shall be in accordance with the product manufacturer's recommendations. Demolition and removal of materials shall be as required to support the work.

B. Summary

1. Section includes passive cathodic protection systems that use magnesium or zinc anodes to protect iron and steel piping and tanks.

C. Performance Requirements

1. Delegated Design: Design, supervise, test, and inspect the installation of cathodic protection systems, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.
 - a. Design cathodic protection for pipelines according to NACE RP0169.
 - b. Design cathodic protection for metal underground storage tanks according to NACE RP0285.
2. Survey site and determine soil or water corrosivity (resistivity), current requirements, potential surveys, stray currents, and water chemistry/corrosivity (pH).
3. Select anodes and accessories relevant to level of protection. Design anodes for an estimated life of 15 **OR** 30, **as directed**, years before replacement.
4. Cathodic protection systems shall provide protective potential that complies with referenced NACE standards. Insulators are required if needed to insulate protected metals from other structures.

D. Submittals

1. Product Data: For each type of product indicated.
2. Shop Drawings: For cathodic protection. Include plans, evaluations, sections, details, and attachments to other work.
 - a. Detail locations of cathodic protection equipment, devices, and outlets, with characteristics and cross-references to products.
 - b. Include calculations and details of anode designs.
 - c. Include labeling and identifying scheme for wires, cables, and test boxes.
3. Delegated-Design Submittal: For cathodic protection system indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified corrosion engineer responsible for their preparation.
 - a. Conduct site tests necessary for design, including soil resistivity, close-interval potential surveys, testing during construction, interference testing, and training of the Owner's personnel.
 - b. Provide system design calculations, stating the maximum recommended anode current output density, and the rate of gaseous production, if any, at that current density.
4. Coordination Drawings: Plans, drawn to scale, and coordinating connections to piping and tanks.
5. Qualification Data: For qualified professional engineer. Submit evidence of current license, corporate authorization (if applicable) of the engineering business, and NACE certifications.
6. Field quality-control reports.
7. Operation and Maintenance Data: Include the following:
 - a. Basic system operation, outlining the step-by-step procedures required for system startup, operation, adjustment of current flow, and shutdown.
 - b. Instructions for pipe-to-reference cell and tank-to-reference cell potential measurements and frequency of monitoring.

- c. Instructions for dielectric connections, interference and sacrificial-anode bonds; and precautions to ensure safe conditions during repair of pipe, tank or other metallic systems. Instructions shall be neatly bound.
- d. Locations of all anodes, test stations, and insulating joints.
- e. Structure-to-reference cell potentials as measured during the tests required by "Field Quality Control" Article.
- f. Recommendations for maintenance testing, including instructions for pipe-to-reference cell potential measurements and frequency of testing.
- g. Precautions to ensure safe conditions during repair of pipe system.
- 8. Warranty: Sample of special warranty.

E. Quality Assurance

- 1. Corrosion Engineer Qualifications: A qualified professional engineer who has education and experience in cathodic protection of buried and submerged metal structures and has NACE accreditation or certification as a Corrosion Specialist or Cathodic Protection Specialist.

F. Delivery, Storage, And Handling

- 1. Protect anodes from exposure to rain and direct sunlight.

G. Warranty

- 1. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace permanent reference electrodes that fail in materials or workmanship within specified warranty period.
 - a. Warranty Period: 15 **OR** 30, **as directed**, years from date of Final Completion.

1.2 PRODUCTS

A. Magnesium Anodes, Type II

- 1. Comply with ASTM B 843.
- 2. Chemical composition as percent of weight shall be as follows:
 - a. Aluminum: 0.010 maximum.
 - b. Manganese: 0.50 to 1.3.
 - c. Zinc: 0.05 maximum.
 - d. Silicon: 0.50 maximum.
 - e. Copper: 0.02 maximum.
 - f. Nickel: 0.001 maximum.
 - g. Iron: 0.03 maximum.
 - h. Other Impurities: 0.05 each; 0.3 maximum total.
 - i. Magnesium: Remainder.
- 3. Anode Core: Galvanized steel with anode wire silver-soldered to the core. Connection shall be recessed and epoxy insulated for 600-V rating. Connection shall be covered with heat-shrinkable tubing, and insulation shall be extended over connection.
- 4. Anode Wires: Factory-installed cables, with copper conductors, suitable for direct burial; not less than No. 10 AWG with Type THWN insulation according to ASTM D 1248 and NEMA WC 70/ICEA S-95-658; long enough to extend to accompanying junction box without splicing.
- 5. Anode Backfill: Backfill materials packaged in water-permeable fabric sack or cardboard container. Anodes shall be factory installed in packaged backfill using methods that result in dense packing of fill with factory-installed anode spacers to ensure centering of anode in packaged anode backfill. Backfill material shall have the following chemical composition by weight:
 - a. Hydrated Gypsum: 75 percent.
 - b. Bentonite Clay: 20 percent.
 - c. Anhydrous Sodium Sulfate: 5 percent.

B. Magnesium/Manganese Alloy Anodes

1. Chemical composition as percent of weight shall be as follows:
 - a. Aluminum: 0.01 maximum.
 - b. Manganese: 0.50 to 1.3.
 - c. Copper: 0.02 maximum.
 - d. Nickel: 0.001 maximum.
 - e. Iron: 0.03 maximum.
 - f. Other Impurities: 0.05 each; 0.3 maximum total.
 - g. Magnesium: Remainder.
2. Bare Anode Weight: **40 lb (18 kg)**, not including core, and a nominal length of **60 inches (1520 mm)**.
3. Anode Wires: Factory-installed cables, with copper conductors, suitable for direct burial; not less than No. 10 AWG with Type THWN insulation according to ASTM D 1248 and NEMA WC 70/ICEA S-95-658; long enough to extend to accompanying junction box without splicing.
4. Anode Backfill: Backfill materials packaged in water-permeable fabric sack or cardboard container. Anodes shall be factory installed in packaged backfill using methods that result in dense packing of fill with factory-installed anode spacers to ensure centering of anode in packaged anode backfill. Backfill material shall have the following chemical composition by weight:
 - a. Hydrated Gypsum: 75 percent.
 - b. Bentonite Clay: 20 percent.
 - c. Anhydrous Sodium Sulfate: 5 percent.

C. Zinc Anodes For Buried Service, Type Z-1

1. Comply with ASTM B 418, Type II.
2. Chemical composition as percent of weight shall be as follows:
 - a. Aluminum: 0.005 maximum.
 - b. Cadmium: 0.003 maximum.
 - c. Iron: 0.0014 maximum.
 - d. Zinc: Remainder.
3. Bare Anode Ingot Weight: **30 lb (13.6 kg)**, **2 inches (50 mm)** square and **30 inches (760 mm)** long. Packaged weight of anode bag shall be **70 lb (32 kg)**.
4. Anode Wires: Factory-installed cables, with copper conductors, suitable for direct burial; not less than No. 10 AWG with Type THWN insulation according to ASTM D 1248 and NEMA WC 70/ICEA S-95-658; long enough to extend to accompanying junction box without splicing.
5. Anode Backfill: Backfill materials packaged in water-permeable fabric sack or cardboard container. Anodes shall be factory installed in packaged backfill using methods that result in dense packing of fill with factory-installed anode spacers to ensure centering of anode in packaged anode backfill. Backfill material shall have the following chemical composition by weight:
 - a. Hydrated Gypsum: 75 percent.
 - b. Bentonite Clay: 20 percent.
 - c. Anhydrous Sodium Sulfate: 5 percent.

D. Permanent Reference Electrodes

1. Copper/copper sulfate (Cu/CuSO₄), suitable for direct burial. Electrode shall be guaranteed by supplier for 15 **OR** 30, **as directed**, years' service in the installed environment.

E. Wire And Cable

1. Anode Header Cable: Single-conductor, Type HMWPE, insulated cable specifically designed for direct-buried dc service in cathodic protection installations.
 - a. Conductor: Stranded, annealed, uncoated copper, not less than No. 8 AWG, complying with ASTM B 3 and ASTM B 8.



- b. Insulation: High-molecular-weight polyethylene, complying with NEMA WC 70/ICEA S-95-658.
 - c. Minimum Average Thickness of Insulation: **110 mils (2.8 mm)** for Nos. 8 through 2 AWG, and **125 mils (3.2 mm)** for Nos. 1 through 4/0 AWG; rated at 600 V.
 - d. Connectors: Copper-compression type or exothermic welds.
- 2. Conductors and Cables: Comply with requirements in Division 26 Section "Low-voltage Electrical Power Conductors And Cables".
 - a. Bonding Conductors for Joint and Continuity Bonds: Not less than No. 8 AWG, stranded, Type THWN copper conductors.
 - b. Flexible Pipe Coupling Bonds: Flexible copper straps with electrical resistance equal to No. 1/0 AWG stranded copper wire and with five holes for five exothermic welds to pipe.
 - c. Test Wires: No. 12 AWG, Type THWN copper conductors.
 - d. Resistance Wires: No. 16 or No. 22 AWG nickel-chromium wire.
 - e. Cables for Installation in Conduit: Type THWN copper conductors.
- F. Test Stations
 - 1. Plastic Test Stations: Flush-mounted type, manufactured of high-impact-resistant PVC or polycarbonate with watertight conduit connections and cover and removable terminal board having at least five terminals.
 - 2. Test Station Mounting Enclosures:
 - a. Non-Traffic-Area Boxes: Comply with requirements in Division 26 Section "Raceway And Boxes For Electrical Systems".
 - b. Traffic-Area Boxes: Comply with requirements in Division 26 Section "Underground Ducts And Raceways For Electrical Systems". Boxes shall have cast-iron covers with a welded bead legend "CP TEST."
- G. Sealing, Potting, And Dielectric Compounds
 - 1. Sealing and Dielectric Insulating Compound: Comply with NACE RP0188. Black, rubber based, soft, permanently pliable, tacky, moldable, and unbacked; **0.125 inch (3 mm) OR 0.5 inch (13 mm), as directed**, thick.
 - 2. Potting Compound: Comply with NACE RP0188. Cast-epoxy, two-package type; fabricated for this purpose and covered with heat-shrinkable tape.
 - 3. Pressure-Sensitive, Vinyl-Plastic Electrical Tape: Comply with UL 510.
- H. Exothermic Welding Materials
 - 1. Exothermic Weld Kits: Specifically designed by manufacturer for welding materials and shapes required.
 - 2. Exothermic Weld Caps: Dome of high-density polyethylene, **10-mil (0.254-mm)** minimum thickness, filled with mastic and containing a tunnel portion to separate lead wire from exothermic weld.
- I. Coating Repair Materials
 - 1. Touchup Coating Materials: Comply with requirements in Division 09 Section "High-performance Coatings" for coating systems for touchup of factory-applied coatings.
 - 2. Adhesive-Applied Coating Materials: Coating materials shall be compatible with factory-applied coating system.
 - a. Nominal thickness of coating materials shall be not less than **8 mils (0.2 mm) OR 16 mils (0.4 mm) OR 24 mils (0.6 mm) OR 40 mils (1.0 mm) OR 60 mils (1.5 mm), as directed**, plus or minus 5 percent.
 - b. Coating materials shall be one of the following supplied by factory-applied coating system manufacturer:
 - 1) Polyvinyl-chloride, pressure-sensitive, adhesive tape.
 - 2) High-density polyethylene/bituminous rubber compound tape.
 - 3) Butyl rubber tape.
 - 4) Coal-tar epoxy.

1.3 EXECUTION

A. General Installation Requirements

1. Comply with ANSI/IEEE C2 and NFPA 70.
2. Make connections to ferrous pipe and metal tanks using exothermic welding.
3. Coat welds with the coating repair material and apply an exothermic weld cap.

B. Magnesium Anode Installation

1. Install magnesium anodes at locations that clear obstructions. Install at least **36 inches (900 mm)** and no more than **10 feet (3 m)** from pipe or tank to be protected. Install in augered holes with top of anode **24 inches (600 mm)** below pipe invert elevation **OR** a minimum of **36 inches (900 mm)** below finished grade. In soils that will collapse into augered holes, use casing of galvanized sheet steel.
2. Install anodes in a dry condition after plastic or waterproof protective covering has been completely removed from water-permeable permanent container that houses anode metal. Do not use anode-connecting wire for lowering anode into hole. Backfill annular space around anode with fine earth in **6-inch (150-mm)** layers; compact each layer using hand tools. Do not strike anode or connecting wire during backfilling and compacting. After backfilling and compacting to within **6 inches (150 mm)** of finished grade, pour approximately **5 gal. (20 L)** of water into each filled hole. After water has been absorbed by earth, complete backfilling to finished level.
3. If rock strata are encountered before achieving specified augered hole depth, install anodes horizontally at depth at least as deep as bottom of pipe to be protected.
4. Install anodes spaced as indicated, directly connected **OR** connected through a test station, **as directed**, to the pipeline, allowing slack in connecting wire to compensate for movement during backfill operation.
5. For tank protection, connect groups of anodes to collector cable. Make contact, through a test station, with tank to be protected.
6. Do not use resistance wires to reduce current output of individual or group anodes.

C. Zinc Anode Installation

1. Install zinc anode horizontally in a hole at least **3 inches (76 mm)** larger than anode. Install anode under new copper water tubing, including service lines, blowoffs, and air releases. Separate piping and anode by at least **24 inches (600 mm)**, but not more than **60 inches (1520 mm)**.
2. Install anode midway between both ends of piping. Install anode wire in piping trench and connect to piping at an accessible location. Install anode wire in PVC conduit where rising out of the ground to the aboveground connection.

D. Installation Of Reference Electrodes

1. Install directly beneath the buried metallic component being protected.

E. Cable And Wire Installation

1. Install conductors, except anode wires, in PVC conduit with waterproof PVC junction boxes. Comply with requirements in Division 26 Section "Raceway And Boxes For Electrical Systems" for conduit and its installation.
2. Anode Wire Installation: Cover trench bottom for the anode wire with **3-inch (76-mm)** layer of sand or stone-free earth. Center wire on backfill layer and do not stretch or kink the conductor. Place backfill over wire in layers not exceeding **6 inches (150 mm)** deep, and compact each layer. Use clean fill, free from roots, vegetable matter, and refuse. Place cable underground-line warning tape within **18 inches (460 mm)** of finished grade, above cable and conduit.
3. Bonding Conductors: Install conductors on metallic pipe and tanks, to and across buried flexible couplings, mechanical joints, and flanged joints except at places where insulating joints are specified. Welded and threaded joints are considered electrically continuous and do not require bonding.
 - a. Install at least two bonds between parts requiring bonding.

- b. Bonding conductors must contain sufficient slack for anticipated movement between structures. Bonding conductors across pipe joints shall have not less than a 4-inch (100-mm) slack for pipe expansion, contraction, and soil stress.
- c. Connect bonding conductors to pipe, coupling follower rings and coupling middle ring or sleeve. Connect bonding conductors with exothermic welds.
4. For wire splicing, use compression connectors or exothermic welds.

F. Test Stations

1. Install test stations as follows:
 - a. At 1000-foot (300-m) intervals.
 - b. At insulating joints.
 - c. At both ends of casings when casing material is included in the cathodic protection system.
 - d. Where pipe crosses other metal pipes.
 - e. Where pipe connects to existing piping system.
 - f. Where pipe connects to dissimilar metal pipe.
 - g. At each tank component.
2. Install test stations on backfill complying with requirements for trench bottom fill for anode wires unless otherwise indicated.
3. Terminate test conductors on terminal boards and install a spare set of test leads at each testing location.

G. Pipe Joints

1. Insulating Flange Sets: Cover flanges with sealing and dielectric compound.
2. Insulating Unions: Install electrical isolation at each building entrance and at other locations indicated on approved Delegated-Design Drawings. Cover unions with sealing and dielectric compound.

H. Insulating Pipe Sleeves

1. Install insulating sleeves between metallic piping and metal buildings, hangers, supports, and other metal structures. Completely surround the metallic pipe for the full length of the steel contact and effectively prevent contact between the cathodically protected metallic pipe and other metallic structures. Support insulating sleeve to prevent damage to coating and to accommodate relative movement, vibrations, and temperature differentials.

I. Dissimilar Metals

1. Underground Dissimilar Piping: Coat insulating joint and pipe at joints of dissimilar piping material with sealing and dielectric compound for a minimum distance of 10 pipe diameters on both sides of joint.
2. Underground Dissimilar Valves: Coat dissimilar ferrous valves and pipe with sealing and dielectric compound for a minimum distance of 10 pipe diameters on both sides of valve.
3. Aboveground Dissimilar Pipe and Valves: If dissimilar metal pipe joints and valves are not buried and are exposed only to atmosphere, coat connection or valve, including pipe, with sealing and dielectric compound for a minimum distance of three pipe diameters on both sides of junction.

J. Coatings

1. Field Joints: Apply adhesive-applied coating system in a thickness to achieve corrosion protection equal to adjacent factory-applied coating.

K. Identification

1. Comply with requirements in Division 26 Section "Identification For Electrical Systems".
 - a. Identify anode wires and anode header cables with marker tape.
 - b. Identify underground wires and cables with underground-line warning tape.
 - c. Identify text boxes with engraved, laminated acrylic or melamine label, permanently attached to text box.

- L. Field Quality Control
1. Comply with NACE RP0169 and NACE RP0285.
 2. Perform tests and inspections.
 - a. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.
 3. Tests and Inspections:
 - a. Static Pull Test: Choose, at random, one completed anode of each type for this destructive test. Demonstrate that anode wire connections have enough strength to withstand a minimum tensile load of **300 lb (136 kg)**. If test fails, replace all anodes and repeat test at another randomly selected anode.
 - b. Insulation Testing: Before anode system is connected to pipe and tank, test insulation at each insulating joint and fitting. Demonstrate that no metallic contact, or short circuit, exists between the two insulated sections of pipe and tank. Replace defective joints or fittings.
 - c. Bonding Tests: Test for electrical continuity across all bonded joints. Repair or add additional bonds until electrical continuity is achieved.
 - d. Baseline Potentials: After backfilling of pipe, tank, and anodes is completed, but before anodes are connected to pipe and tank, measure the static potential of pipe and tank to soil. Record initial measurements.
 - e. Anode Output: Measure electrical current as anodes or groups of anodes are connected to pipe and tank. Use a low-resistance ammeter. Record current, date, time, and location of each measurement.
 - f. Pipe- and- Tank-to-Reference Electrode Potential Measurements: On completion of installation of entire cathodic protection system, make electrode potential measurements according to NACE RP0169, using a copper/copper-sulfate reference electrode and a potentiometer-voltmeter, or a dc voltmeter with an internal resistance (sensitivity) of not less than 100,000 ohms per volt and a full scale of 1 or 2 V. Make measurements at same locations as those used for baseline potentials. Record voltage, date, time, and location of each measurement, using one of the following two methods:
 - 1) 0.85 V Negative Voltage: With cathodic system in operation, measure a negative voltage of at least minus 0.85 V between pipe or tank and a saturated copper/copper-sulfate reference electrode contacting the earth directly over pipe or tank.
 - 2) 100-mV Polarization Voltage: Determine polarization voltage shift by interrupting protective current and measuring polarization decay. An immediate voltage shift will occur if protective current is interrupted. Use voltage reading, after immediate shift, as base reading from which to measure polarization decay. Measure at least a minimum polarization voltage shift of 100 mV between pipe or tank and a saturated copper/copper-sulfate reference electrode contacting the earth directly over pipe or tank.
 4. Location of Measurements for Piping: For coated piping or conduit, measure from reference electrode in contact with the earth directly over pipe. Measure at intervals not exceeding **400 feet (120 m)**. Make additional measurements at each distribution service riser, with reference electrode placed directly over service line.
 5. Location of Measurements for Tanks: For underground tanks, measure from reference electrode located as follows:
 - a. Directly over center of tank.
 - b. At a point directly over tank and midway between each pair of anodes.
 - c. At each end of tank.
 6. Interference Testing: Test interference with cathodic protection from any foreign pipes and tanks in cooperation with the Owner of foreign pipes and tanks. Report results and recommendations.
 7. Stray Current Measurements: Perform at each test station. Mitigate stray currents due to lightning or overhead ac power transmission lines as provided for in NACE standards.
 8. Inspect coatings; comply with NACE RP0188. Repair imperfections of factory-applied coatings as specified in "Coatings" Article.



- a. Use electronic holiday detectors to detect coating imperfections.
- b. All damage to the protective coating during transit and handling shall be repaired before installation.
- c. Repair factory-applied coatings to have equal or better corrosion resistance than the factory-applied coating system. Field-repair material shall be of the type approved by, and shall be applied as recommended by, manufacturer of the coating material.

M. Adjusting

- 1. Adjust cathodic current using resistors as recommended by corrosion engineer who prepared the Delegated-Design Submittal in Part 1.1.
- 2. During the first year after Final Completion, test, inspect, and adjust cathodic protection system every three months to ensure its continued compliance with specified requirements.

N. Demonstration

- 1. Train the Owner's maintenance personnel to adjust, operate, and maintain cathodic protection system.

END OF SECTION 13 47 13 13

SECTION 14 01 30 71 - ELECTRIC TRACTION ELEVATORS

1.1 GENERAL

A. Description Of Work

1. This specification covers the furnishing and installation of materials for electric traction elevators. Products shall be as follows or as directed by the Owner. Installation procedures shall be in accordance with the product manufacturer's recommendations. Demolition and removal of materials shall be as required to support the work.

B. Summary

1. This Section includes electric traction passenger and service elevators.

C. Definitions

1. Definitions in ASME A17.1 apply to work of this Section.
2. Defective Elevator Work: Operation or control system failure, including excessive malfunctions; performances below specified ratings; excessive wear; unusual deterioration or aging of materials or finishes; unsafe conditions; need for excessive maintenance; abnormal noise or vibration; and similar unusual, unexpected, and unsatisfactory conditions.
3. Service Elevator: A passenger elevator that is also used to carry freight.

D. Submittals

1. Product Data: Include capacities, sizes, performances, operations, safety features, finishes, and similar information. Include product data for the following:
 - a. Car enclosures and hoistway entrances.
 - b. Operation, control, and signal systems.
2. Shop Drawings: Show plans, elevations, sections, and large-scale details indicating service at each landing, machine room layout, coordination with building structure, relationships with other construction, and locations of equipment and signals. Include large-scale layout of car control station and standby power operation control panel, **as directed**. Indicate variations from specified requirements, maximum dynamic and static loads imposed on building structure at points of support, and maximum and average power demands.
3. Samples: For exposed finishes of cars, hoistway doors and frames, and signal equipment; **3-inch- (75-mm-)** square Samples of sheet materials; and **4-inch (100-mm)** lengths of running trim members.
4. Manufacturer Certificates: Signed by elevator manufacturer certifying that hoistway, pit, and machine room layout and dimensions, as shown on Drawings, and electrical service, as shown and specified, are adequate for elevator system being provided.
5. Qualification Data: For Installer.
6. Operation and Maintenance Data: For elevators to include in emergency, operation, and maintenance manuals.
7. Inspection and Acceptance Certificates and Operating Permits: As required by authorities having jurisdiction for normal, unrestricted elevator use.
8. Warranty: Special warranty specified in this Section.

E. Quality Assurance

1. Installer Qualifications: Elevator manufacturer or manufacturer's authorized representative who is trained and approved for installation of units required for this Project.
2. Source Limitations: Obtain elevators, including hydraulic passenger elevators specified in another Division 14 Section, through one source from a single manufacturer.
 - a. Provide major elevator components, including driving machines, controllers, signal fixtures, door operators, car frames, cabs, and entrances, manufactured by a single manufacturer.
3. Legal Requirements: Comply with ASME A17.1 and elevator design requirements for earthquake loads in ASCE 7.



- a. Effective peak velocity acceleration (A_v) for Project's location is less than 0.10 (seismic risk zones 0 and 1) **OR** greater than or equal to 0.10, but less than 0.20 (seismic risk zone 2) **OR** greater than or equal to 0.20 (seismic risk zones 3 and 4), **as directed**.
 - b. Provide earthquake equipment required by ASME A17.1.
 - c. Design earthquake spectral response acceleration, short period (S_d s) for Project is determined by Project's location and site classification.
 - d. Project's seismic design category is A **OR** B **OR** C **OR** D, **as directed**.
 - e. Elevator importance factor is 1.5 **OR** 1.0, **as directed**.
 - f. Accessibility Requirements: Americans with Disabilities Act (including the ADA Standards issued by the U.S. Department of Justice and the U.S. Department of Transportation and the United States Access Board's Guide to the ADA Standards, specifically Chapter 4).
4. Fire-Rated Hoistway Entrance Assemblies: Door and frame assemblies complying with NFPA 80 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire-protection ratings indicated, based on testing at as close to neutral pressure as possible according to NFPA 252 **OR** IBC Standard 3002.4 **OR** UL 10B, **as directed**.

F. Delivery, Storage, And Handling

1. Deliver, store, and handle materials, components, and equipment in manufacturer's protective packaging.
2. Store materials, components, and equipment off of ground, under cover, and in a dry location. Handle according to manufacturer's written recommendations to prevent damage, deterioration, or soiling.

G. Coordination

1. Coordinate installation of sleeves, block outs, elevator equipment with integral anchors, and other items that are embedded in concrete or masonry for elevator equipment. Furnish templates, sleeves, elevator equipment with integral anchors, and installation instructions and deliver to Project site in time for installation.
2. Coordinate sequence of elevator installation with other work to avoid delaying the Work.
3. Coordinate locations and dimensions of other work relating to electric traction elevators including pit ladders, sumps, and floor drains in pits; entrance subsills; machine beams, **as directed**; and electrical service, electrical outlets, lights, and switches in pits and machine rooms **OR** hoistways, **as directed**.

H. Warranty

1. Special Manufacturer's Warranty: Manufacturer's standard form in which manufacturer agrees to repair, restore, or replace defective elevator work within specified warranty period.
 - a. Warranty Period: One year from date of Final Completion.

1.2 PRODUCTS

A. Systems And Components

1. General: Provide manufacturer's standard elevator systems. Where components are not otherwise indicated, provide standard components published by manufacturer as included in standard preengineered elevator systems and as required for complete system.
2. Elevator Machines: Provide variable-voltage, variable-frequency, ac-type hoisting machines **OR** At manufacturer's option, provide either variable-voltage, variable-frequency, ac-type or variable-voltage, dc-type hoisting machines, **as directed**. Provide solid-state power converters.
 - a. Provide regenerative **OR** nonregenerative, **as directed**, system.
 - b. Limit total harmonic distortion of regenerated power to 5 percent per IEEE 519.
 - c. Provide means for absorbing regenerated power when elevator system is operating on standby power.
 - d. Provide line filters or chokes to prevent electrical peaks or spikes from feeding back into building power system.

3. Fluid for Oil Buffers: If oil buffers are used, use only fire-resistant hydraulic fluid containing antioxidant, anticorrosive, antifoaming, and metal-passivating additives.
4. Inserts: Furnish required concrete and masonry inserts and similar anchorage devices for installing guide rails, machinery, and other components of elevator work where installation of devices is specified in another Section.
5. Machine Beams: Provide framing to support elevator hoisting machine and deflector sheaves from the building structure. Comply with Division 5 Section "Metal Fabrications" for materials and fabrication.
6. Car Frame and Platform: Welded steel units.
7. Guides: Provide roller guides **OR** polymer-coated, nonlubricated sliding guides, **as directed**, at top and bottom of car and counterweight frames.

B. Operation Systems

1. General: Provide manufacturer's standard microprocessor operation system for each elevator **OR** for each group of elevators, **as directed**, as required to provide type of operation system indicated.
2. Group Automatic Operation with Demand-Based Dispatching: Provide reprogrammable, **as directed**, group automatic system that assigns cars to hall calls based on a dispatching program designed to minimize passenger waiting time. System automatically adjusts to changes in demand for different traffic conditions including heavy incoming, heavy two-way, heavy outgoing, and light off-hours as variations of normal two-way traffic.
3. Destination-Based Group Automatic Operation: Provide reprogrammable group automatic system that assigns elevators leaving the main lobby in the up direction to a selected group of floors and directs passengers to an elevator serving their destination floor. System dispatches cars in a regulated sequence for optimum system efficiency; dispatch is based on origin and destination of calls. System automatically adjusts to changes in demand for different traffic conditions including heavy incoming, heavy two-way, heavy outgoing, and light off-hours as variations of normal two-way traffic.
4. Auxiliary **OR** Single-Car Auxiliary, **as directed**, Operations: In addition to primary operation system features, provide the following operational features for elevators where indicated:
 - a. Standby Power Operation: On activation of standby power, car is returned to a designated floor and parked with doors open. Car can be manually put in service on standby power, either for return operation or for regular operation, by switches in control panel located at main lobby **OR** fire command station, **as directed**. Manual operation causes automatic operation to cease.
 - b. Standby Powered Lowering: On activation of standby power, if car is at a floor, it remains at that floor, opens its doors, and shuts down. If car is between floors, it is lowered to the next floor below, opens its doors, and shuts down.
 - c. Battery-Powered Lowering: If power fails and car is at a floor, it remains at that floor, opens its doors, and shuts down. If car is between floors, it is lowered to the next floor below, opens its doors, and shuts down. System includes rechargeable battery and automatic recharging system.
 - d. Automatic Dispatching of Loaded Car: When car load exceeds 80 percent of rated capacity, doors will begin closing.
 - e. Nuisance Call Cancel: When car calls exceed a preset number while car load is less than a predetermined weight, all car calls are canceled. Preset number of calls and predetermined weight, **as directed**, can be adjusted.
5. Group Auxiliary Operations: In addition to primary operation system features, provide the following operational features for elevators and elevator groups where indicated:
 - a. Standby Power Operation: On activation of standby power, cars are returned to a designated floor and parked with doors open. One car is returned at a time, with priority given to loaded cars. If a car cannot be returned after two attempts, it is removed from the system. When all cars have been returned or removed from the system, one car is automatically placed in service. If car selected for service cannot operate within 60 seconds, the system removes car from service and places another car in service. Cars can be manually put in service on standby power, either for return operation or for regular



- operation, by switches in control panel located at main lobby **OR** fire command station, **as directed**. Manual operation causes automatic operation to cease.
- b. Standby Power Operation: On activation of standby power, cars are returned, one at a time, to a designated floor and parked with doors open. If a car cannot be returned, it is removed from the system. When all cars have been returned or removed from the system, one car can be put in service on standby power by a selector switch in control panel located at main lobby **OR** fire command station, **as directed**.
 - c. Battery-Powered Lowering: If power fails, cars that are at a floor remain at that floor, open their doors, and shut down. Cars that are between floors are lowered one at a time to the next floor below, open their doors, and shut down. System includes rechargeable battery and automatic recharging system.
 - d. Automatic Dispatching of Loaded Car: When car load exceeds 80 percent of rated capacity, doors will begin closing.
 - e. Nuisance Call Cancel: When car calls exceed a preset number while the car load is less than a predetermined weight, all car calls are canceled. Preset number of calls and predetermined weight, **as directed**, can be adjusted.
 - f. Emergency Hospital **OR** Priority, **as directed**, Service: Service is initiated by a keyswitch **OR** card reader **OR** remote switch, **as directed**, at designated floors. One elevator is removed from group operation and directed to the floor where service was initiated. On arriving at the floor, elevator opens its doors and parks and a lighted sign directs passengers to exit elevator, **as directed**. Car is placed in operation by selecting a floor and pressing door close button or by operating keyswitch to put car in independent service. After responding to floor selected or being removed from independent service, car is returned to group operation. If car is not placed in operation within a preset time after being called, it is returned to group operation.
 - g. Independent Service: Keyswitch in car control station removes car from group operation and allows it to respond only to car calls. Key cannot be removed from keyswitch when car is in independent service. When in independent service, doors close only in response to door close button.
 - h. Loaded-Car Bypass: When car load exceeds 80 percent of rated capacity, car will respond only to car calls, not to hall calls.
 - i. Distributed Parking: When cars are not required for response to calls, they are parked with doors closed, distributed in predetermined zones throughout the building. One zone shall include the main floor and adjacent floors; remaining floors shall be divided into approximately equal zones.
6. Security Features: Provide the following security features, where indicated. Security features shall not affect emergency firefighters' service.
- a. Card-Reader Operation: System uses card readers at car control stations **OR** hall push-button stations, **as directed**, to authorize calls. Security system determines which landings and at what times calls require authorization by card reader. Provide required conductors in traveling cable and panel in machine room for interconnecting card readers, other security access system equipment, and elevator controllers. Allow space as indicated for card reader in car **OR** Provide stripe-swipe card reader integral with each car control station, **as directed**.
 - 1) Security access system equipment is specified in Division 28 Section "Access Control".
OR
Security access system equipment is not in the Contract.
 - b. Keyswitch Operation: Push buttons are activated and deactivated by security keyswitches at car control stations **OR** hall push-button stations, **as directed**. Key is removable only in deactivated position **OR** in either position, **as directed**.
 - c. Keypad Operation: Allows each landing to be restricted or unrestricted. When a restricted landing button is pressed, a "Restricted Floor" lamp lights and remains lit until landing access code has been entered into a keypad or predetermined time period has elapsed.

Car calls for restricted landings do not register until landing access code is entered into keypad within predetermined time period after landing button is pressed.

- 1) Access codes are programmed at each car operating panel using a security keyswitch. Keypad operation can be activated and deactivated by security keyswitch at main landing.
 - d. Car-to-Lobby Feature: Feature, activated by keyswitch at main lobby, that causes car **OR** all cars in a group, **as directed**, to return immediately to lobby and open doors for inspection. On deactivation by keyswitch, calls registered before keyswitch activation are completed and normal operation is resumed.
- C. Door Reopening Devices
1. Infrared Array: Provide door reopening devices with uniform array of 36 or more microprocessor-controlled, infrared light beams projecting across car entrance. Interruption of one or more of the light beams shall cause doors to stop and reopen.
 2. Nudging Feature: After car doors are prevented from closing for predetermined adjustable time, through activating door reopening device, a loud buzzer shall sound and doors shall begin to close at reduced kinetic energy.
- D. Finish Materials
1. General: Provide the following materials for exposed parts of elevator car enclosures, car doors, hoistway entrance doors and frames, and signal equipment as indicated.
 2. Cold-Rolled Steel Sheet: ASTM A 1008/A 1008M, commercial steel, Type B, exposed, matte finish.
 3. Hot-Rolled Steel Sheet: ASTM A 1011/A 1011M, commercial steel, Type B, pickled.
 4. Stainless-Steel Sheet: ASTM A 240/A 240M, Type 304.
 - a. Textured Stainless-Steel Sheet: Product with coined **OR** embossed, **as directed**, texture rolled into exposed surface.
 - 1) Metal surface is satin polished **OR** satin relieved **OR** titanium nitride colored **OR** oxide colored **OR** satin polished and titanium nitride colored **OR** satin relieved and titanium nitride colored **OR** satin polished and oxide colored **OR** satin relieved and oxide colored **OR** color coated and satin relieved **OR** color coated and bright relieved, **as directed**, after rolling.
 5. Stainless-Steel Bars: ASTM A 276, Type 304.
 6. Stainless-Steel Tubing: ASTM A 554, Grade MT 304.
 7. Bronze Plate and Sheet: ASTM B 36/B 36M, Alloy UNS No. C28000 (muntz metal).
 8. Bronze Extrusions: ASTM B 455, Alloy UNS No. C38500 (architectural bronze).
 9. Bronze Tubing: **ASTM B 135 (ASTM B 135M)**, Alloy UNS No. C23000 (red brass, 85 percent copper).
 10. Aluminum Extrusions: **ASTM B 221 (ASTM B 221M)**, Alloy 6063.
 11. Nickel Silver Extrusions: ASTM B 151/B 151M, Alloy UNS No. C74500 or No. C77600.
 12. Plastic Laminate: High-pressure type complying with NEMA LD 3, Type HGS for flat applications **OR** Type HGL for flat applications, **as directed**, Type HGP for postformed applications and Type BKV for panel backing.
- E. Car Enclosures
1. General: Provide enameled-steel car enclosures to receive removable **OR** steel-framed car enclosures with nonremovable, **as directed**, wall panels, with car **OR** removable car, **as directed**, roof, access doors, power door operators, and ventilation.
 - a. Provide standard railings complying with ASME A17.1 on car tops where required by ASME A17.1.
 - b. Provide finished car including materials and finishes specified below.
 2. Materials and Finishes: Provide manufacturer's standards, but not less than the following:
 - a. Subfloor: Underlayment grade, exterior plywood, **5/8-inch (16-mm)** nominal thickness.
 - b. Floor Finish: Specified in a Division 9 Section **OR** Elevator manufacturer's standard level-loop nylon carpet; color as selected from manufacturer's full range, **as directed**.

- c. Enameled-Steel Wall Panels: Flush, hollow-metal construction; fabricated from cold-rolled steel sheet. Provide with factory-applied enamel finish; colors as selected from manufacturer's full range.
 - d. Stainless-Steel Wall Panels: Flush, hollow-metal construction; fabricated from stainless-steel sheet.
 - e. Bronze Wall Panels: Flush, hollow-metal construction; fabricated from bronze sheet.
 - f. Plastic-Laminate Wall Panels: Plastic laminate adhesively applied to **1/2-inch (13-mm)** fire-retardant-treated particleboard **OR** manufacturer's standard honeycomb core, **as directed**, with plastic-laminate panel backing and, **as directed**, manufacturer's standard protective edge trim. Panels have a flame-spread index of 25 **OR** 75, **as directed**, or less, when tested according to ASTM E 84. Plastic-laminate color, texture, and pattern as selected from plastic-laminate **OR** elevator, **as directed**, manufacturer's full range.
 - g. Fabricate car with recesses and cutouts for signal equipment.
 - h. Fabricate car door frame integrally with front wall of car.
 - i. Enameled-Steel Doors: Flush, hollow-metal construction; fabricated from cold-rolled steel sheet. Provide with factory-applied enamel finish; colors as selected from manufacturer's full range.
 - j. Stainless-Steel Doors: Flush, hollow-metal construction; fabricated from stainless-steel sheet **OR** by laminating stainless-steel sheet to exposed faces and edges of enameled cold-rolled steel doors using adhesive that fully bonds metal to metal without telegraphing or oil-canning, **as directed**.
 - k. Bronze Doors: Flush, hollow-metal construction; fabricated by laminating bronze sheet to exposed faces and edges of enameled cold-rolled steel doors using adhesive that fully bonds metal to metal without telegraphing or oil-canning.
 - l. Plastic-Laminate Doors: Flush, hollow-metal construction; fabricated by laminating plastic laminate to exposed faces of enameled cold-rolled steel doors and covering edges with protective edge trim matching return panels, **as directed**. Plastic-laminate color, texture, and pattern as selected from plastic-laminate **OR** elevator, **as directed**, manufacturer's full range.
 - m. Sight Guards: Provide sight guards on car doors.
 - n. Sills: Extruded metal, with grooved surface, **1/4 inch (6.4 mm)** thick.
 - o. Luminous Ceiling: Fluorescent light fixtures and ceiling panels of translucent acrylic or other permanent rigid plastic.
 - p. Metal **OR** Metallic-Finish, Plastic-Laminate, **as directed**, Ceiling: Flush panels, with incandescent downlights in the center of **OR** four low-voltage downlights in, **as directed**, each panel. Align ceiling panel joints with joints between wall panels, **as directed**.
 - q. Handrails: Manufacturer's standard handrails, of shape, metal, and finish indicated.
- F. Hoistway Entrances
- 1. General: Provide manufacturer's standard horizontal-sliding, door-and-frame hoistway entrances complete with track systems, hardware, sills, and accessories. Provide frame size and profile to coordinate with hoistway wall construction.
 - a. Where gypsum board wall construction is indicated, provide self-supporting frames with reinforced head sections.
 - 2. Materials and Fabrication: Provide manufacturer's standards, but not less than the following:
 - a. Enameled-Steel Frames: Formed from cold-rolled or hot-rolled steel sheet. Provide with factory-applied enamel finish; colors as selected from manufacturer's full range.
 - b. Steel Subframes: Formed from cold-rolled or hot-rolled steel sheet with factory-applied enamel finish or corrosion-inhibiting primer. Fabricate to receive applied finish as indicated.
 - c. Stainless-Steel Frames: Formed from stainless-steel sheet.
 - d. Bronze Frames: Formed from cold-rolled or hot-rolled steel sheet, with enamel finish, and with formed-bronze sheet laminated to steel frames using adhesive that fully bonds metal to metal without telegraphing or oil-canning.

- e. Enameled-Steel Doors and Transoms: Flush, hollow-metal construction; fabricated from cold-rolled steel sheet. Provide with factory-applied enamel finish; colors as selected from manufacturer's full range.
- f. Stainless-Steel Doors and Transoms: Flush, hollow-metal construction; fabricated from stainless-steel sheet **OR** by laminating stainless-steel sheet to exposed faces and edges of enameled cold-rolled steel doors using adhesive that fully bonds metal to metal without telegraphing or oil-canning, **as directed**.
- g. Bronze Doors and Transoms: Flush, hollow-metal construction; fabricated by laminating bronze sheet to exposed faces and edges of enameled cold-rolled steel doors using adhesive that fully bonds metal to metal without telegraphing or oil-canning.
- h. Plastic-Laminate Doors and Transoms: Flush, hollow-metal construction; fabricated by laminating plastic laminate to exposed faces of enameled cold-rolled steel doors and covering edges with protective edge trim matching door frames, **as directed**. Plastic-laminate color, texture, and pattern as selected from plastic-laminate **OR** elevator, **as directed**, manufacturer's full range.
- i. Sight Guards: Provide sight guards on doors matching door edges.
- j. Sills: Extruded metal, with grooved surface, **1/4 inch (6.4 mm)** thick.
- k. Nonshrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C 1107.

G. Signal Equipment

- 1. General: Provide hall-call and car-call buttons that light when activated and remain lit until call has been fulfilled. Fabricate lighted elements with long-life incandescent lamps and acrylic or other permanent, nonyellowing translucent plastic diffusers **OR** LEDs, **as directed**.
OR
General: Provide signal equipment designed for destination-based system. Fabricate lighted elements with long-life incandescent lamps and acrylic or other permanent, nonyellowing translucent plastic diffusers **OR** LEDs, **as directed**.
- 2. Car Control Stations: Provide manufacturer's standard recessed **OR** semirecessed, **as directed**, car control stations. Mount in return panel adjacent to car door, unless otherwise indicated.
OR
Swing-Return Car Control Stations: Provide car control stations mounted on rear of hinged return panel adjacent to car door and with buttons, switches, controls, and indicator lights projecting through return panel but substantially flush with face of return panel.
 - a. Mark buttons and switches with standard identification for required use or function that complies with ASME A17.1. Use both tactile symbols and Braille.
 - b. Provide "No Smoking" sign matching car control station, either integral with car control station or mounted adjacent to it, with text and graphics as required by authorities having jurisdiction.
- 3. Emergency Communication System: Provide system that complies with ASME A17.1 and the U.S. Architectural & Transportation Barriers Compliance Board's "Americans with Disabilities Act (ADA), Accessibility Guidelines for Buildings and Facilities (ADAAG)." On activation, system dials preprogrammed number of monitoring station and identifies elevator location to monitoring station. System provides two-way voice communication without using a handset and provides visible signals that indicate when system has been activated and when monitoring station has responded. System is contained in flush-mounted cabinet, with identification, instructions for use, and battery backup power supply.
- 4. Firefighters' Two-Way Telephone Communication Service: Provide flush-mounted cabinet **OR** telephone jack, **as directed**, in each car and required conductors in traveling cable for firefighters' two-way telephone communication service specified in Division 28 Section(s) "Digital, Addressable Fire-alarm System" **OR** "Zoned (dc Loop) Fire-alarm System".
- 5. Car Position Indicator: Provide illuminated, **as directed**, digital-type car position indicator, located above car door or above car control station. Also provide audible signal to indicate to passengers that car is either stopping at or passing each of the floors served.
 - a. Include travel direction arrows if not provided in car control station.



6. Hall Push-Button Stations: Provide one hall push-button station at each landing for each single elevator or group of elevators, but not less than one station for each four elevators in a group, **as directed**.
OR
Hall Push-Button Stations: Provide hall push-button stations at each landing as indicated.
 - a. Provide manufacturer's standard wall-mounted units.
OR
Provide units with flat faceplate for mounting with body of unit recessed in wall.
 - b. Equip units with buttons for calling elevator and for indicating desired direction of travel.
OR
Equip units with buttons **OR** touch screen, **as directed**, for calling elevator and for indicating direction of travel or destination as required by system. Provide a signaling system to verify floor selection, where destination registration is required, and to direct passengers to appropriate car.
 - 1) Provide a means for passengers to indicate that they have disabilities so control system can allow extra room in assigned car.
 - 2) Provide for connecting units that require destination registration to building security access system so a card reader can be used to register calls.
 - c. Provide telephone jack in each unit for firefighters' two-way telephone communication service specified in Division 28 Section(s) "Digital, Addressable Fire-alarm System" **OR** "Zoned (dc Loop) Fire-alarm System".
7. Hall Lanterns: Units with illuminated arrows; but provide single arrow at terminal landings. Provide one of the following:
 - a. Manufacturer's standard wall-mounted units, for mounting above entrance frames.
 - b. Units with flat faceplate for mounting with body of unit recessed in wall and with illuminated elements projecting from faceplate for ease of angular viewing.
 - c. Units mounted in both jambs of entrance frame for each elevator, **as directed**.
 - d. Units mounted in both car door jambs; may be used only for single elevators or for two-car groups, **as directed**.
8. Hall Annunciator: With each hall lantern, provide audible signals indicating car arrival and direction of travel. Signals sound once for up and twice for down.
 - a. At manufacturer's option, audible signals may be placed on car **OR** each car, **as directed**.
9. Hall Position Indicators: Provide illuminated, **as directed**, digital-display-type position indicators, located above each, **as directed**, hoistway entrance at ground floor. Provide units with flat faceplate for mounting with body of unit recessed in wall.
 - a. Integrate ground-floor hall lanterns with hall position indicators.
10. Standby Power Elevator Selector Switches: Provide switches, as required by ASME A17.1, where indicated. Adjacent to switches, provide illuminated signal that indicates when normal power supply has failed. For each elevator, provide illuminated signals that indicate when they are operational and when they are at the designated emergency return level with doors open.
OR
Fire Command Center Annunciator Panel: Provide panel containing illuminated position indicators for each elevator, clearly labeled with elevator designation; include illuminated signal that indicates when elevator is operational and when it is at the designated emergency return level with doors open. Provide standby power elevator selector switch(es), as required by ASME A17.1, adjacent to position indicators. Provide illuminated signal that indicates when normal power supply has failed.
11. Corridor Call Station Pictograph Signs: Provide signs matching hall push-button stations, with text and graphics as required by authorities having jurisdiction, indicating that in case of fire elevators are out of service and exits should be used instead. Provide one sign at each hall push-button station, unless otherwise indicated.

H. Elevators

1. Elevator Description:

- a. Group Number: **<Insert a different number for each group of elevators that share a group operation system.>**
- b. Elevator Number(s): **<Insert elevator number(s) as shown on Drawings.>**
- c. Service Elevator Number(s): **<Insert elevator number(s) as shown on Drawings.>**
- d. Type: Geared **OR** Gearless, **as directed**, traction.
- e. Machine Location: Machine room above hoistway **OR** Hoistway; no machine room is provided, **as directed**.
- f. Rated Load: **2000 lb (908 kg) OR 2100 lb (953 kg) OR 2500 lb (1135 kg) OR 3000 lb (1362 kg) OR 3500 lb (1589 kg) OR 4000 lb (1816 kg) OR 4500 lb (2043 kg) OR 5000 lb (2270 kg), as directed.**
- g. Freight Loading Class for Service Elevator(s): Class A.
- h. Rated Speed: **200 fpm (1.0 m/s) OR 350 fpm (1.8 m/s) OR 400 fpm (2.0 m/s) OR 450 fpm (2.3 m/s) OR 500 fpm (2.5 m/s) OR 700 fpm (3.6 m/s) OR 800 fpm (4.1 m/s) OR 1000 fpm (5.1 m/s) OR 1200 fpm (6.1 m/s) OR 1400 fpm (7.1 m/s), as directed.**
- i. Operation System: Selective collective automatic operation **OR** Group automatic operation **OR** Group automatic operation with demand-based dispatching **OR** Destination-based group automatic operation, **as directed**.
- j. Auxiliary Operations:
 - 1) Standby power operation.
 - 2) Standby powered lowering.
 - 3) Battery-powered lowering.
 - 4) Earthquake Emergency Operation: Comply with requirements in ASME A17.1.
 - 5) Automatic dispatching of loaded car.
 - 6) Nuisance call cancel.
 - 7) Emergency hospital **OR** Priority, **as directed**, service at designated floors **OR** all floors, **as directed**.
 - 8) Independent service for service elevator **OR** all cars in group, **as directed**.
 - 9) Loaded-car bypass.
 - 10) Distributed parking.
- k. Security Features: Card-reader operation **OR** Keyswitch operation **OR** Keypad operation **OR** Car-to-lobby feature, **as directed**.
- l. Dual Car Control Stations: Provide two car control stations in each elevator, **as directed**; equip only one with required keyswitches if any.
- m. Car Enclosures:
 - 1) Inside Width: **64 inches (1626 mm) OR 68 inches (1727 mm) OR 80 inches (2032 mm) OR 92 inches (2337 mm), as directed**, from side wall to side wall.
 - 2) Inside Depth: **51 inches (1295 mm) OR 53 inches (1346 mm) OR 57 inches (1448 mm) OR 65 inches (1651 mm) OR 87-1/2 inches (2222 mm) OR 90 inches (2286 mm) OR 93 inches (2362 mm) OR 93-1/2 inches (2375 mm) OR 96 inches (2438 mm) OR 101 inches (2565 mm) OR 102 inches (2591 mm), as directed**, from back wall to front wall (return panels).
 - 3) Inside Height: **88 inches (2235 mm) OR 92 inches (2337 mm) OR 94 inches (2388 mm) OR 100 inches (2540 mm) OR 104 inches (2642 mm) OR 108 inches (2743 mm) OR 112 inches (2845 mm), as directed**, to underside of ceiling.
 - 4) Front Walls (Return Panels): Polished stainless steel, No. 8 finish **OR** Satin stainless steel, No. 4 finish **OR** Polished bronze, lacquered **OR** Satin bronze, lacquered, **as directed**.
 - 5) Car Fixtures: Polished stainless steel, No. 8 finish **OR** Satin stainless steel, No. 4 finish **OR** Polished bronze, lacquered **OR** Satin bronze, lacquered, **as directed**.
 - 6) Side and Rear Wall Panels: Enameled steel **OR** Plastic laminate **OR** Satin stainless steel, No. 4 finish **OR** Textured stainless steel, **as directed**.
 - 7) Reveals: Enameled steel **OR** Polished stainless steel, No. 8 finish **OR** Satin stainless steel, No. 4 finish **OR** Polished bronze, lacquered **OR** Satin bronze, lacquered, **as directed**.

- 8) Door Faces (Interior): Enameled steel **OR** Polished stainless steel, No. 8 finish **OR** Satin stainless steel, No. 4 finish **OR** Textured stainless steel **OR** Polished bronze, lacquered **OR** Satin bronze, lacquered **OR** Plastic laminate, **as directed**.
- 9) Door Sills: Aluminum, mill finish **OR** Bronze, polished **OR** Nickel silver, polished, **as directed**.
- 10) Ceiling: Luminous ceiling **OR** Polished stainless steel, No. 8 finish **OR** Satin stainless steel, No. 4 finish **OR** Polished bronze, lacquered **OR** Reflective metallic-finish, plastic-laminate, stainless steel **OR** Reflective metallic-finish, plastic-laminate, bronze, **as directed**.
- 11) Handrails: 1-1/2 inches (38 mm) round **OR** 1/2 by 2 inches (13 by 50 mm) rectangular, **as directed**, mirror-polished stainless steel, No. 8 finish **OR** satin stainless steel, No. 4 finish **OR** mirror-polished bronze, lacquered **OR** satin bronze, lacquered, **as directed**, at sides **OR** rear **OR** sides and rear, **as directed**, of car.
- 12) Floor: Manufacturer's standard carpet.
OR
 Floor prepared to receive carpet (specified in Division 09 Section "Sheet Carpeting").
OR
 Floor prepared to receive resilient tile (specified in Division 09 Section "Resilient Tile Flooring").
OR
 Floor prepared to receive sheet vinyl (specified in Division 09 Section "Resilient Sheet Flooring").
OR
 Floor recessed and prepared to receive dimension stone tile (specified in Division 09 Section "Stone Tiling") **OR** ceramic tile (specified in Division 09 Section "Tiling"), **as directed**.
- 13) Floor Thickness, Including Setting Materials: <Insert thickness> above plywood subfloor.
- n. Hoistway Entrances: As follows:
 - 1) Width: 36 inches (914 mm) **OR** 42 inches (1067 mm) **OR** 48 inches (1219 mm) **OR** 54 inches (1372 mm), **as directed**.
 - 2) Height: 84 inches (2134 mm) **OR** 96 inches (2438 mm), **as directed**.
 - 3) Type: Single-speed side sliding **OR** Two-speed side sliding **OR** Single-speed center opening **OR** Two-speed center opening, **as directed**.
 - 4) Fire-Protection Rating: 1 hour **OR** 1-1/2 hours, **as directed**, with 30-minute temperature rise of 450 deg F (250 deg C), **as directed**.
 - 5) Frames at First Floor **OR** at Basement Floors, **as directed**: Enameled steel **OR** Polished stainless steel, No. 8 finish **OR** Satin stainless steel, No. 4 finish **OR** Polished bronze, lacquered **OR** Satin bronze, lacquered, **as directed**.
 - 6) Frames at Other Floors: Enameled steel **OR** Polished stainless steel, No. 8 finish **OR** Satin stainless steel, No. 4 finish **OR** Polished bronze, lacquered **OR** Satin bronze, lacquered, **as directed**.
 - 7) Doors and Transoms at First Floor **OR** at Basement Floors, **as directed**: Enameled steel **OR** Polished stainless steel, No. 8 finish **OR** Satin stainless steel, No. 4 finish **OR** Textured stainless steel **OR** Polished bronze, lacquered **OR** Satin bronze, lacquered **OR** Plastic laminate, **as directed**.
 - 8) Doors and Transoms at Other Floors: Enameled steel **OR** Polished stainless steel, No. 8 finish **OR** Satin stainless steel, No. 4 finish **OR** Textured stainless steel **OR** Polished bronze, lacquered **OR** Satin bronze, lacquered **OR** Plastic laminate, **as directed**.
 - 9) Sills at First Floor **OR** at Basement Floors, **as directed**: Aluminum, mill finish **OR** Bronze, polished **OR** Nickel silver, polished, **as directed**.
 - 10) Sills at Other Floors: Aluminum, mill finish **OR** Bronze, polished **OR** Nickel silver, polished, **as directed**.

- o. Hall Fixtures at First Floor **OR** at Basement Floors, **as directed**: Polished stainless steel, No. 8 finish **OR** Satin stainless steel, No. 4 finish **OR** Polished bronze, lacquered **OR** Satin bronze, lacquered **OR** Recessed type with no exposed-metal surfaces, **as directed**.
- p. Hall Fixtures at Other Floors: Polished stainless steel, No. 8 finish **OR** Satin stainless steel, No. 4 finish **OR** Polished bronze, lacquered **OR** Satin bronze, lacquered **OR** Recessed type with no exposed-metal surfaces, **as directed**.
- q. Additional Requirements:
 - 1) Provide inspection certificate in each car, mounted under acrylic cover with frame made from polished stainless steel, No. 8 finish **OR** satin stainless steel, No. 4 finish **OR** polished bronze, lacquered **OR** satin bronze, lacquered, **as directed**.
 - 2) Provide blanket hooks in all cars, **as directed**, and one **OR** two, **as directed**, complete set(s) of full-height protective blankets.

1.3 EXECUTION

A. Examination

- 1. Examine elevator areas, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance. Examine hoistways, hoistway openings, pits, and machine rooms as constructed; verify critical dimensions; and examine supporting structure and other conditions under which elevator work is to be installed.
 - a. For the record, prepare a written report, endorsed by Installer, listing dimensional discrepancies and conditions detrimental to performance or indicating that dimensions and conditions were found to be satisfactory.
 - b. Proceed with installation only after unsatisfactory conditions have been corrected.

B. Installation

- 1. Comply with manufacturer's written instructions.
- 2. Welded Construction: Provide welded connections for installing elevator work where bolted connections are not required for subsequent removal or for normal operation, adjustment, inspection, maintenance, and replacement of worn parts. Comply with AWS standards for workmanship and for qualifications of welding operators.
- 3. Sound Isolation: Mount rotating and vibrating equipment on vibration-isolating mounts designed to minimize transmission of vibrations to structure and thereby minimize structure-borne noise from elevator system.
- 4. Lubricate operating parts of systems, including ropes, as recommended by manufacturers.
- 5. Alignment: Coordinate installation of hoistway entrances with installation of elevator guide rails for accurate alignment of entrances with car. Where possible, delay final adjustment of sills and doors until car is operable in shaft. Reduce clearances to minimum, safe, workable dimension at each landing.
- 6. Leveling Tolerance: **1/8 inch (3 mm)**, up or down, regardless of load and direction of travel.
- 7. Set sills flush with finished floor surface at landing. Fill space under sill solidly with nonshrink, nonmetallic grout.
- 8. Locate hall signal equipment for elevators as follows, unless otherwise indicated:
 - a. For groups of elevators, locate hall push-button stations between two elevators at center of group or at location most convenient for approaching passengers.
 - b. Place hall lanterns either above or beside each hoistway entrance.
 - c. Mount hall lanterns at a minimum of **72 inches (1829 mm)** above finished floor.

C. Field Quality Control

- 1. Acceptance Testing: On completion of elevator installation and before permitting use (either temporary or permanent) of elevators, perform acceptance tests as required and recommended by ASME A17.1 and by governing regulations and agencies.
- 2. Operating Test: Load elevator **OR** each elevator **OR** one elevator of each type, capacity, speed, and travel distance, **as directed**, to rated capacity and operate continuously for 30 minutes over full travel distance, stopping at each level and proceeding immediately to the next. Record

temperature rise of elevator machine during 30-minute test period. Record failure to perform as required.

3. Advise Owner and authorities having jurisdiction in advance of dates and times tests are to be performed on elevators.

D. Protection

1. Temporary Use: Limit temporary use for construction purposes to one elevator **as directed**. Comply with the following requirements for each, **as directed**, elevator used for construction purposes:
 - a. Provide car with temporary enclosure, either within finished car or in place of finished car, to protect finishes from damage.
 - b. Provide strippable protective film on entrance and car doors and frames.
 - c. Provide padded wood bumpers on entrance door frames covering jambs and frame faces.
 - d. Provide other protective coverings, barriers, devices, signs, and procedures as needed to protect elevator and elevator equipment.
 - e. Do not load elevators beyond their rated weight capacity.
 - f. Engage elevator Installer to provide full maintenance service. Include preventive maintenance, repair or replacement of worn or defective components, lubrication, cleaning, and adjusting as necessary for proper elevator operation at rated speed and capacity. Provide parts and supplies same as those used in the manufacture and installation of original equipment.
 - g. Engage elevator Installer to restore damaged work, if any, so no evidence remains of correction. Return items that cannot be refinished in the field to the shop, make required repairs and refinish entire unit, or provide new units as required.

E. Demonstration

1. Train Owner's maintenance personnel to operate, adjust, and maintain elevator(s).
2. Check operation of each elevator with Owner's personnel present and before date of Final Completion. Determine that operation systems and devices are functioning properly.
3. Check operation of each elevator with Owner's personnel present not more than one month before end of warranty period. Determine that operation systems and devices are functioning properly.

END OF SECTION 14 01 30 71

SECTION 14 01 30 71a - HYDRAULIC ELEVATORS

1.1 GENERAL

A. Description Of Work

1. This specification covers the furnishing and installation of materials for hydraulic elevators. Products shall be as follows or as directed by the Owner. Installation procedures shall be in accordance with the product manufacturer's recommendations. Demolition and removal of materials shall be as required to support the work.

B. Summary

1. This Section includes hydraulic passenger and service elevators.

C. Definitions

1. Definitions in ASME A17.1 apply to work of this Section.
2. Defective Elevator Work: Operation or control system failure, including excessive malfunctions; performances below specified ratings; excessive wear; unusual deterioration or aging of materials or finishes; unsafe conditions; need for excessive maintenance; abnormal noise or vibration; and similar unusual, unexpected, and unsatisfactory conditions.
3. Service Elevator: A passenger elevator that is also used to carry freight.

D. Submittals

1. Product Data: Include capacities, sizes, performances, operations, safety features, finishes, and similar information. Include product data for the following:
 - a. Car enclosures and hoistway entrances.
 - b. Operation, control, and signal systems.
2. Shop Drawings: Show plans, elevations, sections, and large-scale details indicating service at each landing, machine room layout, coordination with building structure, relationships with other construction, and locations of equipment and signals. Include large-scale layout of car control station and standby power operation control panel, **as directed**. Indicate variations from specified requirements, maximum dynamic and static loads imposed on building structure at points of support, and maximum and average power demands.
3. Samples: For exposed finishes of cars, hoistway doors and frames, and signal equipment; **3-inch (75-mm)** square Samples of sheet materials; and **4-inch (100-mm)** lengths of running trim members.
4. Manufacturer Certificates: Signed by elevator manufacturer certifying that hoistway, pit, and machine room layout and dimensions, as shown on Drawings, and electrical service, as shown and specified, are adequate for elevator system being provided.
5. Qualification Data: For Installer.
6. Operation and Maintenance Data: For elevators to include in emergency, operation, and maintenance manuals.
7. Inspection and Acceptance Certificates and Operating Permits: As required by authorities having jurisdiction for normal, unrestricted elevator use.
8. Warranty: Special warranty specified in this Section.

E. Quality Assurance

1. Installer Qualifications: Elevator manufacturer or manufacturer's authorized representative who is trained and approved for installation of units required for this Project.
2. Source Limitations: Obtain elevators, including electric traction passenger elevators specified in another Division 14 Section, through one source from a single manufacturer.
 - a. Provide major elevator components, including pump-and-tank units, plunger-cylinder assemblies, controllers, signal fixtures, door operators, car frames, cabs, and entrances, manufactured by a single manufacturer.



3. Legal Requirements: Comply with ASME A17.1 and elevator design requirements for earthquake loads in ASCE 7.
 - a. Effective peak velocity acceleration (A_v) for Project's location is less than 0.10 (seismic risk zones 0 and 1) **OR** greater than or equal to 0.10, but less than 0.20 (seismic risk zone 2) **OR** greater than or equal to 0.20 (seismic risk zones 3 and 4), **as directed**.
 - b. Design earthquake spectral response acceleration, short period (S_d) for Project is determined by Project's location and site classification.
 - c. Project's seismic design category is A **OR** B **OR** C **OR** D, **as directed**.
 - d. Elevator importance factor is 1.5 **OR** 1.0, **as directed**.
 - e. Accessibility Requirements: Comply with to U.S. Department of Justice ADA, U.S. Department of Transportation ADA, U.S. Access Board's Guides ADA Standards Chapter 4.
4. Fire-Rated Hoistway Entrance Assemblies: Door and frame assemblies complying with NFPA 80 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire-protection ratings indicated, based on testing at as close to neutral pressure as possible according to NFPA 252 **OR** IBC Standard 3002 **OR** UL 10B, **as directed**.

F. Delivery, Storage, And Handling

1. Deliver, store, and handle materials, components and equipment in manufacturer's protective packaging.
2. Store materials, components, and equipment off of ground, under cover, and in a dry location. Handle according to manufacturer's written recommendations to prevent damage, deterioration, or soiling.

G. Coordination

1. Coordinate installation of sleeves, block outs, and items that are embedded in concrete or masonry for elevator equipment. Furnish templates and installation instructions and deliver to Project site in time for installation.
2. Furnish well casing and coordinate delivery with related excavation work.
3. Coordinate sequence of elevator installation with other work to avoid delaying the Work.
4. Coordinate locations and dimensions of other work relating to hydraulic elevators including pit ladders, sumps, and floor drains in pits; entrance subsills; and electrical service, electrical outlets, lights, and switches in pits and machine rooms.

H. Warranty

1. Special Manufacturer's Warranty: Manufacturer's standard form in which manufacturer agrees to repair, restore, or replace defective elevator work within specified warranty period.
 - a. Warranty Period: One year from date of Final Completion.

1.2 PRODUCTS

A. Systems And Components

1. General: Provide manufacturer's standard elevator systems. Where components are not otherwise indicated, provide standard components published by manufacturer as included in standard preengineered elevator systems and as required for complete system.
2. Pump Units: Positive-displacement type with a maximum of 10 percent variation between no load and full load and with minimum pulsations. Provide the following, **as directed**:
 - a. Pump, with fan-cooled squirrel-cage induction motor, mounted on oil tank with vibration isolation mounts. Enclose pump in prime-painted steel enclosure lined with 1-inch- (25-mm-) thick, glass-fiber insulation board.
 - b. Submersible pump, with submersible squirrel-cage induction motor, suspended inside oil tank from vibration isolation mounts.
 - c. Provide motor with wye-delta **OR** solid-state, **as directed**, starting.
 - d. Provide variable-voltage variable-frequency motor control.

3. Hydraulic Silencers: Provide hydraulic silencer containing pulsation-absorbing material in a blowout-proof housing at pump unit.
4. Piping: Provide size, type, and weight piping recommended by manufacturer, and provide flexible connectors to minimize sound and vibration transmissions from power unit.
 - a. Provide dielectric couplings at cylinder units.
 - b. Casing for Underground Piping: PVC pipe complying with ASTM D 1785, joined with PVC fittings complying with ASTM D 2466 and solvent cement complying with ASTM D 2564.
5. Hydraulic Fluid: Elevator manufacturer's standard fire-resistant, **as directed**, fluid with additives as needed to prevent oxidation of fluid, corrosion of cylinder and other components, and other adverse effects.
OR
Hydraulic Fluid: Nontoxic, readily biodegradable, fire-resistant, **as directed**, fluid made from vegetable oil with antioxidant, anticorrosive, antifoaming, and metal-passivating additives. Hydraulic fluid is approved by elevator manufacturer for use with elevator equipment.
6. Inserts: Furnish required concrete and masonry inserts and similar anchorage devices for installing guide rails, machinery, and other components of elevator work where installation of devices is specified in another Section.
7. Protective Cylinder Casing: PVC or HDPE pipe casing complying with ASME A17.1, of sufficient size to provide not less than **1-inch (25-mm)** clearance from cylinder and extending above pit floor. Provide means to monitor casing effectiveness to comply with ASME A17.1.
8. Corrosion Protective Filler: A nontoxic, petroleum-based gel formulated for filling the space between hydraulic cylinder and protective casing. Filler is electrically nonconductive, displaces or absorbs water, and gels or solidifies at temperatures below **60 deg F (16 deg C)**.
9. Car Frame and Platform: Welded steel units.
10. Guides: Provide either roller guides or sliding guides at top and bottom of car and counterweight frames. If sliding guides are used, provide guide-rail lubricators or polymer-coated, nonlubricated guides.

B. Operation Systems

1. General: Provide manufacturer's standard microprocessor operation system for each elevator **OR** for each group of elevators, **as directed**, as required to provide type of operation system indicated.
2. Auxiliary **OR** Single-Car Auxiliary, **as directed**, Operations: In addition to primary operation system features, provide the following operational features for elevators where indicated:
 - a. Standby Power Operation: On activation of standby power, car is returned to a designated floor and parked with doors open. Car can be manually put in service on standby power, either for return operation or for regular operation, by switches in control panel located at main lobby **OR** fire command station, **as directed**. Manual operation causes automatic operation to cease.
OR
Standby-Powered Lowering: On activation of standby power, if car is at a floor it remains at that floor, opens its doors, and shuts down. If car is between floors, it is lowered to a preselected floor, opens its doors, and shuts down. If car is below the preselected floor, it is lowered to the next lower floor, opens its doors, and shuts down.
OR
Standby-Powered Lowering: On activation of standby power, car is lowered to the lowest floor, opens its doors, and shuts down.
OR
Battery-Powered Lowering: If power fails and car is at a floor, it remains at that floor, opens its doors, and shuts down. If car is between floors, it is lowered to a preselected floor, opens its doors, and shuts down. If car is below the preselected floor, it is lowered to the next lower floor, opens its doors, and shuts down. System includes rechargeable battery and automatic recharging system.
OR



- Battery-Powered Lowering: When power fails, car is lowered to the lowest floor, opens its doors, and shuts down. System includes rechargeable battery and automatic recharging system.
- b. Automatic Dispatching of Loaded Car: When car load exceeds 80 percent of rated capacity, doors will begin closing.
 - c. Nuisance Call Cancel: When car calls exceed a preset number while car load is less than a predetermined weight, all car calls are canceled. Preset number of calls and predetermined weight, **as directed**, can be adjusted.
3. Group Auxiliary Operations: In addition to primary operation system features, provide the following operational features for elevators and elevator groups where indicated:
- a. Standby Power Operation: On activation of standby power, cars are returned to a designated floor and parked with doors open. Only one car is moved upward at a time, with priority given to loaded cars. If a car cannot be returned after two attempts, it is removed from the system. When all cars have been returned or removed from the system, one car is automatically placed in service. If car selected for service cannot operate within 60 seconds, the system removes car from service and places another car in service. Cars can be manually put in service on standby power, either for return operation or for regular operation, by switches in control panel located at main lobby **OR** fire command station, **as directed**. Manual operation causes automatic operation to cease.
OR
Standby Power Operation: On activation of standby power, cars are returned to lowest floor and parked with doors open. If a car cannot be returned, it is removed from the system. One car is selected for service on standby power by a switch located at main lobby **OR** fire command station, **as directed**.
OR
Standby-Powered Lowering: On activation of standby power, cars that are at a floor remain at that floor, open their doors, and shut down. Cars that are between floors are lowered to a preselected floor, open their doors, and shut down. Cars that are below the preselected floor are lowered to the next lower floor, open their doors, and shut down.
OR
Standby-Powered Lowering: On activation of standby power, cars are lowered to the lowest floor, open their doors, and shut down.
OR
Battery-Powered Lowering: If power fails, cars that are at a floor remain at that floor, open their doors, and shut down. Cars that are between floors are lowered to a preselected floor, open their doors, and shut down. Cars that are below the preselected floor are lowered to the next lower floor, open their doors, and shut down. System includes rechargeable battery and automatic recharging system.
OR
Battery-Powered Lowering: When power fails, cars are lowered to the lowest floor, open their doors, and shut down. System includes rechargeable battery and automatic recharging system.
 - b. Automatic Dispatching of Loaded Car: When car load exceeds 80 percent of rated capacity, doors will begin closing.
 - c. Nuisance Call Cancel: When car calls exceed a preset number while car load is less than a predetermined weight, all car calls are canceled. Preset number of calls and predetermined weight, **as directed**, can be adjusted.
 - d. Emergency Hospital **OR** Priority, **as directed**, Service: Service is initiated by a keyswitch **OR** card reader **OR** remote switch, **as directed**, at designated floors. One elevator is removed from group operation and directed to the floor where service was initiated. On arriving at the floor, elevator opens its doors and parks and a lighted sign directs passengers to exit elevator, **as directed**. Car is placed in operation by selecting a floor and pressing door close button or by operating keyswitch to put car in independent service. After responding to floor selected or being removed from independent service, car is

- returned to group operation. If car is not placed in operation within a preset time after being called, it is returned to group operation.
- e. Independent Service: Keyswitch in car control station removes car from group operation and allows it to respond only to car calls. Key cannot be removed from keyswitch when car is in independent service. When in independent service, doors close only in response to door close button.
 - f. Loaded-Car Bypass: When car load exceeds 80 percent of rated capacity, car will respond only to car calls, not to hall calls.
4. Security Features: Provide the following security features, where indicated. Security features shall not affect emergency firefighters' service.
- a. Card-Reader Operation: System uses card readers at car control stations **OR** hall push-button stations, **as directed**, to authorize calls. Security system determines which landings and at what times calls require authorization by card reader. Provide required conductors in traveling cable and panel in machine room for interconnecting card readers, other security access system equipment, and elevator controllers. Allow space as indicated for card reader in car **OR** Provide stripe-swipe card reader integral with each car control station, **as directed**.
 - 1) Security access system equipment is specified in Division 28 Section "Access Control".
OR
Security access system equipment is not in the Contract.
 - b. Keyswitch Operation: Push buttons are activated and deactivated by security keyswitches at car control stations **OR** hall push-button stations, **as directed**. Key is removable only in deactivated position **OR** in either position, **as directed**.
 - c. Keypad Operation: Allows each landing to be restricted or unrestricted. When a restricted landing button is pressed, a "Restricted Floor" lamp lights and remains lit until landing access code has been entered into a keypad or predetermined time period has elapsed. Car calls for restricted landings do not register until landing access code is entered into keypad within predetermined time period after landing button is pressed.
 - 1) Access codes are programmed at each car operating panel using a security keyswitch. Keypad operation can be activated and deactivated by security keyswitch at main landing.
 - d. Car-to-Lobby Feature: Feature, activated by keyswitch at main lobby, that causes car **OR** all cars in a group, **as directed**, to return immediately to lobby and open doors for inspection. On deactivation by keyswitch, calls registered before keyswitch activation are completed and normal operation is resumed.
- C. Door Reopening Devices
1. Infrared Array: Provide door reopening devices with uniform array of 36 or more microprocessor-controlled, infrared light beams projecting across car entrance. Interruption of one or more of the light beams shall cause doors to stop and reopen.
 2. Nudging Feature: After car doors are prevented from closing for predetermined adjustable time, through activating door reopening device, a loud buzzer shall sound and doors shall begin to close at reduced kinetic energy.
- D. Finish Materials
1. General: Provide the following materials for exposed parts of elevator car enclosures, car doors, hoistway entrance doors and frames, and signal equipment as indicated.
 2. Cold-Rolled Steel Sheet: ASTM A 1008/A 1008M, commercial steel, Type B, exposed, matte finish.
 3. Hot-Rolled Steel Sheet: ASTM A 1011/A 1011M, commercial steel, Type B, pickled.
 4. Stainless-Steel Sheet: ASTM A 240/A 240M, Type 304.
 - a. Textured Stainless-Steel Sheet: Product with coined **OR** embossed, **as directed**, texture rolled into exposed surface.
 - 1) Metal surface is satin polished **OR** satin relieved **OR** titanium nitride colored **OR** oxide colored **OR** satin polished and titanium nitride colored **OR** satin relieved and

titanium nitride colored **OR** satin polished and oxide colored **OR** satin relieved and oxide colored **OR** color coated and satin relieved **OR** color coated and bright relieved, **as directed**, after rolling.

5. Stainless-Steel Bars: ASTM A 276, Type 304.
6. Stainless-Steel Tubing: ASTM A 554, Grade MT 304.
7. Bronze Plate and Sheet: ASTM B 36/B 36M, Alloy UNS No. C28000 (muntz metal).
8. Bronze Extrusions: ASTM B 455, Alloy UNS No. C38500 (architectural bronze).
9. Bronze Tubing: **ASTM B 135 (ASTM B 135M)**, Alloy UNS No. C23000 (red brass, 85 percent copper).
10. Aluminum Extrusions: **ASTM B 221 (ASTM B 221M)**, Alloy 6063.
11. Nickel Silver Extrusions: ASTM B 151/B 151M, Alloy UNS No. C74500 or No. C77600.
12. Plastic Laminate: High-pressure type complying with NEMA LD 3, Type HGS for flat applications **OR** Type HGL for flat applications, **as directed**, Type HGP for postformed applications and Type BKV for panel backing.

E. Car Enclosures

1. General: Provide enameled-steel car enclosures to receive removable **OR** steel-framed car enclosures with nonremovable, **as directed**, wall panels, with car **OR** removable car, **as directed**, roof, access doors, power door operators, and ventilation.
 - a. Provide standard railings complying with ASME A17.1 on car tops where required by ASME A17.1.
 - b. Provide finished car including materials and finishes specified below.
2. Materials and Finishes: Provide manufacturer's standards, but not less than the following:
 - a. Subfloor: Underlayment grade, exterior plywood, **5/8-inch (16-mm)** nominal thickness.
 - b. Floor Finish: Specified in a Division 07 **OR** Elevator manufacturer's standard level-loop nylon carpet; color as selected from manufacturer's full range, **as directed**.
 - c. Enameled-Steel Wall Panels: Flush, hollow-metal construction; fabricated from cold-rolled steel sheet. Provide with factory-applied enamel finish; colors as selected from manufacturer's full range.
 - d. Stainless-Steel Wall Panels: Flush, hollow-metal construction; fabricated from stainless-steel sheet.
 - e. Bronze Wall Panels: Flush, hollow-metal construction; fabricated from bronze sheet.
 - f. Plastic-Laminate Wall Panels: Plastic laminate adhesively applied to **1/2-inch (13-mm)** fire-retardant-treated particleboard **OR** manufacturer's standard honeycomb core, **as directed**, with plastic-laminate panel backing and, **as directed**, manufacturer's standard protective edge trim. Panels have a flame-spread index of 25 **OR** 75, **as directed**, or less, when tested according to ASTM E 84. Plastic-laminate color, texture, and pattern as selected from plastic-laminate **OR** elevator, **as directed**, manufacturer's full range.
 - g. Fabricate car with recesses and cutouts for signal equipment.
 - h. Fabricate car door frame integrally with front wall of car.
 - i. Enameled-Steel Doors: Flush, hollow-metal construction; fabricated from cold-rolled steel sheet. Provide with factory-applied enamel finish; colors as selected from manufacturer's full range.
 - j. Stainless-Steel Doors: Flush, hollow-metal construction; fabricated from stainless-steel sheet **OR** by laminating stainless-steel sheet to exposed faces and edges of enameled cold-rolled steel doors using adhesive that fully bonds metal to metal without telegraphing or oil-canning, **as directed**.
 - k. Bronze Doors: Flush, hollow-metal construction; fabricated by laminating bronze sheet to exposed faces and edges of enameled cold-rolled steel doors using adhesive that fully bonds metal to metal without telegraphing or oil-canning.
 - l. Plastic-Laminate Doors: Flush, hollow-metal construction; fabricated by laminating plastic laminate to exposed faces of enameled cold-rolled steel doors and covering edges with protective edge trim matching return panels, **as directed**. Plastic-laminate color, texture, and pattern as selected from plastic-laminate **OR** elevator, **as directed**, manufacturer's full range.

- m. Sight Guards: Provide sight guards on car doors.
- n. Sills: Extruded metal, with grooved surface, **1/4 inch (6.4 mm)** thick.
- o. Luminous Ceiling: Fluorescent light fixtures and ceiling panels of translucent acrylic or other permanent rigid plastic.
- p. Metal **OR** Metallic-Finish, Plastic-Laminate, **as directed**, Ceiling: Flush panels, with incandescent downlights in the center of **OR** four low-voltage downlights in, **as directed**, each panel. Align ceiling panel joints with joints between wall panels, **as directed**.
- q. Handrails: Manufacturer's standard handrails, of shape, metal, and finish indicated.

F. Hoistway Entrances

- 1. General: Provide manufacturer's standard horizontal-sliding, door-and-frame hoistway entrances complete with track systems, hardware, sills, and accessories. Provide frame size and profile to coordinate with hoistway wall construction.
 - a. Where gypsum board wall construction is indicated, provide self-supporting frames with reinforced head sections.
- 2. Materials and Fabrication: Provide manufacturer's standards, but not less than the following:
 - a. Enameled-Steel Frames: Formed from cold-rolled or hot-rolled steel sheet. Provide with factory-applied enamel finish; colors as selected from manufacturer's full range.
 - b. Steel Subframes: Formed from cold-rolled or hot-rolled steel sheet with factory-applied enamel finish or corrosion-inhibiting primer. Fabricate to receive applied finish as indicated.
 - c. Stainless-Steel Frames: Formed from stainless-steel sheet.
 - d. Bronze Frames: Formed from cold-rolled or hot-rolled steel sheet, with enamel finish, and with formed-bronze sheet laminated to steel frames using adhesive that fully bonds metal to metal without telegraphing or oil-canning.
 - e. Enameled-Steel Doors and Transoms: Flush, hollow-metal construction; fabricated from cold-rolled steel sheet. Provide with factory-applied enamel finish; colors as selected from manufacturer's full range.
 - f. Stainless-Steel Doors and Transoms: Flush, hollow-metal construction; fabricated from stainless-steel sheet **OR** by laminating stainless-steel sheet to exposed faces and edges of enameled cold-rolled steel doors using adhesive that fully bonds metal to metal without telegraphing or oil-canning, **as directed**.
 - g. Bronze Doors and Transoms: Flush, hollow-metal construction; fabricated by laminating bronze sheet to exposed faces and edges of enameled cold-rolled steel doors using adhesive that fully bonds metal to metal without telegraphing or oil-canning.
 - h. Plastic-Laminate Doors and Transoms: Flush, hollow-metal construction; fabricated by laminating plastic laminate to exposed faces of enameled cold-rolled steel doors and covering edges with protective edge trim matching door frames, **as directed**. Plastic-laminate color, texture, and pattern as selected from plastic-laminate **OR** elevator, **as directed**, manufacturer's full range.
 - i. Sight Guards: Provide sight guards on doors matching door edges.
 - j. Sills: Extruded metal, with grooved surface, **1/4 inch (6.4 mm)** thick.
 - k. Nonshrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C 1107.

G. Signal Equipment

- 1. General: Provide hall-call and car-call buttons that light when activated and remain lit until call has been fulfilled. Fabricate lighted elements with long-life incandescent lamps and acrylic or other permanent, nonyellowing translucent plastic diffusers **OR** LEDs, **as directed**.
- 2. Car Control Stations: Provide manufacturer's standard recessed **OR** semirecessed, **as directed**, car control stations. Mount in return panel adjacent to car door, unless otherwise indicated.
OR
Swing-Return Car Control Stations: Provide car control stations mounted on rear of hinged return panel adjacent to car door and with buttons, switches, controls, and indicator lights projecting through return panel but substantially flush with face of return panel.



- a. Mark buttons and switches with standard identification for required use or function that complies with ASME A17.1. Use both tactile symbols and Braille.
 - b. Provide "No Smoking" sign matching car control station, either integral with car control station or mounted adjacent to it, with text and graphics as required by authorities having jurisdiction.
3. Emergency Communication System: Provide system that complies with ASME A17.1 and the U.S. Architectural & Transportation Barriers Compliance Board's "Americans with Disabilities Act (ADA), Accessibility Guidelines for Buildings and Facilities (ADAAG)." On activation, system dials preprogrammed number of monitoring station and identifies elevator location to monitoring station. System provides two-way voice communication without using a handset and provides visible signals that indicate when system has been activated and when monitoring station has responded. System is contained in flush-mounted cabinet, with identification, instructions for use, and battery backup power supply.
4. Firefighters' Two-Way Telephone Communication Service: Provide flush-mounted cabinet **OR** telephone jack, **as directed**, in each car and required conductors in traveling cable for firefighters' two-way telephone communication service specified in Division 28 Section(s) "Digital, Addressable Fire-alarm System" **OR** "Zoned (dc Loop) Fire-alarm System"
5. Car Position Indicator: Provide illuminated, **as directed**, digital-type car position indicator, located above car door or above car control station. Also provide audible signal to indicate to passengers that car is either stopping at or passing each of the floors served.
 - a. Include travel direction arrows if not provided in car control station.
6. Hall Push-Button Stations: Provide one hall push-button station at each landing for each single elevator or group of elevators, but not less than one station for each four elevators in a group, **as directed**.
OR
 Hall Push-Button Stations: Provide hall push-button stations at each landing as indicated.
 - a. Provide manufacturer's standard wall-mounted units.
 - b. Provide units with flat faceplate for mounting with body of unit recessed in wall.
 - c. Equip units with buttons for calling elevator and for indicating desired direction of travel.
 - d. Provide telephone jack in each unit for firefighters' two-way telephone communication service specified in Division 28 Section(s) "Digital, Addressable Fire-alarm System" **OR** "Zoned (dc Loop) Fire-alarm System".
7. Hall Lanterns: Units with illuminated arrows; but provide single arrow at terminal landings. Provide one of the following, **as directed**:
 - a. Manufacturer's standard wall-mounted units, for mounting above entrance frames.
 - b. Units with flat faceplate for mounting with body of unit recessed in wall and with illuminated elements projecting from faceplate for ease of angular viewing.
 - c. Units mounted in both jambs of entrance frame for each elevator, **as directed**.
 - d. Units mounted in both car door jambs; may be used only for single elevators or for two-car groups, **as directed**.
8. Hall Annunciator: With each hall lantern, provide audible signals indicating car arrival and direction of travel. Signals sound once for up and twice for down.
 - a. At manufacturer's option, audible signals may be placed on car **OR** each car, **as directed**.
9. Hall Position Indicators: Provide illuminated, **as directed**, digital-display-type position indicators, located above each, **as directed**, hoistway entrance at ground floor. Provide units with flat faceplate for mounting and with body of unit recessed in wall.
 - a. Integrate ground-floor hall lanterns with hall position indicators.
10. Standby Power Elevator Selector Switches: Provide switches, as required by ASME A17.1, where indicated. Adjacent to switches, provide illuminated signal that indicates when normal power supply has failed. For each elevator, provide illuminated signals that indicate when they are operational and when they are at the designated emergency return level with doors open, **as directed**.
OR
 Fire Command Center Annunciator Panel: Provide panel containing illuminated position indicators for each elevator, clearly labeled with elevator designation; include illuminated signal

that indicates when elevator is operational and when it is at the designated emergency return level with doors open. Provide standby power elevator selector switch(es), as required by ASME A17.1, adjacent to position indicators. Provide illuminated signal that indicates when normal power supply has failed.

11. Corridor Call Station Pictograph Signs: Provide signs matching hall push-button stations, with text and graphics as required by authorities having jurisdiction, indicating that in case of fire elevators are out of service and exits should be used instead. Provide one sign at each hall push-button station, unless otherwise indicated.

H. Elevators

1. Elevator Description:

- a. Group Number: Insert a different number for each group of elevators that share a group operation system, as directed by the Owner.
- b. Elevator Number(s): Insert elevator number(s) as shown on Drawings, as directed by the Owner.
- c. Service Elevator Number(s): Insert elevator number(s) as shown on Drawings, as directed by the Owner.
- d. Type: Under-the-car single cylinder.
OR
Type: Holeless, beside-the-car, single-acting, single **OR** dual, **as directed**, cylinder.
OR
Type: Holeless, beside-the-car, telescoping, single **OR** dual, **as directed**, cylinder.
OR
Type: Holeless, beside-the-car, roped hydraulic, single **OR** dual, **as directed**, cylinder.
- e. Rated Load: **2000 lb (908 kg) OR 2100 lb (953 kg) OR 2500 lb (1135 kg) OR 3000 lb (1362 kg) OR 3500 lb (1589 kg) OR 4000 lb (1816 kg) OR 4500 lb (2043 kg) OR 5000 lb (2270 kg), as directed.**
- f. Freight Loading Class for Service Elevators: Class A.
- g. Rated Speed: **75 or 80 fpm (0.38 or 0.41 m/s) OR 100 fpm (0.51 m/s) OR 125 fpm (0.64 m/s) OR 150 fpm (0.76 m/s) OR 175 fpm (0.89 m/s) OR 200 fpm (1.0 m/s), as directed.**
- h. Operation System: Single automatic **OR** Selective collective automatic **OR** Group automatic, **as directed**, operation.
- i. Auxiliary Operations:
 - 1) Standby power operation.
 - 2) Standby-powered lowering.
 - 3) Battery-powered lowering.
 - 4) Automatic dispatching of loaded car.
 - 5) Nuisance call cancel.
 - 6) Emergency hospital **OR** Priority, **as directed**, service at designated floors **OR** all floors, **as directed**.
 - 7) Independent service for service elevator **OR** all cars in group, **as directed**.
 - 8) Loaded-car bypass.
- j. Security Features: Card-reader operation **OR** Keyswitch operation **OR** Keypad operation **OR** Car-to-lobby feature, **as directed**.
- k. Dual Car Control Stations: Provide two car control stations in each elevator, **as directed**; equip only one with required keyswitches, if any.
- l. Car Enclosures:
 - 1) Inside Width: **64 inches (1626 mm) OR 68 inches (1727 mm) OR 80 inches (2032 mm) OR 92 inches (2337 mm), as directed**, from side wall to side wall.
 - 2) Inside Depth: **51 inches (1295 mm) OR 53 inches (1346 mm) OR 57 inches (1448 mm) OR 65 inches (1651 mm) OR 87-1/2 inches (2222 mm) OR 90 inches (2286 mm) OR 93 inches (2362 mm) OR 93-1/2 inches (2375 mm) OR 96 inches (2438 mm) OR 101 inches (2565 mm) OR 102 inches (2591 mm), as directed**, from back wall to front wall (return panels).

- 3) Inside Height: **88 inches (2235 mm) OR 92 inches (2337 mm) OR 94 inches (2388 mm) OR 100 inches (2540 mm) OR 104 inches (2642 mm) OR 108 inches (2743 mm) OR 112 inches (2845 mm)**, **as directed**, to underside of ceiling.
 - 4) Front Walls (Return Panels): Polished stainless steel, No. 8 finish **OR** Satin stainless steel, No. 4 finish **OR** Polished bronze, lacquered **OR** Satin bronze, lacquered, **as directed**, with integral car door frames.
 - 5) Car Fixtures: Polished stainless steel, No. 8 finish **OR** Satin stainless steel, No. 4 finish **OR** Polished bronze, lacquered **OR** Satin bronze, lacquered, **as directed**.
 - 6) Side and Rear Wall Panels: Enameled steel **OR** Plastic laminate **OR** Satin stainless steel, No. 4 finish **OR** Textured stainless steel, **as directed**.
 - 7) Reveals: Enameled steel **OR** Polished stainless steel, No. 8 finish **OR** Satin stainless steel, No. 4 finish **OR** Polished bronze, lacquered **OR** Satin bronze, lacquered, **as directed**.
 - 8) Door Faces (Interior): Enameled steel **OR** Polished stainless steel, No. 8 finish **OR** Satin stainless steel, No. 4 finish **OR** Textured stainless steel **OR** Polished bronze, lacquered **OR** Satin bronze, lacquered **OR** Plastic laminate, **as directed**.
 - 9) Door Sills: Aluminum, mill finish **OR** Bronze, polished **OR** Nickel silver, polished, **as directed**.
 - 10) Ceiling: Luminous ceiling **OR** Polished stainless steel, No. 8 finish **OR** Satin stainless steel, No. 4 finish **OR** Polished bronze, lacquered **OR** Reflective metallic-finish, plastic-laminate, stainless steel **OR** Reflective metallic-finish, plastic-laminate, bronze, **as directed**.
 - 11) Handrails: **1-1/2 inches (38 mm)** round **OR 1/2 by 2 inches (13 by 50 mm)** rectangular, **as directed**, mirror-polished stainless steel, No. 8 finish **OR** satin stainless steel, No. 4 finish **OR** mirror-polished bronze, lacquered **OR** satin bronze, lacquered, **as directed**, at sides **OR** sides and rear, **as directed**, of car.
 - 12) Floor: Manufacturer's standard carpet.
OR
 Floor prepared to receive carpet (specified in Division 09 Section "Sheet Carpeting").
OR
 Floor prepared to receive resilient tile (specified in Division 09 Section "Resilient Tile Flooring").
OR
 Floor prepared to receive sheet vinyl (specified in Division 09 Section "Resilient Sheet Flooring").
OR
 Floor recessed and prepared to receive dimension stone tile (specified in Division 09 Section "Stone Tiling") **OR** ceramic tile (specified in Division 09 Section "Tiling"), **as directed**.
OR
 Floor Thickness, Including Setting Materials: Thickness above plywood subfloor, shall be as directed by the Owner.
- m. Hoistway Entrances:
- 1) Width: **36 inches (914 mm) OR 42 inches (1067 mm) OR 48 inches (1219 mm) OR 54 inches (1372 mm)**, **as directed**.
 - 2) Height: **84 inches (2134 mm) OR 96 inches (2438 mm)**, **as directed**.
 - 3) Type: Single-speed side sliding **OR** Two-speed side sliding **OR** Single-speed center opening **OR** Two-speed center opening, **as directed**.
 - 4) Fire-Protection Rating: 1 hour **OR** 1-1/2 hours, **as directed**, with 30-minute temperature rise of **450 deg F (250 deg C)**, **as directed**.
 - 5) Frames at First Floor **OR** at Basement Floors, **as directed**: Enameled steel **OR** Polished stainless steel, No. 8 finish **OR** Satin stainless steel, No. 4 finish **OR** Polished bronze, lacquered **OR** Satin bronze, lacquered, **as directed**.

- 6) Frames at Other Floors: Enameled steel **OR** Polished stainless steel, No. 8 finish **OR** Satin stainless steel, No. 4 finish **OR** Polished bronze, lacquered **OR** Satin bronze, lacquered, **as directed**.
- 7) Doors and Transoms at First Floor **OR** at Basement Floors, **as directed**: Enameled steel **OR** Polished stainless steel, No. 8 finish **OR** Satin stainless steel, No. 4 finish **OR** Textured stainless steel **OR** Polished bronze, lacquered **OR** Satin bronze, lacquered **OR** Plastic laminate, **as directed**.
- 8) Doors and Transoms at Other Floors: Enameled steel **OR** Polished stainless steel, No. 8 finish **OR** Satin stainless steel, No. 4 finish **OR** Textured stainless steel **OR** Polished bronze, lacquered **OR** Satin bronze, lacquered **OR** Plastic laminate, **as directed**.
- 9) Sills at First Floor **OR** at Basement Floors, **as directed**: Aluminum, mill finish **OR** Bronze, polished **OR** Nickel silver, polished, **as directed**.
- 10) Sills at Other Floors: Aluminum, mill finish **OR** Bronze, polished **OR** Nickel silver, polished, **as directed**.
- n. Hall Fixtures at First Floor **OR** at Basement Floors, **as directed**: Polished stainless steel, No. 8 finish **OR** Satin stainless steel, No. 4 finish **OR** Polished bronze, lacquered **OR** Satin bronze, lacquered **OR** Recessed type with no exposed-metal surfaces, **as directed**.
- o. Hall Fixtures at Other Floors: Polished stainless steel, No. 8 finish **OR** Satin stainless steel, No. 4 finish **OR** Polished bronze, lacquered **OR** Satin bronze, lacquered **OR** Recessed type with no exposed-metal surfaces, **as directed**.
- p. Additional Requirements:
 - 1) Provide inspection certificate in each car, mounted under acrylic cover with frame made from polished stainless steel, No. 8 finish **OR** satin stainless steel, No. 4 finish **OR** polished bronze, lacquered **OR** satin bronze, lacquered, **as directed**.
 - 2) Provide blanket hooks in all cars, **as directed**, and one **OR** two, **as directed**, complete set(s) of full-height protective blankets.

1.3 EXECUTION

A. Examination

1. Examine elevator areas, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance. Verify critical dimensions and examine supporting structure and other conditions under which elevator work is to be installed.
 - a. For the record, prepare a written report, endorsed by Installer, listing dimensional discrepancies and conditions detrimental to performance or indicating that dimensions and conditions were found to be satisfactory.
 - b. Proceed with installation only after unsatisfactory conditions have been corrected.

B. Installation

1. Excavation for Cylinder: Drill well hole in each, **as directed**, elevator pit to accommodate installation of cylinder; comply with applicable requirements in Division 31 Section "Earth Moving".
2. Provide waterproof well casing as necessary to retain walls of well hole.
3. Install cylinder in protective casing within well hole. Before installing protective casing, remove water and debris from well hole and provide permanent waterproof seal at bottom of well casing, **as directed**.
 - a. Fill void space between protective casing and cylinder with corrosion protective filler.
 - b. Align cylinders and fill space around protective casing with fine sand.
4. Install cylinder plumb and accurately centered for elevator car position and travel. Anchor securely in place, supported at pit floor. Seal between well **OR** protective, **as directed**, casing and pit floor with **4 inches (100 mm)** of nonshrink, nonmetallic grout.
5. Install cylinder plumb and accurately centered for elevator car position and travel. Anchor securely in place, supported at pit floor and braced at intervals as needed to maintain alignment. Anchor cylinder guides at spacing needed to maintain alignment and avoid overstressing guides.



6. Welded Construction: Provide welded connections for installing elevator work where bolted connections are not required for subsequent removal or for normal operation, adjustment, inspection, maintenance, and replacement of worn parts. Comply with AWS standards for workmanship and for qualifications of welding operators.
7. Sound Isolation: Mount rotating and vibrating equipment on vibration-isolating mounts designed to effectively prevent transmission of vibrations to structure and thereby eliminate sources of structure-borne noise from elevator system.
8. Install piping above the floor, where possible. Where not possible, install underground piping in Schedule 40 PVC pipe casing assembled with solvent-cemented fittings.
OR
Install piping above the floor, where possible. Where not possible, cover underground piping with permanent protective wrapping before backfilling.
9. Lubricate operating parts of systems as recommended by manufacturers.
10. Alignment: Coordinate installation of hoistway entrances with installation of elevator guide rails for accurate alignment of entrances with car. Where possible, delay installation of sills and frames until car is operable in shaft. Reduce clearances to minimum, safe, workable dimension at each landing.
11. Leveling Tolerance: **1/4 inch (6 mm)**, up or down, regardless of load and direction of travel.
12. Set sills flush with finished floor surface at landing. Fill space under sill solidly with nonshrink, nonmetallic grout.
13. Locate hall signal equipment for elevators as follows, unless otherwise indicated:
 - a. For groups of elevators, locate hall push-button stations between two elevators at center of group or at location most convenient for approaching passengers.
 - b. Place hall lanterns either above or beside each hoistway entrance.
 - c. Mount hall lanterns at a minimum of **72 inches (1829 mm)** above finished floor.

C. Field Quality Control

1. Acceptance Testing: On completion of elevator installation and before permitting use (either temporary or permanent) of elevators, perform acceptance tests as required and recommended by ASME A17.1 and by governing regulations and agencies.
2. Advise Owner and authorities having jurisdiction in advance of dates and times tests are to be performed on elevators.

D. Protection

1. Temporary Use: Limit temporary use for construction purposes to one elevator, **as directed**. Comply with the following requirements for each, **as directed**, elevator used for construction purposes:
 - a. Provide car with temporary enclosure, either within finished car or in place of finished car, to protect finishes from damage.
 - b. Provide strippable protective film on entrance and car doors and frames.
 - c. Provide padded wood bumpers on entrance door frames covering jambs and frame faces.
 - d. Provide other protective coverings, barriers, devices, signs, and procedures as needed to protect elevator and elevator equipment.
 - e. Do not load elevators beyond their rated weight capacity.
 - f. Engage elevator Installer to provide full maintenance service. Include preventive maintenance, repair or replacement of worn or defective components, lubrication, cleaning, and adjusting as necessary for proper elevator operation at rated speed and capacity. Provide parts and supplies same as those used in the manufacture and installation of original equipment.
 - g. Engage elevator Installer to restore damaged work, if any, so no evidence remains of correction. Return items that cannot be refinished in the field to the shop, make required repairs and refinish entire unit, or provide new units as required.

E. Demonstration

1. Train Owner's maintenance personnel to operate, adjust, and maintain elevator(s).

2. Check operation of each, **as directed**, elevator with Owner's personnel present and before date of Final Completion. Determine that operation systems and devices are functioning properly.
3. Check operation of each, **as directed**, elevator with Owner's personnel present not more than one month before end of warranty period. Determine that operation systems and devices are functioning properly.

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Task	Specification	Specification Description
14 01 30 71	14 31 00 00	Escalators
14 24 13 00	14 01 30 71a	Hydraulic Elevators
14 24 23 00	14 01 30 71a	Hydraulic Elevators

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SECTION 14 31 00 00 - ESCALATORS

1.1 GENERAL

A. Description Of Work

1. This specification covers the furnishing and installation of materials for escalators. Products shall be as follows or as directed by the Owner. Installation procedures shall be in accordance with the product manufacturer's recommendations. Demolition and removal of materials shall be as required to support the work.

B. Summary

1. This Section includes high-traffic, interior and exterior escalators.

C. Definitions

1. High-Traffic Escalators: Escalators designed specifically for use where high-traffic volumes produce dense occupancy resulting in structural, machinery, and brake loads much higher than normal.
2. Defective Escalator Work: Operation or control system failure, including excessive malfunctions; performances below specified ratings; excessive wear; unusual deterioration or aging of materials or finishes; unsafe conditions; the need for excessive maintenance; abnormal noise or vibration; and similar unusual, unexpected, and unsatisfactory conditions.

D. Performance Requirements

1. Rated Speed: 90 fpm (0.46 m/s) or 100 fpm (0.5 m/s).
2. Braking Performance: Provide brakes that stop escalator in up-running mode at a rate no greater than 3 ft./s² (0.91 m/s²).
OR
Braking Performance: Provide brakes that produce a stopping force on escalator in up-running mode that is one-third that used in down-running mode.
3. Step/Skirt Performance Index: Not more than 0.15.
4. Structural and Mechanical Performance for High-Traffic Escalators: For the purpose of structural design, driving machine and power transmission calculations, and brake calculations, design high-traffic escalators for loads not less than 2 times the design loads required by ASME A17.1.
5. Structural Performance of Balustrades, Deck Barricades, and Handrails: Provide components and assemblies capable of withstanding the effects of loads indicated in ASCE 7 for handrail assemblies and guardrail systems.

E. Submittals

1. Product Data: Include capacities, sizes, performances, safety features, finishes, and similar information.
2. Shop Drawings: Show plans, elevations, sections, and details indicating coordination with building structure and relationships with other construction. Indicate variations from specified requirements, maximum loads imposed on building structure at points of support, and power requirements. Indicate access and ventilation for escalator machine space.
3. Samples: For exposed finishes, 3-inch- (75-mm-) square Samples of sheet materials, and 4-inch (100-mm) lengths of running trim members.
4. Manufacturer Certificates: Signed by manufacturer certifying that escalator layout and dimensions, as shown on Drawings, and electrical service, as shown and specified, are adequate for escalator system being provided.
5. Qualification Data: For Installer.
6. Operation and Maintenance Data: For escalators to include in emergency, operation, and maintenance manuals.
7. Inspection and Acceptance Certificates and Operating Permits: As required by authorities having jurisdiction for normal, unrestricted escalator use.

8. Warranty: Special warranty specified in this Section.

F. Quality Assurance

1. Installer Qualifications: Escalator manufacturer or manufacturer's authorized representative who is trained and approved for installation of units required for this Project.
2. Source Limitations: Obtain escalators and moving walks, specified in another Division 14 Section, through one source from a single manufacturer.
3. Regulatory Requirements: Comply with ASME A17.1.

G. Delivery, Storage, And Handling

1. Deliver, store, and handle materials, components, and equipment in manufacturer's protective packaging.
2. Store materials, components, and equipment off of ground, under cover, and in a dry location. Handle according to manufacturer's recommendations to prevent damage, deterioration, or soiling.

H. Coordination

1. Coordinate installation of sleeves, block outs, escalator equipment with integral anchors, and other items that are embedded in concrete or masonry for escalator equipment. Furnish templates, sleeves, escalator equipment with integral anchors, and installation instructions and deliver to Project site in time for installation.
2. Coordinate sequence of escalator installation with other work to avoid delaying the Work.
3. Coordinate locations and dimensions of other work relating to escalators including sumps and floor drains in pits, electrical service, and electrical outlets, lights, and switches in pits.

I. Warranty

1. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair, restore, or replace defective escalator work within specified warranty period.
 - a. Warranty Period: One year from date of Final Completion.

1.2 PRODUCTS

A. Materials

1. Stainless Steel: ASTM A 240/A 240M, Type 304 **OR** 316 **OR** 304, except use Type 316 for exterior escalators, **as directed**.
 - a. Satin Finish: No. 4 directional satin.
 - b. Polished Finish: No. 8 mirror polish.
 - c. Gold-Colored Satin Finish: No. 4 directional satin with gold-colored oxide or titanium nitride finish.
 - d. Gold-Colored Mirror Finish: No. 8 mirror polish with gold-colored oxide or titanium nitride finish.
2. Satin Bronze Sheet: ASTM B 36/B 36M, Alloy UNS No. C28000 (muntz metal), fine satin finish, lacquered.
3. Satin Bronze Extrusions: ASTM B 455, Alloy UNS No. C38500 (architectural bronze), fine satin finish, lacquered.
4. Steel Sheet: Cold-rolled steel sheet, ASTM A 1008/A 1008M, commercial steel, Type B, exposed, matte finish.
5. Clear Tempered Glass: ASTM C 1048, Condition A (uncoated surfaces), Type 1 (transparent glass, flat), Class 1 (clear), Quality q3 (glazing, select), Kind FT (fully tempered), **[10.0] [12.0]** mm thick.
6. Tinted Tempered Glass: ASTM C 1048, Condition A (uncoated surfaces), Type 1 (transparent glass, flat), Class 2 (tinted), Quality q3 (glazing, select), Kind FT (fully tempered), **[10.0] [12.0]** mm thick.
 - a. Color: Bronze **OR** Gray **OR** Green, **as directed**.

B. Components

1. General: Provide preengineered escalators complying with requirements. Unless otherwise indicated, provide standard components as indicated in manufacturers' publications and as required for a complete escalator.
2. General: Provide high-traffic escalators complying with requirements. Unless otherwise indicated, provide heavy-duty components as indicated in manufacturers' publications and as required for a complete escalator.
 - a. Provide escalators with two **OR** three **OR** four, **as directed**, flat steps at top and bottom landings.
 - b. Fabricate exposed metalwork, including deck covers, balustrade panels, and trim to provide surface flatness equivalent to stretcher-leveled standard of flatness and sufficient strength for indicated use; increase metal thickness or reinforce with concealed stiffeners, backing materials, or both, as necessary. Support joints with concealed stiffeners as needed to hold exposed faces of adjoining sheets in flush alignment.
3. Opaque Balustrades: Manufacturer's standard profile or arrangement of moving handrails on fully paneled guide rail with interior balustrade panels, deck covers, skirts, trim, and accessories. Prepare for exterior finish below the deck covers, specified in another Section.
4. Transparent Balustrades: Manufacturer's standard profile or arrangement of moving handrails on guide rail that is supported by tempered glass panels, with deck covers, skirts, trim, and accessories. Prepare for exterior finish below the deck covers, specified in another Section.
5. Guards at Ceiling Intersection: Clear plastic.
6. Handrails: Smooth, jointless, reinforced neoprene.
 - a. Color: Black **OR** As selected from manufacturer's full range, **as directed**.
7. Deck Covers and Trim: Satin stainless steel **OR** Polished stainless steel **OR** Gold-colored satin stainless steel **OR** Gold-colored polished stainless steel **OR** Satin bronze, **as directed**.
8. Antislid Devices: Satin stainless steel **OR** Polished stainless steel **OR** Gold-colored satin stainless steel **OR** Gold-colored polished stainless steel **OR** Satin bronze, **as directed**.
9. Balustrade Interior Panels: Satin stainless steel **OR** Polished stainless steel **OR** Gold-colored satin stainless steel **OR** Gold-colored polished stainless steel **OR** Satin bronze, **as directed**.
10. Balustrade Exterior Panels and Escalator Soffits: Satin stainless steel **OR** Polished stainless steel **OR** Gold-colored satin stainless steel **OR** Gold-colored polished stainless steel **OR** Satin bronze, **as directed**.
11. Skirt Panels, if Applicable: Satin stainless steel **OR** Polished stainless steel **OR** Satin stainless steel with exposed surface coated with clear PTFE **OR** Steel panels with exposed surface coated with PTFE **OR** Manufacturer's standard low-friction material, **as directed**.
12. Steps: One-piece, die-cast aluminum with demarcation grooves at front and rear of tread surface.
 - a. Finish: Powder-coated, gray **OR** black, **as directed**.
 - b. Step Demarcation: Yellow inserts at sides and back of step treads.
 - c. Nosing Demarcation: **2-inch- (50-mm-)** wide yellow stripe at nosings of step treads.
13. Combs: Integrally colored structural plastic **OR** Cast aluminum **OR** Cast aluminum with powder-coated finish, **as directed**.
 - a. Comb Color: Yellow.
14. Floor Plates: Cast or extruded aluminum with grooved or patterned surface and mill finish.
15. Abrasive-Surface Floor Plates: Cast or extruded aluminum **OR** Stainless steel, **as directed**, with grooved or patterned surface and with abrasive material embedded in or metallically bonded to floor-plate surface and having a coefficient of friction of 0.6 or higher when tested according to ASTM C 1028.
16. Operational Control: Provide escalators designed and equipped to run equally in either direction. Provide key-operated switches for directional control and key-operated starter switches located on exterior deck above newel base at both upper and lower landings of escalators.

C. Features

1. Fault Indicator: Provide escalators with a microprocessor unit that monitors safety devices, motor temperature, and escalator speed and records in nonvolatile memory date, time, and device identification if a safety device is activated or escalator malfunctions.

- a. Provide built-in or plug-in unit to display recorded information.
2. Reduced-Current Starting: Provide escalator motors with wye-delta or solid-state starting.
3. Energy-Saving Feature: Provide escalator motors and controls designed for motors to run on partial windings (at reduced power) when not under full load.
4. Provide motors complying with NEMA MG 1, Insulation Class B.
5. Brake-Saving Feature: Provide stopping mechanism that allows escalator to coast to a stop before applying brakes, unless stopping is initiated by a safety device.
6. Equip step drive mechanism with automatic step-chain lubricators.
7. Oil Drip Pan: Provide metal pan under full width and length of escalator to collect and hold oil and grease drippings from lubricated components. Design and fabricate drip pan to sustain a load of **250 lbf (1.1 kN)** on a **1.0-sq. ft. (0.9-sq. m)** area at any location without permanent deflection.
8. Direction Indicator Lights: Provide red and green indicator lights at least **2 inches (50 mm)** in diameter in right-hand **OR** both, **as directed**, balustrade newels at both upper and lower landings. Green light indicates entrance end, and red light indicates exit end. When escalator is stopped, red lights are illuminated at both ends.
9. Combplate Lights: Provide recessed light fixtures with flush lenses mounted in skirt panels at each side of combplates designed to illuminate steps at combplate.
10. Overspeed Governor: Provide units with overspeed governor that is activated if speed of steps exceeds rated speed by more than 20 percent.
11. Upper-Landing, Step Upthrust Device: Activated if a step is displaced against upthrust track at upper curve in passenger-carrying line of track system.
12. Comb-Step Impact Device: Activated if a horizontal force in direction of travel is applied exceeding **112 lbf (500 N)** at either side or exceeding **225 lbf (1000 N)** at center of front edge of combplate, or a resultant force in upward direction is applied exceeding **150 lbf (688 N)** at center of front edge of combplate.

D. Exterior Escalators

1. Fabricate exposed components from stainless steel **OR** bronze, **as directed**, unless otherwise indicated.
2. Hot-dip galvanize escalator trusses and other structural components to comply with ASTM A 123/A 123M. Use only stainless-steel or zinc-plated fasteners for assembly of escalator components.
3. Fabricate oil drip pan from galvanized steel sheet. Provide drain and oil/water separator in oil drip pan.
4. Provide drains, weeps, and drips to prevent water accumulation on horizontal surfaces and to direct water away from electrical equipment and moving parts.
5. Provide enclosures complying with NEMA 250, Type 4 for electrical connections, switches, and equipment.
6. Provide totally enclosed motors complying with NEMA MG 1, Insulation Class B.
7. Equip step drive mechanism with automatic step-chain lubricators.
8. Provide electric heaters with integral thermostats in escalator truss space to maintain temperature above **40 deg F (4.4 deg C)**.
9. Equip combplates with 400-W electric heaters to prevent ice and snow accumulation.

1.3 EXECUTION

A. Examination

1. Examine escalator areas, with Installer present, for compliance with requirements, installation tolerances, and other conditions affecting performance. Examine supporting structure, machine spaces, and pits; verify critical dimensions; and examine conditions under which escalators are to be installed.
 - a. Proceed with installation only after unsatisfactory conditions have been corrected.

- b. For the record, prepare written report, endorsed by Installer, listing dimensional discrepancies and conditions detrimental to performance or indicating that dimensions and conditions were found to be satisfactory.

B. Installation

1. Comply with manufacturer's written instructions.
2. Set escalators true to line and level, properly supported, and anchored to building structure. Use established benchmarks, lines, and levels to ensure dimensional coordination of the Work.
3. Adjust installed components for smooth, efficient operation, complying with required tolerances and free of hazardous conditions. Lubricate operating parts, including bearings, tracks, chains, guides, and hardware. Test operating devices, equipment, signals, controls, and safety devices. Install oil drip pans and verify that no oil drips outside of pans.
4. Repair damaged finishes so no evidence remains of correction work. Return items that cannot be refinished in the field to the shop, make required repairs and refinish entire unit, or provide new units as required.

C. Field Quality Control

1. Acceptance Testing: On completion of escalator installation and before permitting use of escalators, perform acceptance tests as required and recommended by ASME A17.1 and by authorities having jurisdiction.
 - a. For escalators specified to comply with requirements more stringent than those of ASME A17.1, perform tests for compliance with specified requirements. Test optional safety devices.
2. Advise the Owner and authorities having jurisdiction in advance of dates and times tests are to be performed.

D. Demonstration

1. Train the Owner's maintenance personnel to operate, adjust, and maintain escalators.
2. Check operation of escalators with the Owner's personnel present and before date of Final Completion. Determine that operation systems and devices are functioning properly.
3. Check operation of escalators with the Owner's personnel present not more than one month before end of warranty period. Determine that operation systems and devices are functioning properly.

END OF SECTION 14 31 00 00

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SECTION 14 32 00 00 - MOVING WALKS

1.1 GENERAL

A. Description Of Work

1. This specification covers the furnishing and installation of materials for moving walks. Products shall be as follows or as directed by the Owner. Installation procedures shall be in accordance with the product manufacturer's recommendations. Demolition and removal of materials shall be as required to support the work.

B. Summary

1. This Section includes interior and exterior moving walks.

C. Definition

1. Defective Moving Walk Work: Operation or control system failure, including excessive malfunctions; performances below specified ratings; excessive wear; unusual deterioration or aging of materials or finishes; unsafe conditions; the need for excessive maintenance; abnormal noise or vibration; and similar unusual, unexpected, and unsatisfactory conditions.

D. Performance Requirements

1. Rated Speed: 90 fpm (0.45 m/s) OR 100 fpm (0.5 m/s) OR 120 fpm (0.6 m/s) OR 130 fpm (0.66 m/s) OR 150 fpm (0.76 m/s), as directed.
2. Structural Performance of Balustrades, Deck Barricades, and Handrails: Provide components and assemblies capable of withstanding the effects of loads indicated in ASCE 7 for handrail assemblies and guardrail systems.

E. Submittals

1. Product Data: Include capacities, sizes, performances, safety features, finishes, and similar information.
2. Shop Drawings: Show plans, elevations, sections, and details indicating coordination with building structure and relationships with other construction. Indicate variations from specified requirements, maximum loads imposed on building structure at points of support, and power requirements. Indicate access and ventilation for moving walk machine space.
3. Samples: For exposed finishes, 3-inch- (75-mm-) square Samples of sheet materials, and 4-inch (100-mm) lengths of running trim members.
4. Manufacturer Certificates: Signed by manufacturer certifying that moving walk layout and dimensions, as shown on Drawings, and electrical service, as shown and specified, are adequate for moving walks being provided.
5. Operation and Maintenance Data: For moving walks to include in emergency, operation, and maintenance manuals.
6. Inspection and Acceptance Certificates and Operating Permits: As required by authorities having jurisdiction for normal, unrestricted use of moving walks.

F. Quality Assurance

1. Regulatory Requirements: Comply with ASME A17.1.

G. Delivery, Storage, And Handling

1. Deliver, store, and handle materials, components, and equipment in manufacturer's protective packaging.
2. Store materials, components, and equipment off of ground, under cover, and in a dry location. Handle according to manufacturer's recommendations to prevent damage, deterioration, or soiling.

H. Warranty

1. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair, restore, or replace defective moving walk work within one year from date of Final Completion.

I. Maintenance Service

1. Initial Maintenance Service: Beginning at Final Completion, provide one years' full maintenance service by skilled employees of moving walk Installer. Include monthly preventive maintenance, repair or replacement of worn or defective components, lubrication, cleaning, and adjusting as required for proper moving walk operation at rated speed and capacity. Provide parts and supplies same as those used in the manufacture and installation of original equipment.

1.2 PRODUCTS

A. General

1. Provide preengineered pallet- or belt-type moving walks complying with requirements.

B. Materials

1. Stainless Steel: ASTM A 240/A 240M, Type 304 **OR** 316 **OR** 304, except use Type 316 for exterior moving walks, **as directed**.
 - a. Satin Finish: No. 4 directional satin.
 - b. Polished Finish: No. 8 mirror polish.
 - c. Gold-Colored Satin Finish: No. 4 directional satin with gold-colored oxide or titanium nitride finish.
 - d. Gold-Colored Mirror Finish: No. 8 mirror polish with gold-colored oxide or titanium nitride finish.
2. Satin Bronze Sheet: ASTM B 36/B 36M, Alloy UNS No. C28000 (muntz metal), fine satin finish, lacquered.
3. Satin Bronze Extrusions: ASTM B 455, Alloy UNS No. C38500 (architectural bronze), fine satin finish, lacquered.
4. Steel Sheet: Cold-rolled steel sheet, ASTM A 1008/A 1008M, commercial steel, Type B, exposed, matte finish.
5. Clear Tempered Glass: ASTM C 1048, Condition A (uncoated surfaces), Type 1 (transparent glass, flat), Class 1 (clear), Quality q3 (glazing, select), Kind FT (fully tempered), 10.0 **OR** 12.0, **as directed**, mm thick.
6. Tinted Tempered Glass: ASTM C 1048, Condition A (uncoated surfaces), Type 1 (transparent glass, flat), Class 2 (tinted), Quality q3 (glazing, select), Kind FT (fully tempered), 10.0 **OR** 12.0, **as directed**, mm thick.
 - a. Color: Bronze **OR** Gray **OR** Green, **as directed**.

C. Components

1. General: Unless otherwise indicated, provide standard components as indicated in manufacturers' publications and as required for a complete moving walk.
 - a. Fabricate exposed metalwork, including deck covers, balustrade panels, and trim to provide surface flatness equivalent to stretcher-leveled standard of flatness and sufficient strength for indicated use; increase metal thickness or reinforce with concealed stiffeners, backing materials, or both, as necessary. Support joints with concealed stiffeners as needed to hold exposed faces of adjoining sheets in flush alignment.
2. Opaque Balustrades: Manufacturer's standard profile or arrangement of moving handrails on fully paneled guide rail with interior balustrade panels, deck covers, skirts, trim, and accessories. Prepare for exterior finish below the deck covers, specified in another Section.
3. Transparent Balustrades: Manufacturer's standard profile or arrangement of moving handrails on guide rail that is supported by clear **OR** tinted, **as directed**, tempered glass panels, with deck covers, skirts, trim, and accessories. Prepare for exterior finish below the deck covers, specified in another Section.
4. Handrails: Smooth, jointless, reinforced neoprene.

- a. Color: Black **OR** As selected from manufacturer's full range, **as directed**.
5. Deck Covers and Trim: Satin stainless steel **OR** Polished stainless steel **OR** Gold-colored satin stainless steel **OR** Gold-colored polished stainless steel **OR** Satin bronze, **as directed**.
6. Balustrade Interior Panels: Satin stainless steel **OR** Polished stainless steel **OR** Gold-colored satin stainless steel **OR** Gold-colored polished stainless steel **OR** Satin bronze, **as directed**.
7. Balustrade Exterior Panels: Satin stainless steel **OR** Polished stainless steel **OR** Gold-colored satin stainless steel **OR** Gold-colored polished stainless steel **OR** Satin bronze, **as directed**.
8. Skirt Panels, if Applicable: Polished stainless steel **OR** Satin stainless steel with exposed surface coated with clear PTFE **OR** Steel panels with exposed surface coated with PTFE, **as directed**.
 - a. Clearance between skirt panels or overhanging balustrade panels and treadway shall not exceed **1/16 inch (1.6 mm)**.
9. Combs: Integrally colored structural plastic **OR** Cast aluminum **OR** Cast aluminum with powder-coated finish, **as directed**.
 - a. Comb Color: Yellow **OR** Black **OR** Gray **OR** Red, **as directed**.
10. Floor Plates: Cast or extruded aluminum **OR** Stainless steel, **as directed**, with grooved or patterned surface and mill finish.
11. Abrasive-Surface Floor Plates: Cast or extruded aluminum **OR** Stainless steel, **as directed**, with grooved or patterned surface and with abrasive material embedded in or metallicity bonded to floor-plate surface and having a coefficient of friction of 0.6 or higher when tested according to ASTM C 1028.
12. Operational Control: Provide moving walks designed and equipped to run equally in either direction. Provide key-operated switches for directional control and key-operated starter switches located on exterior deck above newel base at both ends of moving walks.

D. Features

1. Fault Indicator: Provide moving walks with a microprocessor unit that monitors safety devices, motor temperature, and moving walk speed and records in nonvolatile memory date, time, and device identification if a safety device is activated or moving walk malfunctions.
 - a. Provide built-in or plug-in unit to display recorded information.
2. Reduced-Current Starting: Provide moving walk motors with wye-delta or solid-state starting.
3. Energy-Saving Feature: Provide moving walk motors and controls designed for motors to run on partial windings (at reduced power) when not under full load.
4. Brake-Saving Feature: Provide stopping mechanism that allows moving walks to coast to a stop before applying brakes, unless stopping is initiated by a safety device.
5. Equip pallet drive mechanism with automatic pallet drive-chain lubricators.
6. Oil Drip Pan: Provide metal pan under full width and length of moving walks to collect and hold oil and grease drippings from lubricated components. Design and fabricate drip pan to sustain a load of **250 lbf (1.1 kN)** on a **1.0-sq. ft. (0.09-sq. m)** area at any location without permanent deflection.
7. Direction Indicator Lights: Provide red and green indicator lights at least **2 inches (50 mm)** in diameter in right-hand **OR** both, **as directed**, balustrade newels at both landings. Green light indicates entrance end, and red light indicates exit end. When moving walk is stopped, red lights are illuminated at both ends.
8. Combplate Lights: Provide recessed light fixtures with flush lenses mounted in interior balustrade panels at each side of combplates designed to illuminate treadway at combplate.
9. Comb-Step Impact Device: Activated if a horizontal force in direction of travel is applied exceeding **112 lbf (500 N)** at either side or exceeding **225 lbf (1000 N)** at center of front edge of combplate, or a resultant force in upward direction is applied exceeding **150 lbf (688 N)** at center of front edge of combplate.

E. Exterior Moving Walks

1. Fabricate exposed components from stainless steel **OR** bronze, **as directed**, unless otherwise indicated.
2. Hot-dip galvanize moving walk trusses and other structural components to comply with ASTM A 123/A 123M. Use only stainless-steel or zinc-plated fasteners for assembly of moving walk components.



3. Fabricate oil drip pan from galvanized steel sheet. Provide drain and oil/water separator in oil drip pan.
4. Provide drains, weeps, and drips to prevent water accumulation on horizontal surfaces and to direct water away from electrical equipment and moving parts.
5. Provide enclosures complying with NEMA 250, Type 4 for electrical connections, switches, and equipment.
6. Provide totally enclosed fan-cooled motors complying with NEMA MG 1, Insulation Class B.
7. Equip pallet drive mechanism with automatic pallet drive-chain lubricators.
8. Provide electric heaters with integral thermostats in moving walk truss space to maintain temperature above 40 deg F (4.4 deg C).
9. Equip combplates with 400-W electric heaters to prevent ice and snow accumulation.

1.3 EXECUTION

A. Installation

1. Comply with manufacturer's written instructions.
2. Set moving walks true to line and level, or to indicated slope, properly supported, and anchored to building structure. Use established benchmarks, lines, and levels to ensure dimensional coordination of the Work.
3. Adjust installed components for smooth, efficient operation, complying with required tolerances and free of hazardous conditions. Lubricate operating parts, including bearings, tracks, chains, guides, and hardware. Test operating devices, equipment, signals, controls, and safety devices. Install oil drip pans and verify that no oil drips outside of pans.
4. Repair damaged finishes so no evidence remains of correction work. Return items that cannot be refinished in the field to the shop, make required repairs and refinish entire unit, or provide new units as required.

B. Field Quality Control

1. Acceptance Testing: On completion of moving walk installation and before permitting use of moving walks, perform acceptance tests as required and recommended by ASME A17.1 and by authorities having jurisdiction.
2. Advise the Owner, Architect, and authorities having jurisdiction in advance of dates and times tests are to be performed.

C. Demonstration

1. Engage a factory-authorized service representative to train the Owner's maintenance personnel to operate, adjust, and maintain moving walks.

END OF SECTION 14 32 00 00

SECTION 14 42 13 00 - WHEELCHAIR LIFTS

1.1 GENERAL

A. Description Of Work

1. This specification covers the furnishing and installation of materials for wheelchair lifts. Products shall be as follows or as directed by the Owner. Installation procedures shall be in accordance with the product manufacturer's recommendations. Demolition and removal of materials shall be as required to support the work.

B. Summary

1. Section Includes:
 - a. Vertical and Private-residence, vertical platform lifts.
 - b. Inclined and Private-residence, inclined platform lifts.
 - c. Inclined and Private-residence, inclined stairway chairlifts.

C. Submittals

1. Product Data: For each type of product indicated.
2. Shop Drawings: For each lift. Include plans, elevations, sections, details, and attachments to other work.
 - a. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
 - b. Wiring Diagrams: For power, signal, and control wiring.
3. Samples: For each type of exposed finish required.
4. Manufacturer Certificates: Signed by lift manufacturer certifying that runway, ramp or pit, and dimensions as shown on Drawings and that electrical service as shown and specified are adequate for lift being provided.
5. Inspection and Acceptance Certificates and Operating Permits: As required by authorities having jurisdiction for normal, unrestricted use of lifts.
6. Operation and Maintenance Data: For each type of lift to include in operation and maintenance manuals.
7. Warranty: Sample of special warranty.
8. Continuing maintenance proposal.

D. Quality Assurance

1. Legal Requirements: In addition to requirements of authorities having jurisdiction, comply with Americans with Disabilities Act (including the ADA Standards issued by the U.S. Department of Justice and the U.S. Department of Transportation and the United States Access Board's Guide to the ADA Standards, specifically Chapter 4. "Elevators and Platform Lifts" (available on-line at <https://www.access-board.gov>), **as directed**.
2. Fire-Rated, Runway-Enclosure Door Assemblies: Assemblies complying with NFPA 80 that are listed and labeled by a qualified testing agency, for fire-protection ratings indicated, based on testing at as close to neutral pressure as possible according to NFPA 252 **OR** IBC Standard **OR** UL 10B, **as directed**.
 - a. Temperature-Rise Limit: Provide doors that have a maximum transmitted temperature end point of not more than **450 deg F (250 deg C)** above ambient after 30 minutes of standard fire-test exposure.

E. Warranty

1. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of lifts that fail in materials or workmanship within two **OR** Four **OR** Five, **as directed**, years from date of Final Completion.

F. Maintenance Service

1. Initial Maintenance Service: Beginning at Final Completion, provide 12 months' full maintenance by skilled employees of lift Installer. Include quarterly preventive maintenance and repair or replacement of worn or defective components, lubrication, cleaning, and adjusting as required for proper lift operation at rated speed and capacity. Provide parts and supplies the same as those used in the manufacture and installation of original equipment.
2. Continuing Maintenance Proposal: From Installer to the Owner, in the form of a standard yearly **OR** two-year **OR** five-year, **as directed**, maintenance agreement, starting on date initial maintenance service is concluded. State services, obligations, conditions, and terms for agreement period and for future renewal options.

1.2 PRODUCTS

A. Materials

1. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.
2. Steel Tubing: ASTM A 500.
3. Steel Pipe: ASTM A 53/A 53M; standard weight (Schedule 40) unless otherwise indicated or required by structural loads.
4. Cold-Rolled Steel Sheet: ASTM A 1008/A 1008M, commercial steel (CS), Type B, exposed, matte finish.
5. Hot-Rolled Steel Sheet: ASTM A 1011/A 1011M, commercial steel (CS), Type B, pickled.
6. Galvanized-Steel Sheet: ASTM A 653/A 653M, **G90 (Z275)** zinc coating,
7. Galvanizing: Hot-dip galvanize items as indicated to comply with applicable standard listed below:
 - a. ASTM A 123/A 123M, for galvanizing steel and iron products.
 - b. ASTM A 153/A 153M, for galvanizing steel and iron hardware.
8. Aluminum: Alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated, and with not less than the strength and durability properties of alloy and temper designated below for each aluminum form required:
 - a. Extruded Aluminum: **ASTM B 221 (ASTM B 221M)**, Alloy 6063-T6.
 - b. Aluminum Sheet: **ASTM B 209 (ASTM B 209M)**, Alloy 5005-H15.
9. Stainless-Steel Bars and Shapes: ASTM A 276, Type 304.
10. Stainless-Steel Tubing: ASTM A 554, Grade MT-304.
11. Stainless-Steel Sheet, Strip, and Plate: ASTM A 240/A 240M or ASTM A 666, Type 304.
12. Stainless-Steel Floor Plate: ASTM A 793.
13. Wood and Wood Panel Products: Comply with requirements in Division 06 Section "Interior Architectural Woodwork".
14. Wood and Wood Panel Products:
 - a. Wood: Clear, vertical-grain, straight, kiln-dried wood, AWPA C20-02, Interior Type A, fire-retardant treated, **as directed**; of manufacturer's standard species.
 - b. Wood Panels: Provide wood panels consisting of wood veneer and wood panel as follows:
 - 1) Wood Veneer: Laminated to core with moisture-resistant adhesive.
 - 2) Plywood: DOC PS 1.
 - 3) Particleboard: ANSI A208.1, made with binder containing no urea formaldehyde, **as directed**.
 - 4) Medium-Density Fiberboard: ANSI A208.2, made with binder containing no urea formaldehyde, **as directed**.
 - c. Fire-Retardant-Treated Wood Panels: Provide wood panels consisting of wood veneer and AWPA C27-02 fire-retardant-treated wood panels. Panels shall have flame-spread index of 75 **OR** 25, **as directed**, or less and smoke-developed index of 450 or less per ASTM E 84.
 - 1) Wood Veneer: Laminated to core with moisture-resistant adhesive.
 - 2) Plywood: DOC PS 1.
 - 3) Particleboard: ANSI A208.1, made with binder containing no urea formaldehyde, **as directed**.

- 4) Medium-Density Fiberboard: ANSI A208.2, made with binder containing no urea formaldehyde, **as directed**.
 15. Fiberglass: Multiple laminations of glass-fiber-reinforced polyester resin with UV-light-stable, colorfast, nonfading, weather- and stain-resistant, colored polyester gel coat, and manufacturer's standard finish.
 16. Glass:
 - a. Comply with requirements in Division 08 Section "Glazing".
OR
As indicated by manufacturer's designations **OR** As selected from manufacturer's full range, **as directed**, and complying with ASME A18.1.
 - 1) Safety Glazing Products: Comply with testing requirements in 16 CFR 1201, Category II.
 - 2) Safety Glass Marking: Glass permanently marked with certification label of SGCC or another certification agency or manufacturer acceptable to authorities having jurisdiction.
 17. Acrylic Glazing: ASTM D 4802, Category A-1 (cell-cast) or Category A-2 (continuous cast), Finish 1 (smooth or polished), clear or tinted as indicated.
 18. Inserts: Furnish required concrete and masonry inserts and similar anchorage devices for installing structural members, guide rails, machines, and other lift components where installation of devices is specified in another Section.
 19. Expansion Anchors: Anchor-bolt-and-sleeve assembly of material indicated below with capability to sustain a load equal to 10 times the load imposed as determined by testing per ASTM E 488 conducted by a qualified independent testing agency.
 - a. Material:
 - 1) Carbon-steel components, zinc plated to comply with ASTM B 633, Class Fe/Zn 5.
OR
Group 1, Alloy 304 or Alloy 316, stainless-steel bolts and nuts complying with **ASTM F 593 (ASTM F 738M)** and **ASTM F 594 (ASTM F 836M)**.
 20. Nonshrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C 1107.
- B. Vertical Platform Lifts
1. Private-Residence, **as directed**, Vertical Platform Lifts: Manufacturer's standard preengineered lift systems as indicated.
 2. Platform Size: **34 by 54 inches (864 by 1372 mm) OR 35 by 48 inches (889 by 1220 mm) OR 35 by 51 inches (889 by 1295 mm) OR 36 by 56 inches (914 by 1422 mm) OR 36 by 60 inches (914 by 1524 mm), as directed.**
 3. Door Operation and Clear Opening Width: Low-energy, power-operated doors that remain open for 20 seconds minimum; end door with minimum **32-inch (815-mm)** and side door with minimum **42-inch (1065-mm)** clear opening width.
 4. Rated Speed: **8 fpm (0.04 m/s) OR 10 fpm (0.05 m/s) OR 12 fpm (0.06 m/s) OR 15 fpm (0.08 m/s) OR 20 fpm (0.10 m/s) OR 22 fpm (0.11 m/s) OR 30 fpm (0.15 m/s), as directed.**
 5. Power Supply: 208 V, 60 Hz, 3 phase **OR** 240 V, 60 Hz, 1 phase **OR** 120 V, 60 Hz, 1 phase, **as directed**.
 6. Emergency Operation: Provide emergency manual operation and emergency battery power system **OR** connection to indicated standby (emergency) power, **as directed**, to raise or lower units in case of malfunction or power loss.
 7. Attendant Operation: Provide attendant operation at location shown.
 8. Self-Supporting Units: Support vertical loads of units only at base, with lateral support only at landing levels.
 9. Partial, **as directed**, Runway Enclosure: Manufacturer's standard weather-resistant, **as directed**, enclosure assembly.
 - a. Runway Enclosure: One of the following, **as directed**.
 - 1) Rectangular steel-tube frame with flush steel-sheet panels.
 - 2) Rectangular hot-dip-galvanized steel-tube frame with flush galvanized-steel-sheet panels.

- 3) Extruded-aluminum frame with flush galvanized-steel-sheet panels.
- 4) Extruded-aluminum frame with flush aluminum-sheet panels; with hot-dip-galvanized steel-tube frame for structural framing that cannot be aluminum.
- 5) Rectangular steel-tube frame with wood panels and trim.
- 6) Rectangular wood frame with wood panels and trim.
- 7) Rectangular steel-tube frame with fiberglass panels.
- b. Glazed Runway Enclosure: Rectangular structure of glazed extruded-aluminum framing with a tinted, acrylic dome roof.
 - 1) Glazing:
 - a) Bronze-tinted acrylic glazing, 6.0 mm thick.
OR
Bronze-tinted, float glass **OR** tempered safety **OR** laminated safety, **as directed**, glass, 6.0 mm thick, where indicated.
- c. Runway-Enclosure Doors: One of the following, **as directed**:
 - 1) Rectangular steel-tube frames with flush steel-sheet panels.
 - 2) Rectangular steel-tube frames glazed with 6.0-mm-thick, clear acrylic glazing and with **12-inch- (300-mm-)** high, steel kick panels.
 - 3) Wide-stile aluminum entrance doors glazed with bronze-tinted tempered safety glass, 6.0 mm thick.
 - 4) Enclosure doors matching appearance of adjacent glass-supported railings, complying with Division 05 Section "Decorative Metal Railings".
- d. Fire-Rated Runway-Enclosure Door: Provide fire-rated runway-enclosure door where shown **OR** at upper landing **OR** at lower landing, **as directed**.
 - 1) Fire-Protection Rating: 1-1/2 hours.
 - 2) Equip door with wired glass vision panel, delay-action door closer, dead latch, dummy trim door handle, and electric strike.
10. Platform: One of the following, **as directed**:
 - a. Galvanized-steel sheet with black rubber flooring.
 - b. Stainless-steel floor plate with checkered texture.
 - c. Aluminum floor plate with nonskid surface texture.
11. Platform Low-Profile Carriage: Fabricate platform floor assembly to total thickness not exceeding **1-1/2 inches (38 mm)**.
12. Platform Enclosure and Door: One of the following, **as directed**:
 - a. Rectangular steel-tube frame with flush steel-sheet panels.
 - b. Rectangular hot-dip-galvanized steel-tube frame with flush galvanized-steel-sheet panels.
 - c. Extruded-aluminum frame with flush galvanized-steel-sheet panels.
 - d. Extruded-aluminum frame with flush aluminum-sheet panels; with hot-dip-galvanized steel-tube frame for structural framing that cannot be aluminum.
 - e. Rectangular steel-tube frame with wood panels and trim.
 - f. Rectangular steel-tube frame with fiberglass panels.
 - g. Enclosure walls and doors matching appearance of adjacent glass-supported railings, complying with Division 05 Section "Decorative Metal Railings".
13. Platform Top: Provide a non-load-bearing top, matching construction of enclosure walls. Permanently mark top to indicate that it cannot sustain a load.
14. Fixed Ramp: Provide fixed ramp matching platform to provide transition from floor to lift platform at bottom landing.
15. Retractable Ramp: Provide ramp matching platform to provide transition from lower floor to lift platform. Ramp lowers to floor automatically when lifts reach lower landing and door opens. Ramp rises automatically when lift control is activated for lift to leave lower landing.
 - a. Ramp Size: End ramps a minimum of **32 inches (815 mm)** and side ramps a minimum of **42 inches (1065 mm)** wide; length as required for slope.
 - b. Ramp Slope: As indicated **OR** Maximum 1:12, **as directed**.
 - c. Ramp Finish: Finish ramps to match lift platform **OR** Ramp finish is specified elsewhere as indicated, **as directed**.
16. Accessories: Provide units with the following accessories:

- a. Fold-down seat with armrests and safety belt.
 - b. Forced Ventilation System: Minimum 1 air change per minute, continuously operating **OR** thermostatically controlled to activate at **90 deg F (32.22 deg C)** , **as directed**, and with auxiliary power source to operate ventilation for 1 hour in case of power failure.
 - c. Lighting system within lift enclosures as indicated on Drawings **OR** selected from manufacturer's available products, **as directed**.
- C. Inclined Platform Lifts
1. Private-Residence, **as directed**, Inclined Platform Lifts: Manufacturer's standard preengineered lift systems as indicated.
 2. Platform Size: **29 by 33 inches (737 by 838 mm) OR 28 by 35 inches (711 by 889 mm) OR 30 by 35 inches (760 by 889 mm) OR 30 by 36 inches (760 by 914 mm) OR 31 by 39 inches (787 by 991 mm) OR 30 by 41 inches (760 by 1041 mm) OR 30 by 42 inches (760 by 1067 mm) OR 31 by 43 inches (787 by 1092 mm) OR 30 by 48 inches (760 by 1220 mm)**, **as directed**.
 3. Door Operation and Clear Opening Width: Low-energy, power-operated doors that remain open for 20 seconds minimum; end door with minimum **32-inch (815-mm)** and side door with minimum **42-inch (1065-mm)** clear opening width.
 4. Rated Speed: **20 fpm (0.10 m/s) OR 22 fpm (0.11 m/s) OR 25 fpm (0.13 m/s) OR 30 fpm (0.15 m/s)**, **as directed**.
 5. Minimum Headroom Clearance during Travel: Minimum of **80 inches (2032 mm)** above any point on platform floor.
 6. Power Supply: 208 V, 60 Hz, 3 phase **OR** 240 V, 60 Hz, 1 phase **OR** 120 V, 60 Hz, 1 phase, **as directed**.
 7. Emergency Operation: Provide emergency manual operation and emergency battery power system **OR** connection to indicated standby (emergency) power, **as directed**, to raise or lower units in case of malfunction or power loss.
 8. Attendant Operation: Provide attendant operation at location shown.
 9. Platform: One of the following, **as directed**:
 - a. Galvanized-steel sheet with black rubber flooring.
 - b. Stainless-steel floor plate with checkered texture.
 - c. Aluminum floor plate with nonskid surface texture.
 10. Automatic Folding Platforms: When not in use, platforms automatically fold up against wall to minimize projection into stairway.
 11. Manual Folding Platforms: When not in use, platforms can be folded up against wall to minimize projection into stairway.
 12. Platform Guarding: Guard platform with passenger restraining arms **OR** enclosure, **as directed**.
 - a. Passenger Restraining Arms: Steel **OR** Galvanized-steel **OR** Stainless-steel, **as directed**, tubing, manually **OR** power, **as directed**, operated.
 - b. Platform Enclosure (Side Walls and Self-Closing Door): One of the following, **as directed**:
 - 1) Rectangular steel-tube frame with flush steel-sheet panels.
 - 2) Enclosure walls and doors matching appearance of adjacent glass-supported railings, complying with Division 05 Section "Decorative Metal Railings".
 13. Platform Guarding: Guard platform with automatically **OR** manually, **as directed**, actuated, retractable metal guard on lower access end of platform.
 14. Fixed Ramp: Provide fixed ramp matching platform to provide transition from floor to lift platform at bottom landing.
 15. Retractable Ramp: Provide ramp matching platform to provide transition from floor to lift platform. Ramp lowers to floor automatically when lifts reach landing and enclosure door opens. Ramp rises automatically when lift control is activated for lift to leave landing.
 - a. Ramp Size: End ramps a minimum of **32 inches (815 mm)** and side ramps a minimum of **42 inches (1065 mm)** wide; length as required for slope.
 - b. Ramp Slope: As indicated **OR** Maximum 1:12, **as directed**.
 - c. Ramp Finish: Finish ramps to match lift platform **OR** Ramp finish is specified elsewhere as indicated, **as directed**.

16. Supporting Structure: Provide framing to support vertical loads from floor or stair treads and only lateral loads from walls. Fabricate framing from steel **OR** stainless-steel, **as directed**, rectangular tubing, plates, shapes, and bars.
17. Guide Rails: Fabricate from steel **OR** stainless-steel, **as directed**, tubing.
18. Accessories: Provide units with the following accessories:
 - a. Fold-down seat with armrests and safety belt.
 - b. Caution sign as required by ASME A18.1.

D. Inclined Stairway Chairlifts

1. Private-Residence, **as directed**, Inclined Stairway Chairlifts: Manufacturer's standard preengineered lift systems as indicated.
2. Systems and Machinery: Manufacturer's standard preengineered lift systems as indicated in published product literature and as follows:
 - a. Rated Capacity: Minimum **250 lb (113 kg) OR 400 lb (181 kg), as directed.**
 - b. Rated Speed: **18 fpm (0.09 m/s) OR 20 fpm (0.10 m/s) OR 22 fpm (0.11 m/s) OR 25 fpm (0.13 m/s), as directed.**
3. Power Supply: 120 V, 60 Hz, 1 phase.
4. Battery Operation: Provide battery-operated drive with automatic charging system.
5. Manual Lowering: Provide means to manually lower units in case of malfunction or power loss.
6. Folding Units: Provide units that can be folded up against wall when not in use, to minimize projection into stairway.
7. Supporting Structure: Provide brackets to support vertical loads from floor or stair treads and to support lateral loads from walls. Fabricate brackets from steel plates, shapes, or bars.
8. Accessories: Provide units with the following accessories:
 - a. Tubular-steel, manually operated safety arms designed to restrain and provide grab bar for occupant.
 - b. Retractable seat belt.
 - c. Seat with back and two handgrips or arms.

E. General Finish Requirements

1. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
2. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
3. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

F. Finishes

1. Steel and Galvanized-Steel Factory Finish:
 - a. Baked-Enamel Finish: Immediately after cleaning and pretreating, apply manufacturer's standard 2-coat, baked-on finish consisting of prime coat and thermosetting topcoat, with a minimum dry film thickness of **1 mil (0.025 mm)** for topcoat.
 - b. Powder-Coat Finish: Immediately after cleaning and pretreating, apply manufacturer's standard, thermosetting polyester or acrylic urethane powder coating with a cured film thickness not less than **1.5 mils (0.04 mm)**.
 - c. Color and Gloss: As indicated by manufacturer's designations **OR** As selected from manufacturer's full range, **as directed**.
2. Stainless-Steel Finishes:
 - a. Floor Plate Finish: Mill **OR** Abrasive blasted, **as directed**.
 - b. Grab Rail Finish: As selected from manufacturer's full range **OR** Directional satin finish No. 4, **as directed**.
3. Aluminum Finishes:
 - a. Clear Anodic Finish: AAMA 611, AA-M12C22A41, Class I, 0.018 mm **OR** AA-M12C22A31, Class II, 0.010 mm, **as directed**, or thicker.

- b. Color Anodic Finish: AAMA 611, AA-M12C22A42/A44, Class I, 0.018 mm **OR** AA-M12C22A32/A34, Class II, 0.010 mm, **as directed**, or thicker.
 - 1) Color: As selected from full range of industry colors and color densities.
- c. Powder-Coat Finish: Immediately after cleaning and pretreating, apply manufacturer's standard, thermosetting polyester or acrylic urethane powder coating with a cured film thickness not less than **1.5 mils (0.04 mm)**.
 - 1) Color and Gloss: As selected from manufacturer's full range.
- 4. Wood Finish:
 - a. As specified in Division 09 Section "Staining And Transparent Finishing".
OR
As selected from manufacturer's full range, as follows:
 - 1) Type: Transparent finish **OR** Transparent finish over stain, **as directed**, over wood variety indicated.
- 5. Fiberglass Color and Gloss: As selected from manufacturer's full range.

1.3 EXECUTION

A. Installation

- 1. Wiring Method: Conceal conductors and cables within housings of units or building construction. Do not install conduit exposed to view in finished spaces. Bundle, lace, and train conductors to terminal points with no excess and without exceeding manufacturer's limitations on bending radii.
- 2. Coordinate runway doors with platform travel and positioning, for accurate alignment and minimum clearance between platforms, runway doors, sills, and door frames.
- 3. Position sills accurately and fill space under sills solidly with nonshrink, nonmetallic grout.
- 4. Coordinate platform doors with platform travel and positioning.
- 5. Adjust stops for accurate stopping and leveling at each landing, within required tolerances.
 - a. Leveling Tolerance: **1/4 inch (6 mm)** up or down, regardless of load and direction of travel.
- 6. Adjust retractable ramps to meet maximum allowable slope and change-in-elevation requirements, and to lie fully against landing surfaces.
- 7. Lubricate operating parts of lift, including drive mechanism, guide rails, hinges, safety devices, and hardware.
- 8. Test safety devices and verify smoothness of required protective enclosures and fascias

B. Field Quality Control

- 1. Acceptance Testing: On completion of lift installation and before permitting use of lifts, perform acceptance tests as required and recommended by ASME A18.1 and authorities having jurisdiction.
- 2. Operating Test: In addition to above testing, load lifts to rated capacity and operate continuously for 30 minutes between lowest and highest landings served. Readjust stops, signal equipment, and other devices for accurate stopping and operation of system.
- 3. Advise the Owner, Architect, and authorities having jurisdiction in advance of dates and times tests are to be performed on lifts.

C. Demonstration

- 1. Engage a factory-authorized service representative to train the Owner's maintenance personnel to adjust, operate, and maintain lifts. Include a review of emergency systems and emergency procedures to be followed at time of operational failure and other building emergencies.

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Task	Specification	Specification Description
14 42 16 00	14 42 13 00	Wheelchair Lifts

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SECTION 14 91 82 00 - CHUTES

1.1 GENERAL

A. Description Of Work

1. This specification covers the furnishing and installation of materials for chutes. Products shall be as follows or as directed by the Owner. Installation procedures shall be in accordance with the product manufacturer's recommendations. Demolition and removal of materials shall be as required to support the work.

B. Summary

1. This Section includes waste and laundry chutes.

C. Submittals

1. Product Data: For each type of product indicated.
2. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
3. Operation and maintenance data.

D. Quality Assurance

1. NFPA Compliance: Provide chutes complying with NFPA 82.
2. Fire-Rated Door Assemblies: Assemblies complying with NFPA 80 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire ratings indicated.
 - a. Test Pressure: Test at atmospheric (neutral) pressure according to NFPA 252 or UL 10B.
 - b. Intake Door: Class B labeled; 1-hour **OR** 1-1/2-hour, **as directed**, fire rated with 30-minute temperature rise of **250 deg F (140 deg C)**, **as directed**.
 - c. Discharge Door: Class B labeled; 1-hour fire rated with 30-minute temperature rise of **250 deg F (140 deg C)**, **as directed**.
 - d. Access Door: Class B labeled; 1-hour **OR** 1-1/2-hour, **as directed**, fire rated with 30-minute temperature rise of **250 deg F (140 deg C)**, **as directed**.
3. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

1.2 PRODUCTS

A. Chutes

1. Chute Metal: Aluminum-coated, cold-rolled, commercial steel sheet; ASTM A 463/A 463M, Type 1 with not less than **T1-40 (T1M-120)** coating **OR** Type 430 stainless steel, ASTM A 240/A 240M **OR** Type 304 stainless steel, ASTM A 240/A 240M, **as directed**.
 - a. Thickness: **0.060 inch (1.6 mm)** **OR** **0.080 inch (2.0 mm)**, **as directed**.
2. Size: **20-inch (508-mm)** diameter **OR** **24-inch (610-mm)** diameter **OR** As indicated on Drawings, **as directed**.

B. Doors

1. Intake Door Assemblies: ASTM A 240/A 240M, Type 304 stainless-steel, self-closing units with positive latch and latch handle; as required to provide fire-protection and temperature-rise, **as directed**, ratings indicated; and with frame suitable for enclosing chase construction.
 - a. Door Type: Hopper **OR** Hopper, limited access **OR** Side hinged, limited access, 180-degree swing, square **OR** Type as indicated on Drawings, **as directed**.
 - b. Size: Manufacturer's standard size for door type, chute type, and diameter indicated.
 - c. Finish: Manufacturer's standard satin or No. 3 directional polish.



- d. Locks: Cylinder locks with keys that are removable only when cylinder is locked. For each chute, key locks alike **OR** to master key system, **as directed**. For each door, furnish four, **as directed**, keys.
- e. Foot Operators: Hopper-type door operators that unlatch and open door when foot pedal is depressed.
- f. Mechanical Interlocks: Interlock system operated from discharge door to automatically lock intake doors.
- g. Electrical Interlocks: Interlock system that is energized by opening one intake door; remaining doors automatically lock when system is energized.
- 2. Discharge-Door Assemblies: Aluminum-coated-steel doors as required to provide fire-protection and temperature-rise, **as directed**, ratings indicated; equipped with fusible links that cause doors to close in the event of fire.
 - a. Direct Vertical Discharge: Provide inclined, horizontally rolling, shutter-type unit.
 - b. Horizontal Discharge: Provide top-hinged, self-closing, hopper door with self-latching hardware; floor-mounted leg brace designed to absorb impact of material dropping against chute; and minimum **NPS 2 (DN 50)** drain pipe connection.
- 3. Heat- **OR** Heat- and Smoke-, **as directed**, Detector System: Interlock system with temperature-rise elements that locks chute doors when temperature in chute reaches a predetermined, adjustable temperature.
 - a. Locate smoke detector outside discharge door with solenoid to close discharge door.
- 4. Access Door Assemblies: Manufacturer's standard ASTM A 240/A 240M, Type 302/304 stainless-steel doors; as required to provide fire-protection and temperature-rise, **as directed**, ratings indicated; with frame suitable for enclosing chase construction; and in satin or No. 3 directional polish finish.
- 5. Manual Control System: Control system with manual switches that lock doors of chute during shutdown hours and service operations.

C. Accessories

- 1. Fire Sprinklers: **NPS 1/2 (DN 13)** fire sprinklers ready for piping connections.
- 2. Flushing Spray Unit: **NPS 3/4 (DN 19)** spray head unit located in chute above highest intake door, ready for hot-water piping connection, and with access for head and piping maintenance.
- 3. Sanitizing Unit: **NPS 3/4 (DN 19)** disinfecting and sanitizing spray head unit located in chute above highest intake door, including **1-gal. (3.8-L)** tank and adjustable proportioning valve with bypass for manual control of sanitizing and flushing operation, ready for hot-water piping connection, and with access for head and piping maintenance.
- 4. Intake Door Baffles: Rubber baffles, **1/8 inch (3 mm)** thick.
- 5. Sound Dampening: Manufacturer's standard exterior mastic coating on chute.
 - a. Sound and vibration isolator pads at floor supporting frames.

D. Fabrication

- 1. General: Factory-assemble chutes to greatest extent practical with continuously welded or lock-seamed joints without bolts, rivets, or clips projecting on chute interior. Include intake-door assemblies and metal supporting framing at each floor, and chute expansion joints between each support point.
- 2. Roof Vent: Fabricate vent unit to extend **36 inches (910 mm) OR 48 inches (1200 mm)**, **as directed**, above roof with full-diameter, screened vent and metal safety cap or glass explosion-release cap. Fabricate with roof-deck flange, counterflashing, and clamping ring of nonferrous metal compatible with chute metal.
- 3. Fire Sprinklers: Comply with NFPA 13. Locate fire sprinklers at or above the top service opening of chutes, within the chute at alternate floor levels in buildings more than two stories tall, and at the lowest service level.
- 4. Equipment Access: Fabricate chutes with access for maintaining equipment located within the chute, such as flushing and sanitizing units, fire sprinklers, and plumbing and electrical connections.

1.3 EXECUTION

A. Installation

1. General: Comply with NFPA 82 requirements and with chute manufacturer's written instructions. Assemble components with tight, nonleaking joints. Anchor securely to supporting structure to withstand impact and stresses on vent units. Install chute and components to maintain fire-resistive construction of chute and enclosing chase.
2. Install chutes plumb, without offsets or obstructions that might prevent materials from free falling within chutes.
3. Anchor roof flanges of chute vents before installing roofing and flashing. Install chute-vent counterflashing after roofing and roof-penetration flashing are installed.
4. Intake and Discharge Doors: Interface door units with throat sections of chutes for safe, snag-resistant, sanitary depositing of materials in chutes by users.
 - a. Coordinate installation of foot-pedal door operator with installation of door and chase.
 - b. Interconnect sanitizer control with door interlock system.
5. Electrical Interlock System: Comply with applicable NECA 1 recommendations.
6. Test chute components after installation. Operate doors, locks, and interlock systems to demonstrate that hardware is adjusted and electrical wiring is connected correctly. Complete test operations before installing chase enclosures.
7. Test fire sprinklers and heat- and smoke-sensing devices for proper operation.
8. Operate sanitizing unit through one complete cycle of chute use and cleanup, and replenish chemicals or cleaning fluids in unit containers.

B. Cleaning

1. After completing chase enclosure, clean exposed surfaces of chute system's components. Do not remove labels of independent testing and inspecting agencies.

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SECTION 21 05 13 00 - COMMON MOTOR REQUIREMENTS FOR FIRE SUPPRESSION EQUIPMENT

1.1 GENERAL

A. Description Of Work

1. This specification covers the furnishing and installation of materials for common motor requirements for fire suppression equipment. Products shall be as follows or as directed by the Owner. Installation procedures shall be in accordance with the products manufacturer's recommendations. Demolition and removal of materials shall be as required to support the work.

B. Summary

1. Section includes general requirements for single-phase and polyphase, general-purpose, horizontal, small and medium, squirrel-cage induction motors for use on ac power systems up to 600 V and installed at equipment manufacturer's factory or shipped separately by equipment manufacturer for field installation.

C. Coordination

1. Coordinate features of motors, installed units, and accessory devices to be compatible with the following:
 - a. Motor controllers.
 - b. Torque, speed, and horsepower requirements of the load.
 - c. Ratings and characteristics of supply circuit and required control sequence.
 - d. Ambient and environmental conditions of installation location.

1.2 PRODUCTS

A. General Motor Requirements

1. Comply with requirements in this Section except when stricter requirements are specified in fire suppression equipment schedules or Sections.
2. Comply with NEMA MG 1 unless otherwise indicated.
3. Comply with IEEE 841 for severe-duty motors.

B. Motor Characteristics

1. Duty: Continuous duty at ambient temperature of 40 deg C and at altitude of 3300 feet (1000 m) above sea level.
2. Capacity and Torque Characteristics: Sufficient to start, accelerate, and operate connected loads at designated speeds, at installed altitude and environment, with indicated operating sequence, and without exceeding nameplate ratings or considering service factor.

C. Polyphase Motors

1. Description: NEMA MG 1, Design B, medium induction motor.
2. Efficiency: Energy efficient, as defined in NEMA MG 1.
3. Service Factor: 1.15.
4. Multispeed Motors: Variable torque.
 - a. For motors with 2:1 speed ratio, consequent pole, single winding.
 - b. For motors with other than 2:1 speed ratio, separate winding for each speed.
5. Multispeed Motors: Separate winding for each speed.
6. Rotor: Random-wound, squirrel cage.
7. Bearings: Regreasable, shielded, antifriction ball bearings suitable for radial and thrust loading.
8. Temperature Rise: Match insulation rating.
9. Insulation: Class F.
10. Code Letter Designation:



- a. Motors 15 HP and Larger: NEMA starting Code F or Code G.
- b. Motors Smaller than 15 HP: Manufacturer's standard starting characteristic.
11. Enclosure Material: Cast iron for motor frame sizes 324T and larger; rolled steel for motor frame sizes smaller than 324T.

D. Polyphase Motors With Additional Requirements

1. Motors Used with Reduced-Voltage and Multispeed Controllers: Match wiring connection requirements for controller with required motor leads. Provide terminals in motor terminal box, suited to control method.
2. Motors Used with Variable Frequency Controllers: Ratings, characteristics, and features coordinated with and approved by controller manufacturer.
 - a. Windings: Copper magnet wire with moisture-resistant insulation varnish, designed and tested to resist transient spikes, high frequencies, and short time rise pulses produced by pulse-width modulated inverters.
 - b. Energy- and Premium-Efficient Motors: Class B temperature rise; Class F insulation.
 - c. Inverter-Duty Motors: Class F temperature rise; Class H insulation.
 - d. Thermal Protection: Comply with NEMA MG 1 requirements for thermally protected motors.
3. Severe-Duty Motors: Comply with IEEE 841, with 1.15 minimum service factor.

E. Single-Phase Motors

1. Motors larger than 1/20 hp shall be one of the following, to suit starting torque and requirements of specific motor application:
 - a. Permanent-split capacitor.
 - b. Split phase.
 - c. Capacitor start, inductor run.
 - d. Capacitor start, capacitor run.
2. Multispeed Motors: Variable-torque, permanent-split-capacitor type.
3. Bearings: Prelubricated, antifriction ball bearings or sleeve bearings suitable for radial and thrust loading.
4. Motors 1/20 HP and Smaller: Shaded-pole type.
5. Thermal Protection: Internal protection to automatically open power supply circuit to motor when winding temperature exceeds a safe value calibrated to temperature rating of motor insulation. Thermal-protection device shall automatically reset when motor temperature returns to normal range.

1.3 EXECUTION (Not Applicable)

END OF SECTION 21 05 13 00

SECTION 21 05 19 00 - METERS AND GAGES FOR PLUMBING PIPING

1.1 GENERAL

A. Description Of Work

1. This specification covers the furnishing and installation of materials for meters and gages for plumbing piping. Products shall be as follows or as directed by the Owner. Installation procedures shall be in accordance with the products manufacturer's recommendations. Demolition and removal of materials shall be as required to support the work.

B. Summary

1. Section Includes:
 - a. Bimetallic-actuated thermometers.
 - b. Filled-system thermometers.
 - c. Liquid-in-glass thermometers.
 - d. Light-activated thermometers.
 - e. Thermowells.
 - f. Dial-type pressure gages.
 - g. Gage attachments.
 - h. Test plugs.
 - i. Test-plug kits.
 - j. Sight flow indicators.

C. Submittals

1. Product Data: For each type of product indicated.
2. Product Certificates: For each type of meter and gage, from manufacturer.
3. Operation and Maintenance Data: For meters and gages to include in operation and maintenance manuals.

1.2 PRODUCTS

A. Bimetallic-Actuated Thermometers

1. Standard: ASME B40.200.
2. Case: Liquid-filled and sealed type(s); stainless steel with **3-inch (76-mm) OR 5-inch (127-mm), as directed**, nominal diameter.
3. Dial: Nonreflective aluminum with permanently etched scale markings and scales in **deg F (deg C) OR deg F and deg C, as directed**.
4. Connector Type(s): Union joint, adjustable angle **OR** rigid, back **OR** rigid, bottom, **as directed**, with unified-inch screw threads.
5. Connector Size: **1/2 inch (13 mm)**, with ASME B1.1 screw threads.
6. Stem: **0.25 or 0.375 inch (6.4 or 9.4 mm)** in diameter; stainless steel.
7. Window: Plain glass or plastic.
8. Ring: Stainless steel.
9. Element: Bimetal coil.
10. Pointer: Dark-colored metal.
11. Accuracy: Plus or minus 1 **OR** 1.5, **as directed**, percent of scale range.

B. Filled-System Thermometers

1. Direct-Mounted, Metal-Case, Vapor-Actuated Thermometers:
 - a. Standard: ASME B40.200.
 - b. Case: Sealed type, cast aluminum or drawn steel; **4-1/2-inch (114-mm) OR 5-inch (127-mm) OR 6-inch (152-mm), as directed**, nominal diameter.
 - c. Element: Bourdon tube or other type of pressure element.

- d. Movement: Mechanical, dampening type, **as directed**, with link to pressure element and connection to pointer.
- e. Dial: Nonreflective aluminum with permanently etched scale markings graduated in **deg F (deg C) OR deg F and deg C, as directed.**
- f. Pointer: Dark-colored metal.
- g. Window: Glass or plastic.
- h. Ring: Metal **OR** Stainless steel, **as directed.**
- i. Connector Type(s): Union joint, adjustable, 180 degrees in vertical plane, 360 degrees in horizontal plane, with locking device **OR** rigid, back **OR** rigid, bottom, **as directed**; with ASME B1.1 screw threads.
- j. Thermal System: Liquid-filled bulb in copper-plated steel, aluminum, or brass stem and of length to suit installation.
 - 1) Design for Thermowell Installation: Bare stem.
- k. Accuracy: Plus or minus 1 percent of scale range.
- 2. Direct-Mounted, Plastic-Case, Vapor-Actuated Thermometers:
 - a. Standard: ASME B40.200.
 - b. Case: Sealed type, plastic; **4-1/2-inch (114-mm) OR 5-inch (127-mm) OR 6-inch (152-mm), as directed**, nominal diameter.
 - c. Element: Bourdon tube or other type of pressure element.
 - d. Movement: Mechanical, with link to pressure element and connection to pointer.
 - e. Dial: Nonreflective aluminum with permanently etched scale markings graduated in **deg F (deg C) OR deg F and deg C, as directed.**
 - f. Pointer: Dark-colored metal.
 - g. Window: Glass or plastic.
 - h. Ring: Metal or plastic.
 - i. Connector Type(s): Union joint, adjustable, 180 degrees in vertical plane, 360 degrees in horizontal plane, with locking device **OR** rigid, back **OR** rigid, bottom, **as directed**; with ASME B1.1 screw threads.
 - j. Thermal System: Liquid-filled bulb in copper-plated steel, aluminum, or brass stem and of length to suit installation.
 - 1) Design for Thermowell Installation: Bare stem.
 - k. Accuracy: Plus or minus 1 percent of scale range.
- 3. Remote-Mounted, Metal-Case, Vapor-Actuated Thermometers:
 - a. Standard: ASME B40.200.
 - b. Case: Sealed type, cast aluminum or drawn steel; **4-1/2-inch (114-mm) OR 6-inch (152-mm), as directed**, nominal diameter with back **OR** front, **as directed**, flange and holes for panel mounting.
 - c. Element: Bourdon tube or other type of pressure element.
 - d. Movement: Mechanical, with link to pressure element and connection to pointer.
 - e. Dial: Nonreflective aluminum with permanently etched scale markings graduated in **deg F (deg C) OR deg F and deg C, as directed.**
 - f. Pointer: Dark-colored metal.
 - g. Window: Glass or plastic.
 - h. Ring: Metal **OR** Stainless steel, **as directed.**
 - i. Connector Type(s): Union joint, back **OR** bottom, **as directed**; with ASME B1.1 screw threads.
 - j. Thermal System: Liquid-filled bulb in copper-plated steel, aluminum, or brass stem and of length to suit installation.
 - 1) Design for Thermowell Installation: Bare stem.
 - k. Accuracy: Plus or minus 1 percent of scale range.
- 4. Remote-Mounted, Plastic-Case, Vapor-Actuated Thermometers:
 - a. Standard: ASME B40.200.
 - b. Case: Sealed type, plastic; **4-1/2-inch (114-mm) OR 6-inch (152-mm), as directed**, nominal diameter with back **OR** front, **as directed**, flange and holes for panel mounting.
 - c. Element: Bourdon tube or other type of pressure element.

- d. Movement: Mechanical, with link to pressure element and connection to pointer.
- e. Dial: Nonreflective aluminum with permanently etched scale markings graduated in **deg F (deg C) OR deg F and deg C, as directed.**
- f. Pointer: Dark-colored metal.
- g. Window: Glass or plastic.
- h. Ring: Metal or plastic.
- i. Connector Type(s): Union joint, threaded, back **OR** bottom, **as directed**; with ASME B1.1 screw threads.
- j. Thermal System: Liquid-filled bulb in copper-plated steel, aluminum, or brass stem and of length to suit installation.
 - 1) Design for Thermowell Installation: Bare stem.
- k. Accuracy: Plus or minus 1 percent of scale range or one scale division, to a maximum of 1.5 percent of scale range.

C. Liquid-In-Glass Thermometers

- 1. Metal-Case, Compact-Style, Liquid-in-Glass Thermometers:
 - a. Standard: ASME B40.200.
 - b. Case: Cast aluminum; **6-inch (152-mm)** nominal size.
 - c. Case Form: Back angle **OR** Straight, **as directed**, unless otherwise indicated.
 - d. Tube: Glass with magnifying lens and blue or red organic liquid.
 - e. Tube Background: Nonreflective aluminum with permanently etched scale markings graduated in **deg F (deg C) OR deg F and deg C, as directed.**
 - f. Window: Glass or plastic.
 - g. Stem: Aluminum or brass and of length to suit installation.
 - 1) Design for Thermowell Installation: Bare stem.
 - h. Connector: **3/4 inch (19 mm)**, with ASME B1.1 screw threads.
 - i. Accuracy: Plus or minus 1 percent of scale range or one scale division, to a maximum of 1.5 percent of scale range.
- 2. Plastic-Case, Compact-Style, Liquid-in-Glass Thermometers:
 - a. Standard: ASME B40.200.
 - b. Case: Plastic; **6-inch (152-mm)** nominal size.
 - c. Case Form: Back angle **OR** Straight, **as directed**, unless otherwise indicated.
 - d. Tube: Glass with magnifying lens and blue or red organic liquid.
 - e. Tube Background: Nonreflective with permanently etched scale markings graduated in **deg F (deg C) OR deg F and deg C, as directed.**
 - f. Window: Glass or plastic.
 - g. Stem: Aluminum or brass and of length to suit installation.
 - 1) Design for Thermowell Installation: Bare stem.
 - h. Connector: **3/4 inch (19 mm)**, with ASME B1.1 screw threads.
 - i. Accuracy: Plus or minus 1 percent of scale range or one scale division, to a maximum of 1.5 percent of scale range.
- 3. Metal-Case, Industrial-Style, Liquid-in-Glass Thermometers:
 - a. Standard: ASME B40.200.
 - b. Case: Cast aluminum; **7-inch (178-mm) OR 9-inch (229-mm)**, **as directed**, nominal size unless otherwise indicated.
 - c. Case Form: Adjustable angle **OR** Back angle **OR** Straight, **as directed**, unless otherwise indicated.
 - d. Tube: Glass with magnifying lens and blue or red organic liquid.
 - e. Tube Background: Nonreflective aluminum with permanently etched scale markings graduated in **deg F (deg C) OR deg F and deg C, as directed.**
 - f. Window: Glass or plastic.
 - g. Stem: Aluminum and of length to suit installation.
 - 1) Design for Thermowell Installation: Bare stem.
 - h. Connector: **1-1/4 inches (32 mm)**, with ASME B1.1 screw threads.
 - i. Accuracy: Plus or minus 1 percent of scale range or one scale division, to a maximum of 1.5 percent of scale range.

4. Plastic-Case, Industrial-Style, Liquid-in-Glass Thermometers:
 - a. Standard: ASME B40.200.
 - b. Case: Plastic; **7-inch (178-mm) OR 9-inch (229-mm)**, **as directed**, nominal size unless otherwise indicated.
 - c. Case Form: Adjustable angle **OR** Back angle **OR** Straight, **as directed**, unless otherwise indicated.
 - d. Tube: Glass with magnifying lens and blue or red organic liquid.
 - e. Tube Background: Nonreflective aluminum with permanently etched scale markings graduated in **deg F (deg C) OR** deg F and deg C, **as directed**.
 - f. Window: Glass or plastic.
 - g. Stem: Aluminum **OR** Brass **OR** Stainless steel **OR** Aluminum, brass, or stainless steel, **as directed**, and of length to suit installation.
 - 1) Design for Thermowell Installation: Bare stem.
 - h. Connector: **1-1/4 inches (32 mm)**, with ASME B1.1 screw threads.
 - i. Accuracy: Plus or minus 1 percent of scale range or one scale division, to a maximum of 1.5 percent of scale range.
- D. Light-Activated Thermometers
 1. Direct-Mounted, Light-Activated Thermometers:
 - a. Case: Plastic **OR** Metal, **as directed**; **7-inch (178-mm) OR 9-inch (229-mm)**, **as directed**, nominal size unless otherwise indicated.
 - b. Scale(s): **Deg F (Deg C) OR** Deg F and deg C, **as directed**.
 - c. Case Form: Adjustable angle.
 - d. Connector: **1-1/4 inches (32 mm)**, with ASME B1.1 screw threads.
 - e. Stem: Aluminum and of length to suit installation.
 - 1) Design for Thermowell Installation: Bare stem.
 - f. Display: Digital.
 - g. Accuracy: Plus or minus **2 deg F (1 deg C)**.
 2. Remote-Mounted, Light-Activated Thermometers:
 - a. Case: Plastic, for wall mounting.
 - b. Scale(s): **Deg F (Deg C) OR** Deg F and deg C, **as directed**.
 - c. Sensor: Bulb and thermister wire.
 - 1) Design for Thermowell Installation: Bare stem.
 - d. Display: Digital.
 - e. Accuracy: Plus or minus **2 deg F (1 deg C)**.
- E. Thermowells
 1. Thermowells:
 - a. Standard: ASME B40.200.
 - b. Description: Pressure-tight, socket-type fitting made for insertion into piping tee fitting.
 - c. Material for Use with Copper Tubing: CNR or CUNI.
 - d. Material for Use with Steel Piping: CRES **OR** CSA, **as directed**.
 - e. Type: Stepped shank unless straight or tapered shank is indicated.
 - f. External Threads: **NPS 1/2, NPS 3/4, or NPS 1, (DN 15, DN 20, or NPS 25,)** ASME B1.20.1 pipe threads.
 - g. Internal Threads: **1/2, 3/4, and 1 inch (13, 19, and 25 mm)**, with ASME B1.1 screw threads.
 - h. Bore: Diameter required to match thermometer bulb or stem.
 - i. Insertion Length: Length required to match thermometer bulb or stem.
 - j. Lagging Extension: Include on thermowells for insulated piping and tubing.
 - k. Bushings: For converting size of thermowell's internal screw thread to size of thermometer connection.
 2. Heat-Transfer Medium: Mixture of graphite and glycerin.
- F. Pressure Gages

1. Direct-Mounted, Metal-Case, Dial-Type Pressure Gages:
 - a. Standard: ASME B40.100.
 - b. Case: Liquid-filled **OR** Sealed **OR** Open-front, pressure relief **OR** Solid-front, pressure relief, **as directed**, type(s); cast aluminum or drawn steel; **4-1/2-inch (114-mm) OR 6-inch (152-mm), as directed**, nominal diameter.
 - c. Pressure-Element Assembly: Bourdon tube unless otherwise indicated.
 - d. Pressure Connection: Brass, with **NPS 1/4 (DN 8) OR NPS 1/4 or NPS 1/2 (DN 8 or DN 15) OR NPS 1/2 (DN 15), as directed**, ASME B1.20.1 pipe threads and bottom-outlet type unless back-outlet type is indicated.
 - e. Movement: Mechanical, with link to pressure element and connection to pointer.
 - f. Dial: Nonreflective aluminum with permanently etched scale markings graduated in **psi (kPa) OR psi and kPa, as directed**.
 - g. Pointer: Dark-colored metal.
 - h. Window: Glass or plastic.
 - i. Ring: Metal **OR** Brass **OR** Stainless steel, **as directed**.
 - j. Accuracy: Grade A, plus or minus 1 percent of middle half of **OR** Grade B, plus or minus 2 percent of middle half of **OR** Grade C, plus or minus 3 percent of middle half of **OR** Grade D, plus or minus 5 percent of whole, **as directed**, scale range.
2. Direct-Mounted, Plastic-Case, Dial-Type Pressure Gages:
 - a. Standard: ASME B40.100.
 - b. Case: Sealed type; plastic; **4-1/2-inch (114-mm) OR 6-inch (152-mm), as directed**, nominal diameter.
 - c. Pressure-Element Assembly: Bourdon tube unless otherwise indicated.
 - d. Pressure Connection: Brass, with **NPS 1/4 (DN 8) OR NPS 1/4 or NPS 1/2 (DN 8 or DN 15) OR NPS 1/2 (DN 15), as directed**, ASME B1.20.1 pipe threads and bottom-outlet type unless back-outlet type is indicated.
 - e. Movement: Mechanical, with link to pressure element and connection to pointer.
 - f. Dial: Nonreflective aluminum with permanently etched scale markings graduated in **psi (kPa) OR psi and kPa, as directed**.
 - g. Pointer: Dark-colored metal.
 - h. Window: Glass or plastic.
 - i. Accuracy: Grade A, plus or minus 1 percent of middle half of **OR** Grade B, plus or minus 2 percent of middle half of **OR** Grade C, plus or minus 3 percent of middle half of **OR** Grade D, plus or minus 5 percent of whole, **as directed**, scale range.
3. Remote-Mounted, Metal-Case, Dial-Type Pressure Gages:
 - a. Standard: ASME B40.100.
 - b. Case: Liquid-filled **OR** Sealed, **as directed**, type; cast aluminum or drawn steel **OR** metal, **as directed**; **4-1/2-inch (114-mm) OR 6-inch (152-mm), as directed**, nominal diameter with back **OR** front, **as directed**, flange and holes for panel mounting.
 - c. Pressure-Element Assembly: Bourdon tube unless otherwise indicated.
 - d. Pressure Connection: Brass, with **NPS 1/4 (DN 8) OR NPS 1/4 or NPS 1/2 (DN 8 or DN 15) OR NPS 1/2 (DN 15), as directed**, ASME B1.20.1 pipe threads and bottom-outlet type unless back-outlet type is indicated.
 - e. Movement: Mechanical, with link to pressure element and connection to pointer.
 - f. Dial: Nonreflective aluminum with permanently etched scale markings graduated in **psi (kPa) OR psi and kPa, as directed**.
 - g. Pointer: Dark-colored metal.
 - h. Window: Glass or plastic.
 - i. Ring: Metal **OR** Stainless steel, **as directed**.
 - j. Accuracy: Grade A, plus or minus 1 percent of middle half of **OR** Grade B, plus or minus 2 percent of middle half of **OR** Grade C, plus or minus 3 percent of middle half of **OR** Grade D, plus or minus 5 percent of whole, **as directed**, scale range.
4. Remote-Mounted, Plastic-Case, Dial-Type Pressure Gages:
 - a. Standard: ASME B40.100.
 - b. Case: Sealed type; plastic; **4-1/2-inch (114-mm) OR 6-inch (152-mm), as directed**, nominal diameter with back **OR** front, **as directed**, flange and holes for panel mounting.

- c. Pressure-Element Assembly: Bourdon tube unless otherwise indicated.
 - d. Pressure Connection: Brass, with **NPS 1/4 (DN 8) OR NPS 1/4 or NPS 1/2 (DN 8 or DN 15) OR NPS 1/2 (DN 15), as directed**, ASME B1.20.1 pipe threads and bottom-outlet type unless back-outlet type is indicated.
 - e. Movement: Mechanical, with link to pressure element and connection to pointer.
 - f. Dial: Nonreflective aluminum with permanently etched scale markings graduated in **psi (kPa) OR psi and kPa, as directed**.
 - g. Pointer: Dark-colored metal.
 - h. Window: Glass or plastic.
 - i. Accuracy: Grade A, plus or minus 1 percent of middle half of **OR** Grade B, plus or minus 2 percent of middle half of **OR** Grade C, plus or minus 3 percent of middle half of **OR** Grade D, plus or minus 5 percent of whole, **as directed**, scale range.
- G. Gage Attachments
1. Snubbers: ASME B40.100, brass; with **NPS 1/4 (DN 8) OR NPS 1/4 or NPS 1/2 (DN 8 or DN 15) OR NPS 1/2 (DN 15), as directed**, ASME B1.20.1 pipe threads and piston **OR** porous-metal, **as directed**,-type surge-dampening device. Include extension for use on insulated piping.
 2. Valves: Brass ball **OR** Brass or stainless-steel needle, **as directed**, with **NPS 1/4 (DN 8) OR NPS 1/4 or NPS 1/2 (DN 8 or DN 15) OR NPS 1/2 (DN 15), as directed**, ASME B1.20.1 pipe threads.
- H. Test Plugs
1. Description: Test-station fitting made for insertion into piping tee fitting.
 2. Body: Brass or stainless steel with core inserts and gasketed and threaded cap. Include extended stem on units to be installed in insulated piping.
 3. Thread Size: **NPS 1/4 (DN 8) or NPS 1/2 (DN 15)**, ASME B1.20.1 pipe thread.
 4. Minimum Pressure and Temperature Rating: **500 psig at 200 deg F (3450 kPa at 93 deg C)**.
 5. Core Inserts: Chlorosulfonated polyethylene synthetic and EPDM self-sealing rubber.
- I. Test-Plug Kits
1. Furnish one test-plug kit(s) containing one **OR** two, **as directed**, thermometer(s), one pressure gage and adapter, and carrying case. Thermometer sensing elements, pressure gage, and adapter probes shall be of diameter to fit test plugs and of length to project into piping.
 2. Low-Range Thermometer: Small, bimetallic insertion type with **1- to 2-inch- (25- to 51-mm-) diameter dial and tapered-end sensing element. Dial range shall be at least 25 to 125 deg F (minus 4 to plus 52 deg C)**.
 3. High-Range Thermometer: Small, bimetallic insertion type with **1- to 2-inch- (25- to 51-mm-) diameter dial and tapered-end sensing element. Dial range shall be at least 0 to 220 deg F (minus 18 to plus 104 deg C)**.
 4. Pressure Gage: Small, Bourdon-tube insertion type with **2- to 3-inch- (51- to 76-mm-) diameter dial and probe. Dial range shall be at least 0 to 200 psig (0 to 1380 kPa)**.
 5. Carrying Case: Metal or plastic, with formed instrument padding.
- J. Sight Flow Indicators
1. Description: Piping inline-installation device for visual verification of flow.
 2. Construction: Bronze or stainless-steel body, with sight glass and ball, flapper, or paddle wheel indicator, and threaded or flanged ends.
 3. Minimum Pressure Rating: **125 psig (860 kPa) OR 150 psig (1034 kPa), as directed**.
 4. Minimum Temperature Rating: **200 deg F (93 deg C)**.
 5. End Connections for **NPS 2 (DN 50) and Smaller: Threaded**.
 6. End Connections for **NPS 2-1/2 (DN 65) and Larger: Flanged**.

1.3 EXECUTION

A. Installation

1. Install thermowells with socket extending a minimum of **2 inches (51 mm)** into fluid **OR** one-third of pipe diameter **OR** to center of pipe, **as directed**, and in vertical position in piping tees.
2. Install thermowells of sizes required to match thermometer connectors. Include bushings if required to match sizes.
3. Install thermowells with extension on insulated piping.
4. Fill thermowells with heat-transfer medium.
5. Install direct-mounted thermometers in thermowells and adjust vertical and tilted positions.
6. Install remote-mounted thermometer bulbs in thermowells and install cases on panels; connect cases with tubing and support tubing to prevent kinks. Use minimum tubing length.
7. Install direct-mounted pressure gages in piping tees with pressure gage located on pipe at the most readable position.
8. Install remote-mounted pressure gages on panel.
9. Install valve and snubber in piping for each pressure gage for fluids.
10. Install test plugs in piping tees.
11. Install thermometers in the following locations:
 - a. Inlet and outlet of each water heater.
 - b. Inlets and outlets of each domestic water heat exchanger.
 - c. Inlet and outlet of each domestic hot-water storage tank.
 - d. Inlet and outlet of each remote domestic water chiller.
12. Install pressure gages in the following locations:
 - a. Building water service entrance into building.
 - b. Inlet and outlet of each pressure-reducing valve.
 - c. Suction and discharge of each domestic water pump.

B. Connections

1. Install meters and gages adjacent to machines and equipment to allow service and maintenance of meters, gages, machines, and equipment.

C. Adjusting

1. Adjust faces of meters and gages to proper angle for best visibility.

D. Thermometer Schedule

1. Thermometers at inlet and outlet of each domestic water heater shall be one of the following:
 - a. Liquid-filled **OR** Sealed, **as directed**, bimetallic-actuated type.
 - b. Direct **OR** Remote, **as directed**, -mounted, metal **OR** plastic, **as directed**, -case, vapor-actuated type.
 - c. Compact **OR** Industrial, **as directed**, -style, liquid-in-glass type.
 - d. Direct **OR** Remote, **as directed**, -mounted, light-activated type.
 - e. Test plug with chlorosulfonated polyethylene synthetic **OR** EPDM, **as directed**, self-sealing rubber inserts.
2. Thermometers at inlets and outlets of each domestic water heat exchanger shall be one of the following:
 - a. Liquid-filled **OR** Sealed, **as directed**, bimetallic-actuated type.
 - b. Direct **OR** Remote, **as directed**, -mounted, metal **OR** plastic, **as directed**, -case, vapor-actuated type.
 - c. Compact **OR** Industrial, **as directed**, -style, liquid-in-glass type.
 - d. Direct **OR** Remote, **as directed**, -mounted, light-activated type.
 - e. Test plug with chlorosulfonated polyethylene synthetic **OR** EPDM, **as directed**, self-sealing rubber inserts.
3. Thermometers at inlet and outlet of each domestic hot-water storage tank shall be one of the following:
 - a. Liquid-filled **OR** Sealed, **as directed**, bimetallic-actuated type.

- b. Direct **OR** Remote, **as directed**, -mounted, metal **OR** plastic, **as directed**, -case, vapor-actuated type.
 - c. Compact **OR** Industrial, **as directed**, -style, liquid-in-glass type.
 - d. Direct **OR** Remote, **as directed**, -mounted, light-activated type.
 - e. Test plug with chlorosulfonated polyethylene synthetic **OR** EPDM, **as directed**, self-sealing rubber inserts.
 4. Thermometers at inlet and outlet of each remote domestic water chiller shall be one of the following:
 - a. Liquid-filled **OR** Sealed, **as directed**, bimetallic-actuated type.
 - b. Direct **OR** Remote, **as directed**, -mounted, metal **OR** plastic, **as directed**, -case, vapor-actuated type.
 - c. Compact **OR** Industrial, **as directed**, -style, liquid-in-glass type.
 - d. Direct **OR** Remote, **as directed**, -mounted, light-activated type.
 - e. Test plug with chlorosulfonated polyethylene synthetic **OR** EPDM, **as directed**, self-sealing rubber inserts.
 5. Thermometer stems shall be of length to match thermowell insertion length.
- E. Thermometer Scale-Range Schedule
1. Scale Range for Domestic Cold-Water Piping: 0 to 100 deg F (Minus 20 to plus 50 deg C) **OR** 0 to 100 deg F and minus 20 to plus 50 deg C, **as directed**.
 2. Scale Range for Domestic Cold-Water Piping: 0 to 150 deg F (Minus 20 to plus 70 deg C) **OR** 0 to 150 deg F and minus 20 to plus 70 deg C, **as directed**.
 3. Scale Range for Domestic Cold-Water Piping: 30 to 240 deg F (0 to plus 115 deg C) **OR** 30 to 240 deg F and 0 to plus 115 deg C, **as directed**.
 4. Scale Range for Domestic Hot-Water Piping: 0 to 250 deg F (0 to 150 deg C) **OR** 0 to 250 deg F and 0 to 150 deg C, **as directed**.
 5. Scale Range for Domestic Hot-Water Piping: 20 to 240 deg F (0 to 150 deg C) **OR** 20 to 240 deg F and 0 to 150 deg C, **as directed**.
 6. Scale Range for Domestic Hot-Water Piping: 30 to 240 deg F (0 to plus 115 deg C) **OR** 30 to 240 deg F and 0 to plus 115 deg C, **as directed**.
 7. Scale Range for Domestic Cooled-Water Piping: 0 to 100 deg F (Minus 20 to plus 50 deg C) **OR** 0 to 100 deg F and minus 20 to plus 50 deg C, **as directed**.
 8. Scale Range for Domestic Cooled-Water Piping: 0 to 150 deg F (Minus 20 to plus 70 deg C) **OR** 0 to 150 deg F and minus 20 to plus 70 deg C, **as directed**.
- F. Pressure-Gage Schedule
1. Pressure gages at discharge of each water service into building shall be one of the following:
 - a. Liquid-filled **OR** Sealed **OR** Open-front, pressure-relief **OR** Solid-front, pressure-relief, **as directed**, direct **OR** remote, **as directed**, -mounted, metal case.
 - b. Sealed, direct **OR** remote, **as directed**, -mounted, plastic case.
 - c. Test plug with chlorosulfonated polyethylene synthetic **OR** EPDM, **as directed**, self-sealing rubber inserts.
 2. Pressure gages at inlet and outlet of each water pressure-reducing valve shall be one of the following:
 - a. Liquid-filled **OR** Sealed **OR** Open-front, pressure-relief **OR** Solid-front, pressure-relief, **as directed**, direct **OR** remote, **as directed**, -mounted, metal case.
 - b. Sealed, direct **OR** remote, **as directed**, -mounted, plastic case.
 - c. Test plug with chlorosulfonated polyethylene synthetic **OR** EPDM, **as directed**, self-sealing rubber inserts.
 3. Pressure gages at suction and discharge of each domestic water pump shall be one of the following:
 - a. Liquid-filled **OR** Sealed **OR** Open-front, pressure-relief **OR** Solid-front, pressure-relief, **as directed**, direct **OR** remote, **as directed**, -mounted, metal case.
 - b. Sealed, direct **OR** remote, **as directed**, -mounted, plastic case.

- c. Test plug with chlorosulfonated polyethylene synthetic **OR** EPDM, **as directed**, self-sealing rubber inserts.

G. Pressure-Gage Scale-Range Schedule

1. Scale Range for Water Service Piping: **0 to 100 psi (0 to 600 kPa)** **OR** 0 to 100 psi and 0 to 600 kPa, **as directed**.
2. Scale Range for Water Service Piping: **0 to 160 psi (0 to 1100 kPa)** **OR** 0 to 160 psi and 0 to 1100 kPa, **as directed**.
3. Scale Range for Water Service Piping: **0 to 200 psi (0 to 1400 kPa)** **OR** 0 to 200 psi and 0 to 1400 kPa, **as directed**.
4. Scale Range for Domestic Water Piping: **0 to 100 psi (0 to 600 kPa)** **OR** 0 to 100 psi and 0 to 600 kPa, **as directed**.
5. Scale Range for Domestic Water Piping: **0 to 160 psi (0 to 1100 kPa)** **OR** 0 to 160 psi and 0 to 1100 kPa, **as directed**.
6. Scale Range for Domestic Water Piping: **0 to 200 psi (0 to 1400 kPa)** **OR** 0 to 200 psi and 0 to 1400 kPa, **as directed**.
7. Scale Range for Domestic Water Piping: **0 to 300 psi (0 to 2500 kPa)** **OR** 0 to 300 psi and 0 to 2500 kPa, **as directed**.

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SECTION 21 05 19 00a - METERS AND GAGES FOR HVAC PIPING

1.1 GENERAL

A. Description Of Work

1. This specification covers the furnishing and installation of materials for meters and gages for HVAC piping. Products shall be as follows or as directed by the Owner. Installation procedures shall be in accordance with the products manufacturer's recommendations. Demolition and removal of materials shall be as required to support the work.

B. Summary

1. Section Includes:
 - a. Bimetallic-actuated thermometers.
 - b. Filled-system thermometers.
 - c. Liquid-in-glass thermometers.
 - d. Light-activated thermometers.
 - e. Thermowells.
 - f. Dial-type pressure gages.
 - g. Gage attachments.
 - h. Test plugs.
 - i. Test-plug kits.
 - j. Sight flow indicators.
 - k. Orifice flowmeters.
 - l. Pitot-tube flowmeters.
 - m. Turbine flowmeters.
 - n. Venturi flowmeters.
 - o. Vortex-shedding flowmeters.
 - p. Impeller-turbine, thermal-energy meters.
 - q. Ultrasonic, thermal-energy meters.

C. Submittals

1. Product Data: For each type of product indicated.
2. Wiring Diagrams: For power, signal, and control wiring.
3. Product Certificates: For each type of meter and gage, from manufacturer.
4. Operation and Maintenance Data: For meters and gages to include in operation and maintenance manuals.

1.2 PRODUCTS

A. Bimetallic-Actuated Thermometers

1. Standard: ASME B40.200.
2. Case: Liquid-filled and sealed type(s); stainless steel with **3-inch (76-mm) OR 5-inch (127-mm), as directed**, nominal diameter.
3. Dial: Nonreflective aluminum with permanently etched scale markings and scales in **deg F (deg C) OR deg F and deg C, as directed**.
4. Connector Type(s): Union joint, adjustable angle **OR** rigid, back **OR** rigid, bottom, **as directed**, with unified-inch screw threads.
5. Connector Size: **1/2 inch (13 mm)**, with ASME B1.1 screw threads.
6. Stem: **0.25 or 0.375 inch (6.4 or 9.4 mm)** in diameter; stainless steel.
7. Window: Plain glass or plastic.
8. Ring: Stainless steel.
9. Element: Bimetal coil.
10. Pointer: Dark-colored metal.

11. Accuracy: Plus or minus 1 **OR** 1.5, **as directed**, percent of scale range.

B. Filled-System Thermometers

1. Direct-Mounted, Metal-Case, Vapor-Actuated Thermometers:
 - a. Standard: ASME B40.200.
 - b. Case: Sealed type, cast aluminum or drawn steel; 4-1/2-inch (114-mm) **OR** 5-inch (127-mm) **OR** 6-inch (152-mm), **as directed**, nominal diameter.
 - c. Element: Bourdon tube or other type of pressure element.
 - d. Movement: Mechanical, dampening type, **as directed**, with link to pressure element and connection to pointer.
 - e. Dial: Nonreflective aluminum with permanently etched scale markings graduated in **deg F (deg C)** **OR** deg F and deg C, **as directed**.
 - f. Pointer: Dark-colored metal.
 - g. Window: Glass or plastic.
 - h. Ring: Metal **OR** Stainless steel.
 - i. Connector Type(s): Union joint, adjustable, 180 degrees in vertical plane, 360 degrees in horizontal plane, with locking device **OR** rigid, back **OR** rigid, bottom, **as directed**; with ASME B1.1 screw threads.
 - j. Thermal System: Liquid-filled bulb in copper-plated steel, aluminum, or brass stem and of length to suit installation.
 - 1) Design for Air-Duct Installation: With ventilated shroud.
 - 2) Design for Thermowell Installation: Bare stem.
 - k. Accuracy: Plus or minus 1 percent of scale range.
2. Direct-Mounted, Plastic-Case, Vapor-Actuated Thermometers:
 - a. Standard: ASME B40.200.
 - b. Case: Sealed type, plastic; 4-1/2-inch (114-mm) **OR** 5-inch (127-mm) **OR** 6-inch (152-mm), **as directed**, nominal diameter.
 - c. Element: Bourdon tube or other type of pressure element.
 - d. Movement: Mechanical, with link to pressure element and connection to pointer.
 - e. Dial: Nonreflective aluminum with permanently etched scale markings graduated in **deg F (deg C)** **OR** deg F and deg C, **as directed**.
 - f. Pointer: Dark-colored metal.
 - g. Window: Glass or plastic.
 - h. Ring: Metal or plastic.
 - i. Connector Type(s): Union joint, adjustable, 180 degrees in vertical plane, 360 degrees in horizontal plane, with locking device **OR** rigid, back **OR** rigid, bottom, **as directed**; with ASME B1.1 screw threads.
 - j. Thermal System: Liquid-filled bulb in copper-plated steel, aluminum, or brass stem and of length to suit installation.
 - 1) Design for Air-Duct Installation: With ventilated shroud.
 - 2) Design for Thermowell Installation: Bare stem.
 - k. Accuracy: Plus or minus 1 percent of scale range.
3. Remote-Mounted, Metal-Case, Vapor-Actuated Thermometers:
 - a. Standard: ASME B40.200.
 - b. Case: Sealed type, cast aluminum or drawn steel; 4-1/2-inch (114-mm) **OR** 6-inch (152-mm), **as directed**, nominal diameter with back **OR** front, **as directed**, flange and holes for panel mounting.
 - c. Element: Bourdon tube or other type of pressure element.
 - d. Movement: Mechanical, with link to pressure element and connection to pointer.
 - e. Dial: Nonreflective aluminum with permanently etched scale markings graduated in **deg F (deg C)** **OR** deg F and deg C, **as directed**.
 - f. Pointer: Dark-colored metal.
 - g. Window: Glass or plastic.
 - h. Ring: Metal **OR** Stainless steel, **as directed**.

- i. Connector Type(s): Union joint, back **OR** bottom, **as directed**; with ASME B1.1 screw threads.
- j. Thermal System: Liquid-filled bulb in copper-plated steel, aluminum, or brass stem and of length to suit installation.
 - 1) Design for Air-Duct Installation: With ventilated shroud.
 - 2) Design for Thermowell Installation: Bare stem.
- k. Accuracy: Plus or minus 1 percent of scale range.
- 4. Remote-Mounted, Plastic-Case, Vapor-Actuated Thermometers:
 - a. Standard: ASME B40.200.
 - b. Case: Sealed type, plastic; **4-1/2-inch (114-mm) OR 6-inch (152-mm)**, **as directed**, nominal diameter with back **OR** front, **as directed**, flange and holes for panel mounting.
 - c. Element: Bourdon tube or other type of pressure element.
 - d. Movement: Mechanical, with link to pressure element and connection to pointer.
 - e. Dial: Nonreflective aluminum with permanently etched scale markings graduated in **deg F (deg C) OR deg F and deg C, as directed**.
 - f. Pointer: Dark-colored metal.
 - g. Window: Glass or plastic.
 - h. Ring: Metal or plastic.
 - i. Connector Type(s): Union joint, threaded, back **OR** bottom, **as directed**; with ASME B1.1 screw threads.
 - j. Thermal System: Liquid-filled bulb in copper-plated steel, aluminum, or brass stem and of length to suit installation.
 - 1) Design for Air-Duct Installation: With ventilated shroud.
 - 2) Design for Thermowell Installation: Bare stem.
 - k. Accuracy: Plus or minus 1 percent of scale range or one scale division, to a maximum of 1.5 percent of scale range.
- C. Liquid-In-Glass Thermometers
 - 1. Metal-Case, Compact-Style, Liquid-in-Glass Thermometers:
 - a. Standard: ASME B40.200.
 - b. Case: Cast aluminum; **6-inch (152-mm)** nominal size.
 - c. Case Form: Back angle **OR** Straight, **as directed**, unless otherwise indicated.
 - d. Tube: Glass with magnifying lens and blue or red, **as directed**, organic liquid.
 - e. Tube Background: Nonreflective aluminum with permanently etched scale markings graduated in **deg F (deg C) OR deg F and deg C, as directed**.
 - f. Window: Glass or plastic.
 - g. Stem: Aluminum or brass and of length to suit installation.
 - 1) Design for Air-Duct Installation: With ventilated shroud.
 - 2) Design for Thermowell Installation: Bare stem.
 - h. Connector: **3/4 inch (19 mm)**, with ASME B1.1 screw threads.
 - i. Accuracy: Plus or minus 1 percent of scale range or one scale division, to a maximum of 1.5 percent of scale range.
 - 2. Plastic-Case, Compact-Style, Liquid-in-Glass Thermometers:
 - a. Standard: ASME B40.200.
 - b. Case: Plastic; **6-inch (152-mm)** nominal size.
 - c. Case Form: Back angle **OR** Straight, **as directed**, unless otherwise indicated.
 - d. Tube: Glass with magnifying lens and blue or red, **as directed**, organic liquid.
 - e. Tube Background: Nonreflective with permanently etched scale markings graduated in **deg F (deg C) OR deg F and deg C, as directed**.
 - f. Window: Glass or plastic.
 - g. Stem: Aluminum or brass and of length to suit installation.
 - 1) Design for Air-Duct Installation: With ventilated shroud.
 - 2) Design for Thermowell Installation: Bare stem.
 - h. Connector: **3/4 inch (19 mm)**, with ASME B1.1 screw threads.
 - i. Accuracy: Plus or minus 1 percent of scale range or one scale division, to a maximum of 1.5 percent of scale range.

3. Metal-Case, Industrial-Style, Liquid-in-Glass Thermometers:
 - a. Standard: ASME B40.200.
 - b. Case: Cast aluminum; **7-inch (178-mm) OR 9-inch (229-mm)**, **as directed**, nominal size unless otherwise indicated.
 - c. Case Form: Adjustable angle **OR** Back angle **OR** Straight, **as directed**, unless otherwise indicated.
 - d. Tube: Glass with magnifying lens and blue or red, **as directed**, organic liquid.
 - e. Tube Background: Nonreflective aluminum with permanently etched scale markings graduated in **deg F (deg C) OR** deg F and deg C, **as directed**.
 - f. Window: Glass or plastic.
 - g. Stem: Aluminum and of length to suit installation.
 - 1) Design for Air-Duct Installation: With ventilated shroud.
 - 2) Design for Thermowell Installation: Bare stem.
 - h. Connector: **1-1/4 inches (32 mm)**, with ASME B1.1 screw threads.
 - i. Accuracy: Plus or minus 1 percent of scale range or one scale division, to a maximum of 1.5 percent of scale range.
 4. Plastic-Case, Industrial-Style, Liquid-in-Glass Thermometers:
 - a. Standard: ASME B40.200.
 - b. Case: Plastic; **7-inch (178-mm) OR 9-inch (229-mm)**, **as directed**, nominal size unless otherwise indicated.
 - c. Case Form: Adjustable angle **OR** Back angle **OR** Straight, **as directed**, unless otherwise indicated.
 - d. Tube: Glass with magnifying lens and blue or red, **as directed**, organic liquid.
 - e. Tube Background: Nonreflective aluminum with permanently etched scale markings graduated in **deg F (deg C) OR** deg F and deg C, **as directed**.
 - f. Window: Glass or plastic.
 - g. Stem: Aluminum **OR** Brass **OR** Stainless steel, **as directed**, and of length to suit installation.
 - 1) Design for Air-Duct Installation: With ventilated shroud.
 - 2) Design for Thermowell Installation: Bare stem.
 - h. Connector: **1-1/4 inches (32 mm)**, with ASME B1.1 screw threads.
 - i. Accuracy: Plus or minus 1 percent of scale range or one scale division, to a maximum of 1.5 percent of scale range.
- D. Light-Activated Thermometers
1. Direct-Mounted, Light-Activated Thermometers:
 - a. Case: Plastic **OR** Metal, **as directed**; **7-inch (178-mm) OR 9-inch (229-mm)**, **as directed**, nominal size unless otherwise indicated.
 - b. Scale(s): **Deg F (Deg C) OR** Deg F and deg C, **as directed**.
 - c. Case Form: Adjustable angle.
 - d. Connector: **1-1/4 inches (32 mm)**, with ASME B1.1 screw threads.
 - e. Stem: Aluminum and of length to suit installation.
 - 1) Design for Air-Duct Installation: With ventilated shroud.
 - 2) Design for Thermowell Installation: Bare stem.
 - f. Display: Digital.
 - g. Accuracy: Plus or minus **2 deg F (1 deg C)**.
 2. Remote-Mounted, Light-Activated Thermometers:
 - a. Case: Plastic, for wall mounting.
 - b. Scale(s): **Deg F (Deg C) OR** Deg F and deg C, **as directed**.
 - c. Sensor: Bulb and thermister wire.
 - 1) Design for Air-Duct Installation: With ventilated shroud.
 - 2) Design for Thermowell Installation: Bare stem.
 - d. Display: Digital.
 - e. Accuracy: Plus or minus **2 deg F (1 deg C)**.

- E. Duct-Thermometer Mounting Brackets
1. Description: Flanged bracket with screw holes, for attachment to air duct and made to hold thermometer stem.
- F. Thermowells
1. Thermowells:
 - a. Standard: ASME B40.200.
 - b. Description: Pressure-tight, socket-type fitting made for insertion into piping tee fitting.
 - c. Material for Use with Copper Tubing: CNR **OR** CUNI, **as directed**.
 - d. Material for Use with Steel Piping: CRES **OR** CSA, **as directed**.
 - e. Type: Stepped shank unless straight or tapered shank is indicated.
 - f. External Threads: **NPS 1/2, NPS 3/4, or NPS 1, (DN 15, DN 20, or NPS 25,)** ASME B1.20.1 pipe threads.
 - g. Internal Threads: **1/2, 3/4, and 1 inch (13, 19, and 25 mm)**, with ASME B1.1 screw threads.
 - h. Bore: Diameter required to match thermometer bulb or stem.
 - i. Insertion Length: Length required to match thermometer bulb or stem.
 - j. Lagging Extension: Include on thermowells for insulated piping and tubing.
 - k. Bushings: For converting size of thermowell's internal screw thread to size of thermometer connection.
 2. Heat-Transfer Medium: Mixture of graphite and glycerin.
- G. Pressure Gages
1. Direct-Mounted, Metal-Case, Dial-Type Pressure Gages:
 - 1) Standard: ASME B40.100.
 - 2) Case: Liquid-filled **OR** Sealed **OR** Open-front, pressure relief **OR** Solid-front, pressure relief, **as directed**, type(s); cast aluminum or drawn steel; **4-1/2-inch (114-mm) OR 6-inch (152-mm), as directed**, nominal diameter.
 - 3) Pressure-Element Assembly: Bourdon tube unless otherwise indicated.
 - 4) Pressure Connection: Brass, with **NPS 1/4 (DN 8) OR NPS 1/2 (DN 15), as directed**, ASME B1.20.1 pipe threads and bottom-outlet type unless back-outlet type is indicated.
 - 5) Movement: Mechanical, with link to pressure element and connection to pointer.
 - 6) Dial: Nonreflective aluminum with permanently etched scale markings graduated in **psi (kPa) OR psi and kPa, as directed**.
 - 7) Pointer: Dark-colored metal.
 - 8) Window: Glass or plastic.
 - 9) Ring: Metal **OR** Brass **OR** Stainless steel, **as directed**.
 - 10) Accuracy: Grade A, plus or minus 1 percent of middle half of **OR** Grade B, plus or minus 2 percent of middle half of **OR** Grade C, plus or minus 3 percent of middle half of **OR** Grade D, plus or minus 5 percent of whole, **as directed**, scale range.
 2. Direct-Mounted, Plastic-Case, Dial-Type Pressure Gages:
 - a. Standard: ASME B40.100.
 - b. Case: Sealed type; plastic; **4-1/2-inch (114-mm) OR 6-inch (152-mm), as directed**, nominal diameter.
 - c. Pressure-Element Assembly: Bourdon tube unless otherwise indicated.
 - d. Pressure Connection: Brass, with **NPS 1/4 (DN 8) OR NPS 1/2 (DN 15), as directed**, ASME B1.20.1 pipe threads and bottom-outlet type unless back-outlet type is indicated.
 - e. Movement: Mechanical, with link to pressure element and connection to pointer.
 - f. Dial: Nonreflective aluminum with permanently etched scale markings graduated in **psi (kPa) OR psi and kPa, as directed**.
 - g. Pointer: Dark-colored metal.
 - h. Window: Glass or plastic.
 - i. Accuracy: Grade A, plus or minus 1 percent of middle half of **OR** Grade B, plus or minus 2 percent of middle half of **OR** Grade C, plus or minus 3 percent of middle half of **OR** Grade D, plus or minus 5 percent of whole, **as directed**, scale range.

3. Remote-Mounted, Metal-Case, Dial-Type Pressure Gages:
 - a. Standard: ASME B40.100.
 - b. Case: Liquid-filled **OR** Sealed, **as directed**, type; cast aluminum or drawn steel **OR** metal, **as directed**; 4-1/2-inch (114-mm) **OR** 6-inch (152-mm), **as directed**, nominal diameter with back **OR** front, **as directed**, flange and holes for panel mounting.
 - c. Pressure-Element Assembly: Bourdon tube unless otherwise indicated.
 - d. Pressure Connection: Brass, with **NPS 1/4 (DN 8) OR NPS 1/2 (DN 15)**, **as directed**, ASME B1.20.1 pipe threads and bottom-outlet type unless back-outlet type is indicated.
 - e. Movement: Mechanical, with link to pressure element and connection to pointer.
 - f. Dial: Nonreflective aluminum with permanently etched scale markings graduated in **psi (kPa) OR psi and kPa, as directed**.
 - g. Pointer: Dark-colored metal.
 - h. Window: Glass or plastic.
 - i. Ring: Metal **OR** Stainless steel, **as directed**.
 - j. Accuracy: Grade A, plus or minus 1 percent of middle half of **OR** Grade B, plus or minus 2 percent of middle half of **OR** Grade C, plus or minus 3 percent of middle half of **OR** Grade D, plus or minus 5 percent of whole, **as directed**, scale range.
 4. Remote-Mounted, Plastic-Case, Dial-Type Pressure Gages:
 - a. Standard: ASME B40.100.
 - b. Case: Sealed type; plastic; 4-1/2-inch (114-mm) **OR** 6-inch (152-mm), **as directed**, nominal diameter with back **OR** front, **as directed**, flange and holes for panel mounting.
 - c. Pressure-Element Assembly: Bourdon tube unless otherwise indicated.
 - d. Pressure Connection: Brass, with **NPS 1/4 (DN 8) OR NPS 1/2 (DN 15)**, **as directed**, ASME B1.20.1 pipe threads and bottom-outlet type unless back-outlet type is indicated.
 - e. Movement: Mechanical, with link to pressure element and connection to pointer.
 - f. Dial: Nonreflective aluminum with permanently etched scale markings graduated in **psi (kPa) OR psi and kPa, as directed**.
 - g. Pointer: Dark-colored metal.
 - h. Window: Glass or plastic.
 - i. Accuracy: Grade A, plus or minus 1 percent of middle half of **OR** Grade B, plus or minus 2 percent of middle half of **OR** Grade C, plus or minus 3 percent of middle half of **OR** Grade D, plus or minus 5 percent of whole, **as directed**, scale range.
- H. Gage Attachments
1. Snubbers: ASME B40.100, brass; with **NPS 1/4 (DN 8) OR NPS 1/2 (DN 15)**, **as directed**, ASME B1.20.1 pipe threads and piston-type **OR** porous-metal-type, **as directed**, surge-dampening device. Include extension for use on insulated piping.
 2. Siphons: Loop-shaped section of brass **OR** stainless-steel **OR** steel, **as directed**, pipe with **NPS 1/4 (DN 8) OR NPS 1/2 (DN 15)**, **as directed**, pipe threads.
 3. Valves: Brass ball **OR** Brass or stainless-steel needle, **as directed**, with **NPS 1/4 (DN 8) OR NPS 1/2 (DN 15)**, **as directed**, ASME B1.20.1 pipe threads.
- I. Test Plugs
1. Description: Test-station fitting made for insertion into piping tee fitting.
 2. Body: Brass or stainless steel with core inserts and gasketed and threaded cap. Include extended stem on units to be installed in insulated piping.
 3. Thread Size: **NPS 1/4 (DN 8) OR NPS 1/2 (DN 15)**, **as directed**, ASME B1.20.1 pipe thread.
 4. Minimum Pressure and Temperature Rating: **500 psig at 200 deg F (3450 kPa at 93 deg C)**.
 5. Core Inserts: Chlorosulfonated polyethylene synthetic **OR** EPDM, **as directed**, self-sealing rubber.
- J. Test-Plug Kits
1. Furnish one test-plug kit(s) containing one **OR** two, **as directed**, thermometer(s), one pressure gage and adapter, and carrying case. Thermometer sensing elements, pressure gage, and adapter probes shall be of diameter to fit test plugs and of length to project into piping.

2. Low-Range Thermometer: Small, bimetallic insertion type with 1- to 2-inch- (25- to 51-mm-) diameter dial and tapered-end sensing element. Dial range shall be at least 25 to 125 deg F (minus 4 to plus 52 deg C).
 3. High-Range Thermometer: Small, bimetallic insertion type with 1- to 2-inch- (25- to 51-mm-) diameter dial and tapered-end sensing element. Dial range shall be at least 0 to 220 deg F (minus 18 to plus 104 deg C).
 4. Pressure Gage: Small, Bourdon-tube insertion type with 2- to 3-inch- (51- to 76-mm-) diameter dial and probe. Dial range shall be at least 0 to 200 psig (0 to 1380 kPa).
 5. Carrying Case: Metal or plastic, with formed instrument padding.
- K. Sight Flow Indicators
1. Description: Piping inline-installation device for visual verification of flow.
 2. Construction: Bronze or stainless-steel body, with sight glass and ball, flapper, or paddle wheel indicator, and threaded or flanged ends.
 3. Minimum Pressure Rating: 125 psig (860 kPa) OR 150 psig (1034 kPa), as directed.
 4. Minimum Temperature Rating: 200 deg F (93 deg C).
 5. End Connections for NPS 2 (DN 50) and Smaller: Threaded.
 6. End Connections for NPS 2-1/2 (DN 65) and Larger: Flanged.
- L. Flowmeters
1. Orifice Flowmeters:
 - a. Description: Flowmeter with sensor, hoses or tubing, fittings, valves, indicator, and conversion chart.
 - b. Flow Range: Sensor and indicator shall cover operating range of equipment or system served.
 - c. Sensor: Wafer-orifice-type, calibrated, flow-measuring element; for installation between pipe flanges.
 - 1) Design: Differential-pressure-type measurement for gas OR oil OR steam OR water, as directed.
 - 2) Construction: Cast-iron body, brass valves with integral check valves and caps, and calibrated nameplate.
 - 3) Minimum Pressure Rating: 300 psig (2070 kPa).
 - 4) Minimum Temperature Rating: 250 deg F (121 deg C).
 - d. Permanent Indicators: Meter suitable for wall or bracket mounting, calibrated for connected sensor and having 6-inch- (152-mm-) diameter, or equivalent, dial with fittings and copper tubing for connecting to sensor.
 - 1) Scale: Gallons per minute (Liters per second).
 - 2) Accuracy: Plus or minus 1 percent between 20 and 80 percent of scale range.
 - e. Portable Indicators: Hand-held, differential-pressure type, calibrated for connected sensor and having two 12-foot (3.7-m) hoses, with carrying case.
 - 1) Scale: Gallons per minute (Liters per second).
 - 2) Accuracy: Plus or minus 2 percent between 20 and 80 percent of scale range.
 - f. Display: Shows rate of flow, with register to indicate total volume in gallons (liters).
 - g. Conversion Chart: Flow rate data compatible with sensor and indicator.
 - h. Operating Instructions: Include complete instructions with each flowmeter.
 2. Pitot-Tube Flowmeters:
 - a. Description: Flowmeter with sensor and indicator.
 - b. Flow Range: Sensor and indicator shall cover operating range of equipment or system served.
 - c. Sensor: Insertion type; for inserting probe into piping and measuring flow directly in gallons per minute (liters per second).
 - 1) Design: Differential-pressure-type measurement for oil OR water, as directed.
 - 2) Construction: Stainless-steel probe of length to span inside of pipe, with integral transmitter and direct-reading scale.
 - 3) Minimum Pressure Rating: 150 psig (1035 kPa).
 - 4) Minimum Temperature Rating: 250 deg F (121 deg C).

- d. Indicator: Hand-held meter; either an integral part of sensor or a separate meter.
 - e. Integral Transformer: For low-voltage power connection.
 - f. Accuracy: Plus or minus 3 percent.
 - g. Display: Shows rate of flow, with register to indicate total volume in **gallons (liters)**.
 - h. Operating Instructions: Include complete instructions with each flowmeter.
3. Turbine Flowmeters:
- a. Description: Flowmeter with sensor and indicator.
 - b. Flow Range: Sensor and indicator shall cover operating range of equipment or system served.
 - c. Sensor: Impeller turbine; for inserting into pipe fitting or for installing in piping and measuring flow directly in **gallons per minute (liters per second)**.
 - 1) Design: Device or pipe fitting with inline turbine and integral direct-reading scale for gas **OR** oil **OR** steam **OR** water, **as directed**.
 - 2) Construction: Bronze or stainless-steel body, with plastic turbine or impeller.
 - 3) Minimum Pressure Rating: **150 psig (1035 kPa)**.
 - 4) Minimum Temperature Rating: **180 deg F (82 deg C)**.
 - d. Indicator: Hand-held meter; either an integral part of sensor or a separate meter.
 - e. Accuracy: Plus or minus 1-1/2 percent.
 - f. Display: Shows rate of flow, with register to indicate total volume in **gallons (liters)**.
 - g. Operating Instructions: Include complete instructions with each flowmeter.
4. Venturi Flowmeters:
- a. Description: Flowmeter with calibrated flow-measuring element, hoses or tubing, fittings, valves, indicator, and conversion chart.
 - b. Flow Range: Sensor and indicator shall cover operating range of equipment or system served.
 - c. Sensor: Venturi-type, calibrated, flow-measuring element; for installation in piping.
 - 1) Design: Differential-pressure-type measurement for gas **OR** oil **OR** steam **OR** water, **as directed**.
 - 2) Construction: Bronze, brass, or factory-primed steel, with brass fittings and attached tag with flow conversion data.
 - 3) Minimum Pressure Rating: **250 psig (1725 kPa)**.
 - 4) Minimum Temperature Rating: **250 deg F (121 deg C)**.
 - 5) End Connections for **NPS 2 (DN 50)** and Smaller: Threaded.
 - 6) End Connections for **NPS 2-1/2 (DN 65)** and Larger: Flanged or welded.
 - 7) Flow Range: Flow-measuring element and flowmeter shall cover operating range of equipment or system served.
 - d. Permanent Indicators: Meter suitable for wall or bracket mounting, calibrated for connected flowmeter element, and having **6-inch- (152-mm-)** diameter, or equivalent, dial with fittings and copper tubing for connecting to flowmeter element.
 - 1) Scale: **Gallons per minute (Liters per second)**.
 - 2) Accuracy: Plus or minus 1 percent between 20 and 80 percent of scale range.
 - e. Portable Indicators: Hand-held, differential-pressure type, calibrated for connected flowmeter element and having two **12-foot (3.7-m)** hoses, with carrying case.
 - 1) Scale: **Gallons per minute (Liters per second)**.
 - 2) Accuracy: Plus or minus 2 percent between 20 and 80 percent of scale range.
 - f. Display: Shows rate of flow, with register to indicate total volume in **gallons (liters)**.
 - g. Conversion Chart: Flow rate data compatible with sensor.
 - h. Operating Instructions: Include complete instructions with each flowmeter.
5. Vortex-Shedding Flowmeters:
- a. Description: Flowmeter with sensor and indicator.
 - b. Flow Range: Sensor and indicator shall cover operating range of equipment or system served.
 - c. Sensor: Inline type; for installing between pipe flanges and measuring flow directly in **gallons per minute (liters per second)**.

- 1) Design: Flow obstruction device, vortex-measurement type for gas **OR** steam **OR** liquids, **as directed**.
- 2) Construction: Stainless-steel body, with integral transmitter and direct-reading scale.
- 3) Minimum Pressure Rating: **1000 psig (6900 kPa)**.
- 4) Minimum Temperature Rating: **500 deg F (260 deg C)**.
- 5) Integral Transformer: For low-voltage power operation.
- d. Indicator: Hand-held meter; either an integral part of sensor or a separate meter.
- e. Accuracy: Plus or minus 0.25 percent for liquids and 0.75 percent for gases.
- f. Display: Shows rate of flow, with register to indicate total volume in **gallons (liters)**.
- g. Operating Instructions: Include complete instructions with each flowmeter.

M. Thermal-Energy Meters

1. Impeller-Turbine, Thermal-Energy Meters:

- a. Description: System with strainer, **as directed**, flow sensor, temperature sensors, transmitter, indicator, and connecting wiring.
- b. Flow Sensor: Impeller turbine with corrosion-resistant-metal body and transmitter; for installing in piping.
 - 1) Design: Total thermal-energy measurement.
 - 2) Minimum Pressure Rating: **150 psig (1035 kPa)**.
 - 3) Minimum Temperature Range: **40 to 250 deg F (5 to 121 deg C)**.
- c. Temperature Sensors: Insertion-type transducer.
- d. Indicator: Solid-state, integrating-type meter with integral battery pack, **as directed**; for wall mounting.
 - 1) Data Output: Six-digit electromechanical counter with readout in kilowatts per hour or **British thermal units (joules)**.
 - 2) Battery Pack: Five-year lithium battery.
- e. Accuracy: Plus or minus 1 percent.
- f. Display: Visually indicates total fluid volume in **gallons (liters)** and thermal-energy flow in kilowatts per hour or **British thermal units (joules)**.
- g. Strainer: Full size of main line piping.
- h. Operating Instructions: Include complete instructions with each thermal-energy meter system.

2. Ultrasonic, Thermal-Energy Meters:

- a. Description: Meter with flow sensor, temperature sensors, transmitter, indicator, and connecting wiring.
- b. Flow Sensor: Transit-time ultrasonic type with transmitter.
- c. Temperature Sensors: Insertion-type or strap-on transducer.
- d. Indicator: Solid-state, integrating-type meter with integral battery pack, **as directed**.
 - 1) Data Output: Six-digit electromechanical counter with readout in kilowatts per hour or **British thermal units (joules)**.
 - 2) Battery Pack: Five-year lithium battery.
- e. Accuracy: Plus or minus 1 percent.
- f. Display: Visually indicates total fluid volume in **gallons (liters)** and thermal-energy flow in kilowatts per hour or **British thermal units (joules)**.
- g. Operating Instructions: Include complete instructions with each thermal-energy meter system.

1.3 EXECUTION

A. Installation

1. Install thermowells with socket extending a minimum of **2 inches (51 mm)** into fluid **OR** one-third of pipe diameter **OR** to center of pipe, **as directed**, and in vertical position in piping tees.
2. Install thermowells of sizes required to match thermometer connectors. Include bushings if required to match sizes.

3. Install thermowells with extension on insulated piping.
4. Fill thermowells with heat-transfer medium.
5. Install direct-mounted thermometers in thermowells and adjust vertical and tilted positions.
6. Install remote-mounted thermometer bulbs in thermowells and install cases on panels; connect cases with tubing and support tubing to prevent kinks. Use minimum tubing length.
7. Install duct-thermometer mounting brackets in walls of ducts. Attach to duct with screws.
8. Install direct-mounted pressure gages in piping tees with pressure gage located on pipe at the most readable position.
9. Install remote-mounted pressure gages on panel.
10. Install valve and snubber in piping for each pressure gage for fluids (except steam).
11. Install valve and syphon fitting in piping for each pressure gage for steam.
12. Install test plugs in piping tees.
13. Install flow indicators in piping systems in accessible positions for easy viewing.
14. Assemble and install connections, tubing, and accessories between flow-measuring elements and flowmeters according to manufacturer's written instructions.
15. Install flowmeter elements in accessible positions in piping systems.
16. Install wafer-orifice flowmeter elements between pipe flanges.
17. Install differential-pressure-type flowmeter elements, with at least minimum straight lengths of pipe, upstream and downstream from element according to manufacturer's written instructions.
18. Install permanent indicators on walls or brackets in accessible and readable positions.
19. Install connection fittings in accessible locations for attachment to portable indicators.
20. Mount thermal-energy meters on wall if accessible; if not, provide brackets to support meters.
21. Install thermometers in the following locations:
 - a. Inlet and outlet of each hydronic zone.
 - b. Inlet and outlet of each hydronic boiler.
 - c. Two inlets and two outlets of each chiller.
 - d. Inlet and outlet of each hydronic coil in air-handling units.
 - e. Two inlets and two outlets of each hydronic heat exchanger.
 - f. Inlet and outlet of each thermal-storage tank.
 - g. Outside-, return-, supply-, and mixed-air ducts.
22. Install pressure gages in the following locations:
 - a. Discharge of each pressure-reducing valve.
 - b. Inlet and outlet of each chiller chilled-water and condenser-water connection.
 - c. Suction and discharge of each pump.

B. Connections

1. Install meters and gages adjacent to machines and equipment to allow service and maintenance of meters, gages, machines, and equipment.
2. Connect flowmeter-system elements to meters.
3. Connect flowmeter transmitters to meters.
4. Connect thermal-energy meter transmitters to meters.

C. Adjusting

1. After installation, calibrate meters according to manufacturer's written instructions.
2. Adjust faces of meters and gages to proper angle for best visibility.

D. Thermometer Schedule

1. Thermometers at inlet and outlet of each hydronic zone shall be one of the following:
 - a. Liquid-filled **OR** Sealed, **as directed**, bimetallic-actuated type.
 - b. Direct-mounted **OR** Remote-mounted, **as directed**, metal-case **OR** plastic-case, **as directed**, vapor-actuated type.
 - c. Compact-style **OR** Industrial-style, **as directed**, liquid-in-glass type.
 - d. Direct-mounted **OR** Remote-mounted, **as directed**, light-activated type.
 - e. Test plug with chlorosulfonated polyethylene synthetic **OR** EPDM, **as directed**, self-sealing rubber inserts.

2. Thermometers at inlet and outlet of each hydronic boiler shall be one of the following:
 - a. Liquid-filled **OR** Sealed, **as directed**, bimetallic-actuated type.
 - b. Direct-mounted **OR** Remote-mounted, **as directed**, metal-case **OR** plastic-case, **as directed**, vapor-actuated type.
 - c. Compact-style **OR** Industrial-style, **as directed**, liquid-in-glass type.
 - d. Direct-mounted **OR** Remote-mounted, **as directed**, light-activated type.
 - e. Test plug with chlorosulfonated polyethylene synthetic **OR** EPDM, **as directed**, self-sealing rubber inserts.
3. Thermometers at inlets and outlets of each chiller shall be one of the following:
 - a. Liquid-filled **OR** Sealed, **as directed**, bimetallic-actuated type.
 - b. Direct-mounted **OR** Remote-mounted, **as directed**, metal-case **OR** plastic-case, **as directed**, vapor-actuated type.
 - c. Compact-style **OR** Industrial-style, **as directed**, liquid-in-glass type.
 - d. Direct-mounted **OR** Remote-mounted, **as directed**, light-activated type.
 - e. Test plug with chlorosulfonated polyethylene synthetic **OR** EPDM, **as directed**, self-sealing rubber inserts.
4. Thermometers at inlet and outlet of each hydronic coil in air-handling units and built-up central systems shall be one of the following:
 - a. Liquid-filled **OR** Sealed, **as directed**, bimetallic-actuated type.
 - b. Direct-mounted **OR** Remote-mounted, **as directed**, metal-case **OR** plastic-case, **as directed**, vapor-actuated type.
 - c. Compact-style **OR** Industrial-style, **as directed**, liquid-in-glass type.
 - d. Direct-mounted **OR** Remote-mounted, **as directed**, light-activated type.
 - e. Test plug with chlorosulfonated polyethylene synthetic **OR** EPDM, **as directed**, self-sealing rubber inserts.
5. Thermometers at inlets and outlets of each hydronic heat exchanger shall be one of the following:
 - a. Liquid-filled **OR** Sealed, **as directed**, bimetallic-actuated type.
 - b. Direct-mounted **OR** Remote-mounted, **as directed**, metal-case **OR** plastic-case, **as directed**, vapor-actuated type.
 - c. Compact-style **OR** Industrial-style, **as directed**, liquid-in-glass type.
 - d. Direct-mounted **OR** Remote-mounted, **as directed**, light-activated type.
 - e. Test plug with chlorosulfonated polyethylene synthetic **OR** EPDM, **as directed**, self-sealing rubber inserts.
6. Thermometers at inlet and outlet of each hydronic heat-recovery unit shall be one of the following:
 - a. Liquid-filled **OR** Sealed, **as directed**, bimetallic-actuated type.
 - b. Direct-mounted **OR** Remote-mounted, **as directed**, metal-case **OR** plastic-case, **as directed**, vapor-actuated type.
 - c. Compact-style **OR** Industrial-style, **as directed**, liquid-in-glass type.
 - d. Direct-mounted **OR** Remote-mounted, **as directed**, light-activated type.
 - e. Test plug with chlorosulfonated polyethylene synthetic **OR** EPDM, **as directed**, self-sealing rubber inserts.
7. Thermometers at inlet and outlet of each thermal-storage tank shall be one of the following:
 - a. Liquid-filled **OR** Sealed, **as directed**, bimetallic-actuated type.
 - b. Direct-mounted **OR** Remote-mounted, **as directed**, metal-case **OR** plastic-case, **as directed**, vapor-actuated type.
 - c. Compact-style **OR** Industrial-style, **as directed**, liquid-in-glass type.
 - d. Direct-mounted **OR** Remote-mounted, **as directed**, light-activated type.
 - e. Test plug with chlorosulfonated polyethylene synthetic **OR** EPDM, **as directed**, self-sealing rubber inserts.
8. Thermometers at outside-, return-, supply-, and mixed-air ducts shall be one of the following:
 - a. Liquid-filled **OR** Sealed, **as directed**, bimetallic-actuated type.
 - b. Direct-mounted **OR** Remote-mounted, **as directed**, metal-case **OR** plastic-case, **as directed**, vapor-actuated type.
 - c. Compact-style **OR** Industrial-style, **as directed**, liquid-in-glass type.
 - d. Direct-mounted **OR** Remote-mounted, **as directed**, light-activated type.
9. Thermometer stems shall be of length to match thermowell insertion length.

E. Thermometer Scale-Range Schedule

1. Scale Range for Chilled-Water Piping: **Minus 40 to plus 160 deg F** (Minus 40 to plus 100 deg C) **OR** Minus 40 to plus 160 deg F and minus 40 to plus 100 deg C, **as directed**.
2. Scale Range for Chilled-Water Piping: **0 to 100 deg F** (Minus 20 to plus 50 deg C) **OR** 0 to 100 deg F and minus 20 to plus 50 deg C, **as directed**.
3. Scale Range for Chilled-Water Piping: **0 to 150 deg F** (Minus 20 to plus 70 deg C) **OR** 0 to 150 deg F and minus 20 to plus 70 deg C, **as directed**.
4. Scale Range for Chilled-Water Piping: **0 to 250 deg F** (0 to 150 deg C) **OR** 0 to 250 deg F and 0 to 150 deg C, **as directed**.
5. Scale Range for Condenser-Water Piping: **0 to 100 deg F** (Minus 20 to plus 50 deg C) **OR** 0 to 100 deg F and minus 20 to plus 50 deg C, **as directed**.
6. Scale Range for Condenser-Water Piping: **0 to 150 deg F** (Minus 20 to plus 70 deg C) **OR** 0 to 150 deg F and minus 20 to plus 70 deg C, **as directed**.
7. Scale Range for Condenser-Water Piping: **0 to 250 deg F** (0 to 150 deg C) **OR** 0 to 250 deg F and 0 to 150 deg C, **as directed**.
8. Scale Range for Condenser-Water Piping: **20 to 240 deg F** (0 to 150 deg C) **OR** 20 to 240 deg F and 0 to 150 deg C, **as directed**.
9. Scale Range for Condenser-Water Piping: **30 to 240 deg F** (0 to plus 115 deg C) **OR** 30 to 240 deg F and 0 to plus 115 deg C, **as directed**.
10. Scale Range for Heating, Hot-Water Piping: **0 to 250 deg F** (0 to 150 deg C) **OR** 0 to 250 deg F and 0 to 150 deg C, **as directed**.
11. Scale Range for Heating, Hot-Water Piping: **20 to 240 deg F** (0 to 150 deg C) **OR** 20 to 240 deg F and 0 to 150 deg C, **as directed**.
12. Scale Range for Heating, Hot-Water Piping: **30 to 240 deg F** (0 to plus 115 deg C) **OR** 30 to 240 deg F and 0 to plus 115 deg C, **as directed**.
13. Scale Range for Heating, Hot-Water Piping: **50 to 400 deg F** (0 to 200 deg C) **OR** 50 to 400 deg F and 0 to 200 deg C, **as directed**.
14. Scale Range for Heating, Hot-Water Piping: **50 to 550 deg F** (10 to 300 deg C) **OR** 50 to 550 deg F and 10 to 300 deg C, **as directed**.
15. Scale Range for Steam and Steam-Condensate Piping: **0 to 250 deg F** (0 to 150 deg C) **OR** 0 to 250 deg F and 0 to 150 deg C, **as directed**.
16. Scale Range for Steam and Steam-Condensate Piping: **20 to 240 deg F** (0 to 150 deg C) **OR** 20 to 240 deg F and 0 to 150 deg C, **as directed**.
17. Scale Range for Steam and Steam-Condensate Piping: **30 to 240 deg F** (0 to plus 115 deg C) **OR** 30 to 240 deg F and 0 to plus 115 deg C, **as directed**.
18. Scale Range for Steam and Steam-Condensate Piping: **50 to 400 deg F** (0 to 200 deg C) **OR** 50 to 400 deg F and 0 to 200 deg C, **as directed**.
19. Scale Range for Air Ducts: **Minus 40 to plus 110 deg F** (Minus 40 to plus 45 deg C) **OR** Minus 40 to plus 110 deg F and minus 40 to plus 45 deg C, **as directed**.
20. Scale Range for Air Ducts: **Minus 40 to plus 160 deg F** (Minus 40 to plus 100 deg C) **OR** Minus 40 to plus 160 deg F and minus 40 to plus 100 deg C, **as directed**.
21. Scale Range for Air Ducts: **0 to 100 deg F** (Minus 20 to plus 50 deg C) **OR** 0 to 100 deg F and minus 20 to plus 50 deg C, **as directed**.
22. Scale Range for Air Ducts: **0 to 150 deg F** (Minus 20 to plus 70 deg C) **OR** 0 to 150 deg F and minus 20 to plus 70 deg C, **as directed**.
23. Scale Range for Air Ducts: **0 to 250 deg F** (0 to 150 deg C) **OR** 0 to 250 deg F and 0 to 150 deg C, **as directed**.
24. Scale Range for Air Ducts: **20 to 240 deg F** (0 to 150 deg C) **OR** 20 to 240 deg F and 0 to 150 deg C, **as directed**.
25. Scale Range for Air Ducts: **30 to 240 deg F** (0 to plus 115 deg C) **OR** 30 to 240 deg F and 0 to plus 115 deg C, **as directed**.
26. Scale Range for Air Ducts: **50 to 400 deg F** (0 to 200 deg C) **OR** 50 to 400 deg F and 0 to 200 deg C, **as directed**.

F. Pressure-Gage Schedule

1. Pressure gages at discharge of each pressure-reducing valve shall be one of the following:
 - a. Liquid-filled **OR** Sealed **OR** Open-front, pressure-relief **OR** Solid-front, pressure-relief, **as directed**, direct-mounted **OR** remote-mounted, **as directed**, metal case.
 - b. Sealed, direct-mounted **OR** remote-mounted, **as directed**, plastic case.
 - c. Test plug with chlorosulfonated polyethylene synthetic **OR** EPDM, **as directed**, self-sealing rubber inserts.
 2. Pressure gages at inlet and outlet of each chiller chilled-water and condenser-water connection shall be one of the following:
 - a. Liquid-filled **OR** Sealed **OR** Open-front, pressure-relief **OR** Solid-front, pressure-relief, **as directed**, direct-mounted **OR** remote-mounted, **as directed**, metal case.
 - b. Sealed, direct-mounted **OR** remote-mounted, **as directed**, plastic case.
 - c. Test plug with chlorosulfonated polyethylene synthetic **OR** EPDM, **as directed**, self-sealing rubber inserts.
 3. Pressure gages at suction and discharge of each pump shall be one of the following:
 - a. Liquid-filled **OR** Sealed **OR** Open-front, pressure-relief **OR** Solid-front, pressure-relief, **as directed**, direct-mounted **OR** remote-mounted, **as directed**, metal case.
 - b. Sealed, direct-mounted **OR** remote-mounted, **as directed**, plastic case.
 - c. Test plug with chlorosulfonated polyethylene synthetic **OR** EPDM, **as directed**, self-sealing rubber inserts.
- G. Pressure-Gage Scale-Range Schedule
1. Scale Range for Chilled-Water Piping: 30 in. Hg to 15 psi (minus 100 to 0 kPa) **OR** 30 in. Hg to 15 psi and minus 100 to 0 kPa, **as directed**.
 2. Scale Range for Chilled-Water Piping: 0 to 30 psi (0 to 240 kPa) **OR** 0 to 30 psi and 0 to 240 kPa, **as directed**.
 3. Scale Range for Chilled-Water Piping: 0 to 100 psi (0 to 600 kPa) **OR** 0 to 100 psi and 0 to 600 kPa, **as directed**.
 4. Scale Range for Chilled-Water Piping: 0 to 160 psi (0 to 1100 kPa) **OR** 0 to 160 psi and 0 to 1100 kPa, **as directed**.
 5. Scale Range for Chilled-Water Piping: 0 to 200 psi (0 to 1400 kPa) **OR** 0 to 200 psi and 0 to 1400 kPa, **as directed**.
 6. Scale Range for Chilled-Water Piping: 0 to 300 psi (0 to 2500 kPa) **OR** 0 to 300 psi and 0 to 2500 kPa, **as directed**.
 7. Scale Range for Chilled-Water Piping: 0 to 600 psi (0 to 4000 kPa) **OR** 0 to 600 psi and 0 to 4000 kPa, **as directed**.
 8. Scale Range for Condenser-Water Piping: 30 in. Hg to 15 psi (minus 100 to 0 kPa) **OR** 30 in. Hg to 15 psi and minus 100 to 0 kPa, **as directed**.
 9. Scale Range for Condenser-Water Piping: 0 to 30 psi (0 to 240 kPa) **OR** 0 to 30 psi and 0 to 240 kPa, **as directed**.
 10. Scale Range for Condenser-Water Piping: 0 to 100 psi (0 to 600 kPa) **OR** 0 to 100 psi and 0 to 600 kPa, **as directed**.
 11. Scale Range for Condenser-Water Piping: 0 to 160 psi (0 to 1100 kPa) **OR** 0 to 160 psi and 0 to 1100 kPa, **as directed**.
 12. Scale Range for Condenser-Water Piping: 0 to 200 psi (0 to 1400 kPa) **OR** 0 to 200 psi and 0 to 1400 kPa, **as directed**.
 13. Scale Range for Condenser-Water Piping: 0 to 300 psi (0 to 2500 kPa) **OR** 0 to 300 psi and 0 to 2500 kPa, **as directed**.
 14. Scale Range for Condenser-Water Piping: 0 to 600 psi (0 to 4000 kPa) **OR** 0 to 600 psi and 0 to 4000 kPa, **as directed**.
 15. Scale Range for Heating, Hot-Water Piping: 30 in. Hg to 15 psi (minus 100 to 0 kPa) **OR** 30 in. Hg to 15 psi and minus 100 to 0 kPa, **as directed**.
 16. Scale Range for Heating, Hot-Water Piping: 0 to 30 psi (0 to 240 kPa) **OR** 0 to 30 psi and 0 to 240 kPa, **as directed**.
 17. Scale Range for Heating, Hot-Water Piping: 0 to 100 psi (0 to 600 kPa) **OR** 0 to 100 psi and 0 to 600 kPa, **as directed**.

18. Scale Range for Heating, Hot-Water Piping: **0 to 160 psi (0 to 1100 kPa) OR 0 to 160 psi and 0 to 1100 kPa, as directed.**
19. Scale Range for Heating, Hot-Water Piping: **0 to 200 psi (0 to 1400 kPa) OR 0 to 200 psi and 0 to 1400 kPa, as directed.**
20. Scale Range for Heating, Hot-Water Piping: **0 to 300 psi (0 to 2500 kPa) OR 0 to 300 psi and 0 to 2500 kPa, as directed.**
21. Scale Range for Heating, Hot-Water Piping: **0 to 600 psi (0 to 4000 kPa) OR 0 to 600 psi and 0 to 4000 kPa, as directed.**
22. Scale Range for Steam Piping: **30 in. Hg to 15 psi (minus 100 to 0 kPa) OR 30 in. Hg to 15 psi and minus 100 to 0 kPa, as directed.**
23. Scale Range for Steam Piping: **0 to 30 psi (0 to 240 kPa) OR 0 to 30 psi and 0 to 240 kPa, as directed.**
24. Scale Range for Steam Piping: **0 to 100 psi (0 to 600 kPa) OR 0 to 100 psi and 0 to 600 kPa, as directed.**
25. Scale Range for Steam Piping: **0 to 160 psi (0 to 1100 kPa) OR 0 to 160 psi and 0 to 1100 kPa, as directed.**
26. Scale Range for Steam Piping: **0 to 200 psi (0 to 1400 kPa) OR 0 to 200 psi and 0 to 1400 kPa, as directed.**
27. Scale Range for Steam Piping: **0 to 300 psi (0 to 2500 kPa) OR 0 to 300 psi and 0 to 2500 kPa, as directed.**
28. Scale Range for Steam Piping: **0 to 600 psi (0 to 4000 kPa) OR 0 to 600 psi and 0 to 4000 kPa, as directed.**

H. Flowmeter Schedule

1. Flowmeters for Chilled-Water Piping: Orifice **OR** Pitot-tube **OR** Turbine **OR** Venturi **OR** Vortex-shedding, **as directed**, type.
2. Flowmeters for Condenser-Water Piping: Orifice **OR** Pitot-tube **OR** Turbine **OR** Venturi **OR** Vortex-shedding, **as directed**, type.
3. Flowmeters for Heating, Hot-Water Piping: Orifice **OR** Pitot-tube **OR** Turbine **OR** Venturi **OR** Vortex-shedding, **as directed**, type.
4. Flowmeters for Steam and Steam-Condensate Piping: Orifice **OR** Turbine **OR** Venturi **OR** Vortex-shedding, **as directed**, type.

I. Thermal-Energy Meter Schedule

1. Thermal-Energy Meters for Chilled-Water Piping: Impeller-turbine **OR** Ultrasonic, **as directed**, type.
2. Thermal-Energy Meters for Condenser-Water Piping: Impeller-turbine **OR** Ultrasonic, **as directed**, type.
3. Thermal-Energy Meters for Heating, Hot-Water Piping: Impeller-turbine **OR** Ultrasonic, **as directed**, type.
4. Thermal-Energy Meters for Steam and Steam-Condensate Piping: Impeller-turbine **OR** Ultrasonic, **as directed**, type.

END OF SECTION 21 05 19 00a



Task	Specification	Specification Description
21 05 19 00	01 22 16 00	No Specification Required
21 05 19 00	13 12 13 00	Water Distribution

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SECTION 21 05 23 00 - PIPED UTILITIES BASIC MATERIALS AND METHODS

1.1 GENERAL

A. Description Of Work

1. This specification covers the furnishing and installation of materials for piped utilities - basic materials and methods. Products shall be as follows or as directed by the Owner. Installation procedures shall be in accordance with the product manufacturer's recommendations. Demolition and removal of materials shall be as required to support the work.

B. Summary

1. This Section includes the following:
 - a. Piping joining materials.
 - b. Transition fittings.
 - c. Dielectric fittings.
 - d. Sleeves.
 - e. Identification devices.
 - f. Grout.
 - g. Flowable fill.
 - h. Piped utility demolition.
 - i. Piping system common requirements.
 - j. Equipment installation common requirements.
 - k. Painting.
 - l. Concrete bases.
 - m. Metal supports and anchorages.

C. Definitions

1. Exposed Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions.
2. Concealed Installations: Concealed from view and protected from weather conditions and physical contact by building occupants but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.
3. ABS: Acrylonitrile-butadiene-styrene plastic.
4. CPVC: Chlorinated polyvinyl chloride plastic.
5. PE: Polyethylene plastic.
6. PVC: Polyvinyl chloride plastic.

D. Submittals

1. Product Data: For the following:
 - a. Dielectric fittings.
 - b. Identification devices.
2. Welding certificates.

E. Quality Assurance

1. Steel Support Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
2. Steel Piping Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."
 - a. Comply with provisions in ASME B31 Series, "Code for Pressure Piping."
 - b. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.
3. Comply with ASME A13.1 for lettering size, length of color field, colors, and viewing angles of identification devices.

F. Delivery, Storage, And Handling

1. Deliver pipes and tubes with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe end damage and to prevent entrance of dirt, debris, and moisture.
2. Store plastic pipes protected from direct sunlight. Support to prevent sagging and bending.

1.2 PRODUCTS

A. Piping Joining Materials

1. Pipe-Flange Gasket Materials: Suitable for chemical and thermal conditions of piping system contents.
 - a. ASME B16.21, nonmetallic, flat, asbestos free, **1/8-inch (3.2-mm)** maximum thickness, unless otherwise indicated.
 - 1) Full-Face Type: For flat-face, Class 125, cast-iron and cast-bronze flanges.
 - 2) Narrow-Face Type: For raised-face, Class 250, cast-iron and steel flanges.
 - b. AWWA C110, rubber, flat face, **1/8 inch (3.2 mm)** thick, unless otherwise indicated; and full-face or ring type, unless otherwise indicated.
2. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated.
3. Plastic, Pipe-Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer, unless otherwise indicated.
4. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.
5. Brazing Filler Metals: AWS A5.8, BCuP Series, copper-phosphorus alloys for general-duty brazing, unless otherwise indicated; and AWS A5.8, BAg1, silver alloy for refrigerant piping, unless otherwise indicated.
6. Welding Filler Metals: Comply with AWS D10.12/D10.12M for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.
7. Solvent Cements for Joining Plastic Piping:
 - a. ABS Piping: ASTM D 2235.
 - b. CPVC Piping: ASTM F 493.
 - c. PVC Piping: ASTM D 2564. Include primer according to ASTM F 656.
 - d. PVC to ABS Piping Transition: ASTM D 3138.
8. Fiberglass Pipe Adhesive: As furnished or recommended by pipe manufacturer.

B. Transition Fittings

1. Transition Fittings, General: Same size as, and with pressure rating at least equal to and with ends compatible with, piping to be joined.
2. Transition Couplings **NPS 1-1/2 (DN 40)** and Smaller:
 - a. Underground Piping: Manufactured piping coupling or specified piping system fitting.
 - b. Aboveground Piping: Specified piping system fitting.
3. AWWA Transition Couplings **NPS 2 (DN 50)** and Larger:
 - a. Description: AWWA C219, metal sleeve-type coupling for underground pressure piping.
4. Plastic-to-Metal Transition Fittings:
 - a. Description: CPVC and PVC one-piece fitting with manufacturer's Schedule 80 equivalent dimensions; one end with threaded brass insert, and one solvent-cement-joint or threaded end.
5. Plastic-to-Metal Transition Unions:
 - a. Description: MSS SP-107, CPVC and PVC four-part union. Include brass or stainless-steel threaded end, solvent-cement-joint or threaded plastic end, rubber O-ring, and union nut.
6. Flexible Transition Couplings for Underground Nonpressure Drainage Piping:
 - a. Description: ASTM C 1173 with elastomeric sleeve, ends same size as piping to be joined, and corrosion-resistant metal band on each end.

C. Dielectric Fittings

1. Dielectric Fittings, General: Assembly of copper alloy and ferrous materials or ferrous material body with separating nonconductive insulating material suitable for system fluid, pressure, and temperature.
2. Dielectric Unions:
 - a. Description: Factory fabricated, union, **NPS 2 (DN 50)** and smaller.
 - 1) Pressure Rating: **150 psig (1035 kPa)** minimum **OR 250 psig (1725 kPa)**, **as directed**, at **180 deg F (82 deg C)**.
 - 2) End Connections: Solder-joint copper alloy and threaded ferrous; threaded ferrous.
3. Dielectric Flanges:
 - a. Description: Factory-fabricated, bolted, companion-flange assembly, **NPS 2-1/2 to NPS 4 (DN 65 to DN 100)** and larger.
 - 1) Pressure Rating: **150 psig (1035 kPa)** minimum **OR 175 psig (1200 kPa)** minimum **OR 300 psig (2070 kPa)**, **as directed**.
 - 2) End Connections: Solder-joint copper alloy and threaded ferrous; threaded solder-joint copper alloy and threaded ferrous.
4. Dielectric-Flange Kits:
 - a. Description: Nonconducting materials for field assembly of companion flanges, **NPS 2-1/2 (DN 65)** and larger.
 - 1) Pressure Rating: **150 psig (1035 kPa)** minimum.
 - 2) Gasket: Neoprene or phenolic.
 - 3) Bolt Sleeves: Phenolic or polyethylene.
 - 4) Washers: Phenolic with steel backing washers.
5. Dielectric Couplings:
 - a. Description: Galvanized-steel coupling with inert and noncorrosive, thermoplastic lining, **NPS 3 (DN 80)** and smaller.
 - 1) Pressure Rating: **300 psig (2070 kPa)** at **225 deg F (107 deg C)**.
 - 2) End Connections: Threaded.
6. Dielectric Nipples:
 - a. Description: Electroplated steel nipple with inert and noncorrosive, thermoplastic lining.
 - 1) Pressure Rating: **300 psig (2070 kPa)** at **225 deg F (107 deg C)**.
 - 2) End Connections: Threaded or grooved.

D. Sleeves

1. Mechanical sleeve seals for pipe penetrations are specified in Division 22 Section "Common Work Results For Plumbing".
2. Galvanized-Steel Sheet Sleeves: **0.0239-inch (0.6-mm)** minimum thickness; round tube closed with welded longitudinal joint.
3. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, galvanized, plain ends.
4. Cast-Iron Sleeves: Cast or fabricated "wall pipe" equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.
5. Molded PVC Sleeves: Permanent, with nailing flange for attaching to wooden forms.
6. PVC Pipe Sleeves: ASTM D 1785, Schedule 40.
7. Molded PE Sleeves: Reusable, PE, tapered-cup shaped, and smooth outer surface with nailing flange for attaching to wooden forms.

E. Identification Devices

1. Equipment Nameplates: Metal permanently fastened to equipment with data engraved or stamped.
 - a. Data: Manufacturer, product name, model number, serial number, capacity, operating and power characteristics, labels of tested compliances, and essential data.
 - b. Location: Accessible and visible.
2. Stencils: Standard stencils prepared with letter sizes complying with recommendations in ASME A13.1. Minimum letter height is **1-1/4 inches (30 mm)** for ducts, and **3/4 inch (20 mm)** for access door signs and similar operational instructions.
 - a. Material: Fiberboard **OR** Brass, **as directed**.



- b. Stencil Paint: Exterior, oil-based, alkyd-gloss black enamel, unless otherwise indicated. Paint may be in pressurized spray-can form.
 - c. Identification Paint: Exterior, oil-based, alkyd enamel in colors according to ASME A13.1, unless otherwise indicated.
- 3. Snap-on Plastic Pipe Markers: Manufacturer's standard preprinted, semirigid, snap-on type. Include color-coding according to ASME A13.1, unless otherwise indicated.
- 4. Pressure-Sensitive Pipe Markers: Manufacturer's standard preprinted, color-coded, pressure-sensitive-vinyl type with permanent adhesive.
- 5. Pipes with OD, Including Insulation, Less Than **6 Inches (150 mm)**: Full-band pipe markers, extending 360 degrees around pipe at each location.
- 6. Pipes with OD, Including Insulation, **6 Inches (150 mm)** and Larger: Either full-band or strip-type pipe markers, at least three times letter height and of length required for label.
- 7. Lettering: Manufacturer's standard preprinted captions as selected by the Owner.
- 8. Lettering: Use piping system terms indicated and abbreviate only as necessary for each application length.
 - a. Arrows: Either integrally with piping system service lettering to accommodate both directions of flow, or as separate unit on each pipe marker to indicate direction of flow.
- 9. Plastic Tape: Manufacturer's standard color-coded, pressure-sensitive, self-adhesive vinyl tape, at least **3 mils (0.08 mm)** thick.
 - a. Width: **1-1/2 inches (40 mm)** on pipes with OD, including insulation, less than **6 inches (150 mm)**; **2-1/2 inches (65 mm)** for larger pipes.
 - b. Color: Comply with ASME A13.1, unless otherwise indicated.
- 10. Valve Tags: Stamped or engraved with **1/4-inch (6.4-mm)** letters for piping system abbreviation and **1/2-inch (13-mm)** sequenced numbers. Include **5/32-inch (4-mm)** hole for fastener.
 - a. Material: **0.032-inch- (0.8-mm-)** thick, polished brass **OR** aluminum, **as directed**.
 - b. Material: **0.0375-inch- (1-mm-)** thick stainless steel.
 - c. Material: **3/32-inch- (2.4-mm-)** thick plastic laminate with 2 black surfaces and a white inner layer.
 - d. Material: Valve manufacturer's standard solid plastic.
 - e. Size: **1-1/2 inches (40 mm)** in diameter, unless otherwise indicated.
 - f. Shape: As indicated for each piping system.
- 11. Valve Tag Fasteners: Brass, wire-link or beaded chain; or brass S-hooks.
- 12. Engraved Plastic-Laminate Signs: ASTM D 709, Type I, cellulose, paper-base, phenolic-resin-laminate engraving stock; Grade ES-2, black surface, black phenolic core, with white melamine subcore, unless otherwise indicated. Fabricate in sizes required for message. Provide holes for mechanical fastening.
 - a. Engraving: Engraver's standard letter style, of sizes and with terms to match equipment identification.
 - b. Thickness: **1/16 inch (1.6 mm)**, for units up to **20 sq. in. (130 sq. cm)** or **8 inches (200 mm)** in length, and **1/8 inch (3 mm)** for larger units.
 - c. Fasteners: Self-tapping, stainless-steel screws or contact-type permanent adhesive.
- 13. Plastic Equipment Markers: Manufacturer's standard laminated plastic, in the following color codes:
 - a. Green: Cooling equipment and components.
 - b. Yellow: Heating equipment and components.
 - c. Brown: Energy reclamation equipment and components.
 - d. Blue: Equipment and components that do not meet criteria above.
 - e. Hazardous Equipment: Use colors and designs recommended by ASME A13.1.
 - f. Terminology: Match schedules as closely as possible. Include the following:
 - 1) Name and plan number.
 - 2) Equipment service.
 - 3) Design capacity.
 - 4) Other design parameters such as pressure drop, entering and leaving conditions, and speed.

- g. Size: **2-1/2 by 4 inches (65 by 100 mm)** for control devices, dampers, and valves; **4-1/2 by 6 inches (115 by 150 mm)** for equipment.
- 14. Plasticized Tags: Preprinted or partially preprinted, accident-prevention tags, of plasticized card stock with mat finish suitable for writing.
 - a. Size: **3-1/4 by 5-5/8 inches (83 by 143 mm)**.
 - b. Fasteners: Brass grommets and wire.
 - c. Nomenclature: Large-size primary caption such as DANGER, CAUTION, or DO NOT OPERATE.
- 15. Lettering and Graphics: Coordinate names, abbreviations, and other designations used in piped utility identification with corresponding designations indicated. Use numbers, letters, and terms indicated for proper identification, operation, and maintenance of piped utility systems and equipment.
 - a. Multiple Systems: Identify individual system number and service if multiple systems of same name are indicated.

F. Grout

- 1. Description: ASTM C 1107, Grade B, nonshrink and nonmetallic, dry hydraulic-cement grout.
 - a. Characteristics: Post hardening, volume adjusting, nonstaining, noncorrosive, nongaseous, and recommended for interior and exterior applications.
 - b. Design Mix: **5000-psi (34.5-MPa)**, 28-day compressive strength.
 - c. Packaging: Premixed and factory packaged.

G. Flowable Fill

- 1. Description: Low-strength-concrete, flowable-slurry mix.
 - a. Cement: ASTM C 150, Type I, portland.
 - b. Density: **115- to 145-lb/cu. ft. (1840- to 2325-kg/cu. m)**.
 - c. Aggregates: ASTM C 33, natural sand, fine and crushed gravel or stone, coarse
OR
Aggregates: ASTM C 33, natural sand, fine with admixture, ASTM C 618, fly-ash mineral.
 - d. Water: Comply with ASTM C 94/C 94M.
 - e. Strength: **100 to 200 psig (690 to 1380 kPa)** at 28 days.

1.3 EXECUTION

A. Piped Utility Demolition

- 1. Refer to Division 01 Section(s) "Cutting And Patching" AND Division 02 Section(s) "Selective Structure Demolition" for general demolition requirements and procedures.
- 2. Disconnect, demolish, and remove piped utility systems, equipment, and components indicated to be removed.
 - a. Piping to Be Removed: Remove portion of piping indicated to be removed and cap or plug remaining piping with same or compatible piping material.
 - b. Piping to Be Abandoned in Place: Drain piping. Fill abandoned piping with flowable fill, and cap or plug piping with same or compatible piping material.
 - c. Equipment to Be Removed: Disconnect and cap services and remove equipment.
 - d. Equipment to Be Removed and Reinstalled: Disconnect and cap services and remove, clean, and store equipment; when appropriate, reinstall, reconnect, and make operational.
 - e. Equipment to Be Removed and Salvaged: Disconnect and cap services and remove equipment and deliver to the Owner.
- 3. If pipe, insulation, or equipment to remain is damaged in appearance or is unserviceable, remove damaged or unserviceable portions and replace with new products of equal capacity and quality.

B. Dielectric Fitting Applications

- 1. Dry Piping Systems: Connect piping of dissimilar metals with the following:
 - a. **NPS 2 (DN 50)** and Smaller: Dielectric unions.
 - b. **NPS 2-1/2 to NPS 12 (DN 65 to DN 300)**: Dielectric flanges or dielectric flange kits.



2. Wet Piping Systems: Connect piping of dissimilar metals with the following:
 - a. **NPS 2 (DN 50)** and Smaller: Dielectric couplings **OR** dielectric nipples, **as directed**.
 - b. **NPS 2-1/2 to NPS 4 (DN 65 to DN 100)**: Dielectric nipples.
 - c. **NPS 2-1/2 to NPS 8 (DN 65 to DN 200)**: Dielectric nipples or dielectric flange kits.
 - d. **NPS 10 and NPS 12 (DN 250 and DN 300)**: Dielectric flange kits.

C. Piping Installation

1. Install piping according to the following requirements and Division 33 specifying piping systems.
2. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on the Coordination Drawings.
3. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
4. Install piping to permit valve servicing.
5. Install piping at indicated slopes.
6. Install piping free of sags and bends.
7. Install fittings for changes in direction and branch connections.
8. Select system components with pressure rating equal to or greater than system operating pressure.
9. Sleeves are not required for core-drilled holes, unless directed otherwise.
10. Permanent sleeves are not required for holes formed by removable PE sleeves, unless directed otherwise.
11. Install sleeves for pipes passing through concrete and masonry walls and concrete floor and roof slabs.
 - a. Cut sleeves to length for mounting flush with both surfaces.
 - 1) Exception: Extend sleeves installed in floors of equipment areas or other wet areas **2 inches (50 mm)** above finished floor level.
 - b. Install sleeves in new walls and slabs as new walls and slabs are constructed.
 - 1) **PVC OR Steel, as directed**, Pipe Sleeves: For pipes smaller than **NPS 6 (DN 150)**.
 - 2) Steel Sheet Sleeves: For pipes **NPS 6 (DN 150)** and larger, penetrating gypsum-board partitions.
12. Verify final equipment locations for roughing-in.
13. Refer to equipment specifications in other Sections for roughing-in requirements.

D. Piping Joint Construction

1. Join pipe and fittings according to the following requirements and Division 33 specifying piping systems.
2. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
3. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
4. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
 - a. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
 - b. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.
5. Welded Joints: Construct joints according to AWS D10.12/D10.12M, using qualified processes and welding operators according to Part 1.1 "Quality Assurance" Article.
6. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.
7. Grooved Joints: Assemble joints with grooved-end pipe coupling with coupling housing, gasket, lubricant, and bolts according to coupling and fitting manufacturer's written instructions.

8. Soldered Joints: Apply ASTM B 813 water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook," using lead-free solder alloy (0.20 percent maximum lead content) complying with ASTM B 32.
 9. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter, using copper-phosphorus brazing filler metal complying with AWS A5.8.
 10. Pressure-Sealed Joints: Assemble joints for plain-end copper tube and mechanical pressure seal fitting with proprietary crimping tool to according to fitting manufacturer's written instructions.
 11. Plastic Piping Solvent-Cemented Joints: Clean and dry joining surfaces. Join pipe and fittings according to the following:
 - a. Comply with ASTM F 402 for safe-handling practice of cleaners, primers, and solvent cements.
 - b. ABS Piping: Join according to ASTM D 2235 and ASTM D 2661 appendixes.
 - c. CPVC Piping: Join according to ASTM D 2846/D 2846M Appendix.
 - d. PVC Pressure Piping: Join schedule number ASTM D 1785, PVC pipe and PVC socket fittings according to ASTM D 2672. Join other-than-schedule-number PVC pipe and socket fittings according to ASTM D 2855.
 - e. PVC Nonpressure Piping: Join according to ASTM D 2855.
 - f. PVC to ABS Nonpressure Transition Fittings: Join according to ASTM D 3138 Appendix.
 12. Plastic Pressure Piping Gasketed Joints: Join according to ASTM D 3139.
 13. Plastic Nonpressure Piping Gasketed Joints: Join according to ASTM D 3212.
 14. Plastic Piping Heat-Fusion Joints: Clean and dry joining surfaces by wiping with clean cloth or paper towels. Join according to ASTM D 2657.
 - a. Plain-End PE Pipe and Fittings: Use butt fusion.
 - b. Plain-End PE Pipe and Socket Fittings: Use socket fusion.
 15. Bonded Joints: Prepare pipe ends and fittings, apply adhesive, and join according to pipe manufacturer's written instructions.
- E. Piping Connections
1. Make connections according to the following, unless otherwise indicated:
 - a. Install unions, in piping **NPS 2 (DN 50)** and smaller, adjacent to each valve and at final connection to each piece of equipment.
 - b. Install flanges, in piping **NPS 2-1/2 (DN 65)** and larger, adjacent to flanged valves and at final connection to each piece of equipment.
 - c. Install dielectric fittings at connections of dissimilar metal pipes.
- F. Equipment Installation
1. Install equipment level and plumb, unless otherwise indicated.
 2. Install equipment to facilitate service, maintenance, and repair or replacement of components. Connect equipment for ease of disconnecting, with minimum interference with other installations. Extend grease fittings to an accessible location.
 3. Install equipment to allow right of way to piping systems installed at required slope.
- G. Painting
1. Painting of piped utility systems, equipment, and components is specified in Division 09.
 2. Damage and Touchup: Repair marred and damaged factory-painted finishes with materials and procedures to match original factory finish.
- H. Identification
1. Piping Systems: Install pipe markers on each system. Include arrows showing normal direction of flow.
 - a. Stenciled Markers: According to ASME A13.1.
 - b. Plastic markers, with application systems. Install on insulation segment if required for hot noninsulated piping.
 - c. Locate pipe markers on exposed piping according to the following:
 - 1) Near each valve and control device.

- 2) Near each branch, excluding short takeoffs for equipment and terminal units. Mark each pipe at branch if flow pattern is not obvious.
- 3) Near locations where pipes pass through walls or floors or enter inaccessible enclosures.
- 4) At manholes and similar access points that permit view of concealed piping.
- 5) Near major equipment items and other points of origination and termination.
2. Equipment: Install engraved plastic-laminate sign or equipment marker on or near each major item of equipment.
 - a. Lettering Size: Minimum **1/4 inch (6.4 mm)** high for name of unit if viewing distance is less than **24 inches (610 mm)**, **1/2 inch (13 mm)** high for distances up to **72 inches (1800 mm)**, and proportionately larger lettering for greater distances. Provide secondary lettering two-thirds to three-fourths of size of principal lettering.
 - b. Text of Signs: Provide name of identified unit. Include text to distinguish among multiple units, inform user of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations.
3. Adjusting: Relocate identifying devices that become visually blocked by work of this or other Divisions.

I. Concrete Bases

1. Concrete Bases: Anchor equipment to concrete base according to equipment manufacturer's written instructions and according to seismic codes at Project.
 - a. Construct concrete bases of dimensions indicated, but not less than **4 inches (100 mm)** larger in both directions than supported unit.
 - b. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on **18-inch (450-mm)** centers around the full perimeter of base.
 - c. Install epoxy-coated anchor bolts for supported equipment that extend through concrete base, and anchor into structural concrete floor.
 - d. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 - e. Install anchor bolts to elevations required for proper attachment to supported equipment.
 - f. Install anchor bolts according to anchor-bolt manufacturer's written instructions.
 - g. Use **3000-psi (20.7-MPa)**, 28-day compressive-strength concrete and reinforcement as specified in Division 03 Section "Cast-in-place Concrete".

J. Erection Of Metal Supports And Anchorages

1. Refer to Division 05 Section "Metal Fabrications" for structural steel.
2. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor piped utility materials and equipment.
3. Field Welding: Comply with AWS D1.1/D1.1M.

K. Grouting

1. Mix and install grout for equipment base bearing surfaces, pump and other equipment base plates, and anchors.
2. Clean surfaces that will come into contact with grout.
3. Provide forms as required for placement of grout.
4. Avoid air entrapment during placement of grout.
5. Place grout, completely filling equipment bases.
6. Place grout on concrete bases and provide smooth bearing surface for equipment.
7. Place grout around anchors.
8. Cure placed grout.

END OF SECTION 21 05 23 00

SECTION 21 05 23 00a - GENERAL-DUTY VALVES FOR PLUMBING PIPING

1.1 GENERAL

A. Description Of Work

1. This specification covers the furnishing and installation of general-duty valves for plumbing piping. Products shall be as follows or as directed by the Owner. Installation procedures shall be in accordance with the products manufacturer's recommendations. Demolition and removal of materials shall be as required to support the work.

B. Summary

1. Section Includes:
 - a. Bronze angle valves.
 - b. Brass ball valves.
 - c. Bronze ball valves.
 - d. Iron ball valves.
 - e. Iron, single-flange butterfly valves.
 - f. Iron, grooved-end butterfly valves.
 - g. Bronze lift check valves.
 - h. Bronze swing check valves.
 - i. Iron swing check valves.
 - j. Iron swing check valves with closure control.
 - k. Iron, grooved-end swing check valves.
 - l. Iron, center-guided check valves.
 - m. Iron, plate-type check valves.
 - n. Bronze gate valves.
 - o. Iron gate valves.
 - p. Bronze globe valves.
 - q. Iron globe valves.
 - r. Lubricated plug valves.
 - s. Chainwheels.

C. Definitions

1. CWP: Cold working pressure.
2. EPDM: Ethylene propylene copolymer rubber.
3. NBR: Acrylonitrile-butadiene, Buna-N, or nitrile rubber.
4. NRS: Nonrising stem.
5. OS&Y: Outside screw and yoke.
6. RS: Rising stem.
7. SWP: Steam working pressure.

D. Submittals

1. Product Data: For each type of valve indicated.

E. Quality Assurance

1. Source Limitations for Valves: Obtain each type of valve from single source from single manufacturer.
2. ASME Compliance:
 - a. ASME B16.10 and ASME B16.34 for ferrous valve dimensions and design criteria.
 - b. ASME B31.1 for power piping valves.
 - c. ASME B31.9 for building services piping valves.
3. NSF Compliance: NSF 61 for valve materials for potable-water service.

F. Delivery, Storage, And Handling

1. Prepare valves for shipping as follows:
 - a. Protect internal parts against rust and corrosion.
 - b. Protect threads, flange faces, grooves, and weld ends.
 - c. Set angle, gate, and globe valves closed to prevent rattling.
 - d. Set ball and plug valves open to minimize exposure of functional surfaces.
 - e. Set butterfly valves closed or slightly open.
 - f. Block check valves in either closed or open position.
2. Use the following precautions during storage:
 - a. Maintain valve end protection.
 - b. Store valves indoors and maintain at higher than ambient dew point temperature. If outdoor storage is necessary, store valves off the ground in watertight enclosures.
3. Use sling to handle large valves; rig sling to avoid damage to exposed parts. Do not use handwheels or stems as lifting or rigging points.

1.2 PRODUCTS

A. General Requirements For Valves

1. Refer to valve schedule articles for applications of valves.
2. Valve Pressure and Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.
3. Valve Sizes: Same as upstream piping unless otherwise indicated.
4. Valve Actuator Types:
 - a. Gear Actuator: For quarter-turn valves **NPS 8 (DN 200)** and larger.
 - b. Handwheel: For valves other than quarter-turn types.
 - c. Handlever: For quarter-turn valves **NPS 6 (DN 150)** and smaller except plug valves, **as directed**.
 - d. Wrench: For plug valves with square heads. Furnish the Owner with 1 wrench for every 5 **OR 10, as directed**, plug valves, for each size square plug-valve head.
 - e. Chainwheel: Device for attachment to valve handwheel, stem, or other actuator; of size and with chain for mounting height, as indicated in the "Valve Installation" Article.
5. Valves in Insulated Piping: With **2-inch (50-mm)** stem extensions and the following features:
 - a. Gate Valves: With rising stem.
 - b. Ball Valves: With extended operating handle of non-thermal-conductive material, and protective sleeve that allows operation of valve without breaking the vapor seal or disturbing insulation.
 - c. Butterfly Valves: With extended neck.
6. Valve-End Connections:
 - a. Flanged: With flanges according to ASME B16.1 for iron valves.
 - b. Grooved: With grooves according to AWWA C606.
 - c. Solder Joint: With sockets according to ASME B16.18.
 - d. Threaded: With threads according to ASME B1.20.1.
7. Valve Bypass and Drain Connections: MSS SP-45.

B. Bronze Angle Valves

1. Class 125, Bronze Angle Valves with Bronze Disc:
 - a. Description:
 - 1) Standard: MSS SP-80, Type 1.
 - 2) CWP Rating: **200 psig (1380 kPa)**.
 - 3) Body Material: ASTM B 62, bronze with integral seat and screw-in bonnet.
 - 4) Ends: Threaded.
 - 5) Stem and Disc: Bronze.
 - 6) Packing: Asbestos free.
 - 7) Handwheel: Malleable iron, bronze, or aluminum, **as directed**.
2. Class 125, Bronze Angle Valves with Nonmetallic Disc:

- a. Description:
 - 1) Standard: MSS SP-80, Type 2.
 - 2) CWP Rating: **200 psig** (1380 kPa).
 - 3) Body Material: ASTM B 62, bronze with integral seat and screw-in bonnet.
 - 4) Ends: Threaded.
 - 5) Stem: Bronze.
 - 6) Disc: PTFE or TFE.
 - 7) Packing: Asbestos free.
 - 8) Handwheel: Malleable iron, bronze, or aluminum, **as directed**.
 3. Class 150, Bronze Angle Valves with Bronze Disc:
 - a. Description:
 - 1) Standard: MSS SP-80, Type 1.
 - 2) CWP Rating: **300 psig** (2070 kPa).
 - 3) Body Material: ASTM B 62, bronze with integral seat and union-ring bonnet.
 - 4) Ends: Threaded.
 - 5) Stem and Disc: Bronze.
 - 6) Packing: Asbestos free.
 - 7) Handwheel: Malleable iron, bronze, or aluminum, **as directed**.
 4. Class 150, Bronze Angle Valves with Nonmetallic Disc:
 - a. Description:
 - 1) Standard: MSS SP-80, Type 2.
 - 2) CWP Rating: **300 psig** (2070 kPa).
 - 3) Body Material: ASTM B 62, bronze with integral seat and union-ring bonnet.
 - 4) Ends: Threaded.
 - 5) Stem: Bronze.
 - 6) Disc: PTFE or TFE.
 - 7) Packing: Asbestos free.
 - 8) Handwheel: Malleable iron, bronze, or aluminum, **as directed**.
- C. Brass Ball Valves
1. One-Piece, Reduced-Port, Brass Ball Valves with Brass Trim:
 - a. Description:
 - 1) Standard: MSS SP-110.
 - 2) CWP Rating: **400 psig** (2760 kPa).
 - 3) Body Design: One piece.
 - 4) Body Material: Forged brass.
 - 5) Ends: Threaded.
 - 6) Seats: PTFE or TFE.
 - 7) Stem: Brass.
 - 8) Ball: Chrome-plated brass.
 - 9) Port: Reduced.
 2. Two-Piece, Full-Port, Brass Ball Valves with Brass Trim:
 - a. Description:
 - 1) Standard: MSS SP-110.
 - 2) SWP Rating: **150 psig** (1035 kPa).
 - 3) CWP Rating: **600 psig** (4140 kPa).
 - 4) Body Design: Two piece.
 - 5) Body Material: Forged brass.
 - 6) Ends: Threaded.
 - 7) Seats: PTFE or TFE.
 - 8) Stem: Brass.
 - 9) Ball: Chrome-plated brass.
 - 10) Port: Full.
 3. Two-Piece, Full-Port, Brass Ball Valves with Stainless-Steel Trim:
 - a. Description:
 - 1) Standard: MSS SP-110.

- 2) SWP Rating: 150 psig (1035 kPa).
 - 3) CWP Rating: 600 psig (4140 kPa).
 - 4) Body Design: Two piece.
 - 5) Body Material: Forged brass.
 - 6) Ends: Threaded.
 - 7) Seats: PTFE or TFE.
 - 8) Stem: Stainless steel.
 - 9) Ball: Stainless steel, vented.
 - 10) Port: Full.
4. Two-Piece, Regular-Port, Brass Ball Valves with Brass Trim:
- a. Description:
 - 1) Standard: MSS SP-110.
 - 2) SWP Rating: 150 psig (1035 kPa).
 - 3) CWP Rating: 600 psig (4140 kPa).
 - 4) Body Design: Two piece.
 - 5) Body Material: Forged brass.
 - 6) Ends: Threaded.
 - 7) Seats: PTFE or TFE.
 - 8) Stem: Brass.
 - 9) Ball: Chrome-plated brass.
 - 10) Port: Regular.
5. Two-Piece, Regular-Port, Brass Ball Valves with Stainless-Steel Trim:
- a. Description:
 - 1) Standard: MSS SP-110.
 - 2) SWP Rating: 150 psig (1035 kPa).
 - 3) CWP Rating: 600 psig (4140 kPa).
 - 4) Body Design: Two piece.
 - 5) Body Material: Brass or bronze.
 - 6) Ends: Threaded.
 - 7) Seats: PTFE or TFE.
 - 8) Stem: Stainless steel.
 - 9) Ball: Stainless steel, vented.
 - 10) Port: Regular.
6. Three-Piece, Full-Port, Brass Ball Valves with Brass Trim:
- a. Description:
 - 1) Standard: MSS SP-110.
 - 2) SWP Rating: 150 psig (1035 kPa).
 - 3) CWP Rating: 600 psig (4140 kPa).
 - 4) Body Design: Three piece.
 - 5) Body Material: Forged brass.
 - 6) Ends: Threaded.
 - 7) Seats: PTFE or TFE.
 - 8) Stem: Brass.
 - 9) Ball: Chrome-plated brass.
 - 10) Port: Full.
7. Three-Piece, Full-Port, Brass Ball Valves with Stainless-Steel Trim:
- a. Description:
 - 1) Standard: MSS SP-110.
 - 2) SWP Rating: 150 psig (1035 kPa).
 - 3) CWP Rating: 600 psig (4140 kPa).
 - 4) Body Design: Three piece.
 - 5) Body Material: Forged brass.
 - 6) Ends: Threaded.
 - 7) Seats: PTFE or TFE.
 - 8) Stem: Stainless steel.

- 9) Ball: Stainless steel, vented.
- 10) Port: Full.

D. Bronze Ball Valves

1. One-Piece, Reduced-Port, Bronze Ball Valves with Bronze Trim:

a. Description:

- 1) Standard: MSS SP-110.
- 2) CWP Rating: 400 psig (2760 kPa).
- 3) Body Design: One piece.
- 4) Body Material: Bronze.
- 5) Ends: Threaded.
- 6) Seats: PTFE or TFE.
- 7) Stem: Bronze.
- 8) Ball: Chrome-plated brass.
- 9) Port: Reduced.

2. One-Piece, Reduced-Port, Bronze Ball Valves with Stainless-Steel Trim:

a. Description:

- 1) Standard: MSS SP-110.
- 2) CWP Rating: 600 psig (4140 kPa).
- 3) Body Design: One piece.
- 4) Body Material: Bronze.
- 5) Ends: Threaded.
- 6) Seats: PTFE or TFE.
- 7) Stem: Stainless steel.
- 8) Ball: Stainless steel, vented.
- 9) Port: Reduced.

3. Two-Piece, Full-Port, Bronze Ball Valves with Bronze Trim:

a. Description:

- 1) Standard: MSS SP-110.
- 2) SWP Rating: 150 psig (1035 kPa).
- 3) CWP Rating: 600 psig (4140 kPa).
- 4) Body Design: Two piece.
- 5) Body Material: Bronze.
- 6) Ends: Threaded.
- 7) Seats: PTFE or TFE.
- 8) Stem: Bronze.
- 9) Ball: Chrome-plated brass.
- 10) Port: Full.

4. Two-Piece, Full-Port, Bronze Ball Valves with Stainless-Steel Trim:

a. Description:

- 1) Standard: MSS SP-110.
- 2) SWP Rating: 150 psig (1035 kPa).
- 3) CWP Rating: 600 psig (4140 kPa).
- 4) Body Design: Two piece.
- 5) Body Material: Bronze.
- 6) Ends: Threaded.
- 7) Seats: PTFE or TFE.
- 8) Stem: Stainless steel.
- 9) Ball: Stainless steel, vented.
- 10) Port: Full.

5. Two-Piece, Regular-Port, Bronze Ball Valves with Bronze Trim:

a. Description:

- 1) Standard: MSS SP-110.
- 2) SWP Rating: 150 psig (1035 kPa).
- 3) CWP Rating: 600 psig (4140 kPa).
- 4) Body Design: Two piece.

- 5) Body Material: Bronze.
- 6) Ends: Threaded.
- 7) Seats: PTFE or TFE.
- 8) Stem: Bronze.
- 9) Ball: Chrome-plated brass.
- 10) Port: Regular.
6. Two-Piece, Regular-Port, Bronze Ball Valves with Stainless-Steel Trim:
 - a. Description:
 - 1) Standard: MSS SP-110.
 - 2) SWP Rating: 150 psig (1035 kPa).
 - 3) CWP Rating: 600 psig (4140 kPa).
 - 4) Body Design: Two piece.
 - 5) Body Material: Bronze.
 - 6) Ends: Threaded.
 - 7) Seats: PTFE or TFE.
 - 8) Stem: Stainless steel.
 - 9) Ball: Stainless steel, vented.
 - 10) Port: Regular.
7. Three-Piece, Full-Port, Bronze Ball Valves with Bronze Trim:
 - a. Description:
 - 1) Standard: MSS SP-110.
 - 2) SWP Rating: 150 psig (1035 kPa).
 - 3) CWP Rating: 600 psig (4140 kPa).
 - 4) Body Design: Three piece.
 - 5) Body Material: Bronze.
 - 6) Ends: Threaded.
 - 7) Seats: PTFE or TFE.
 - 8) Stem: Bronze.
 - 9) Ball: Chrome-plated brass.
 - 10) Port: Full.
8. Three-Piece, Full-Port, Bronze Ball Valves with Stainless-Steel Trim:
 - a. Description:
 - 1) Standard: MSS SP-110.
 - 2) SWP Rating: 150 psig (1035 kPa).
 - 3) CWP Rating: 600 psig (4140 kPa).
 - 4) Body Design: Three piece.
 - 5) Body Material: Bronze.
 - 6) Ends: Threaded.
 - 7) Seats: PTFE or TFE.
 - 8) Stem: Stainless steel.
 - 9) Ball: Stainless steel, vented.
 - 10) Port: Full.

E. Iron Ball Valves

1. Class 125, Iron Ball Valves:
 - a. Description:
 - 1) Standard: MSS SP-72.
 - 2) CWP Rating: 200 psig (1380 kPa).
 - 3) Body Design: Split body.
 - 4) Body Material: ASTM A 126, gray iron.
 - 5) Ends: Flanged.
 - 6) Seats: PTFE or TFE.
 - 7) Stem: Stainless steel.
 - 8) Ball: Stainless steel.
 - 9) Port: Full.

F. Iron, Single-Flange Butterfly Valves

1. 200 CWP, Iron, Single-Flange Butterfly Valves with EPDM Seat and Aluminum-Bronze Disc:
 - a. Description:
 - 1) Standard: MSS SP-67, Type I.
 - 2) CWP Rating: 200 psig (1380 kPa).
 - 3) Body Design: Lug type; suitable for bidirectional dead-end service at rated pressure without use of downstream flange.
 - 4) Body Material: ASTM A 126, cast iron or ASTM A 536, ductile iron.
 - 5) Seat: EPDM.
 - 6) Stem: One- or two-piece stainless steel.
 - 7) Disc: Aluminum bronze.
2. 200 CWP, Iron, Single-Flange Butterfly Valves with NBR Seat and Aluminum-Bronze Disc:
 - a. Description:
 - 1) Standard: MSS SP-67, Type I.
 - 2) CWP Rating: 200 psig (1380 kPa).
 - 3) Body Design: Lug type; suitable for bidirectional dead-end service at rated pressure without use of downstream flange.
 - 4) Body Material: ASTM A 126, cast iron or ASTM A 536, ductile iron.
 - 5) Seat: NBR.
 - 6) Stem: One- or two-piece stainless steel.
 - 7) Disc: Aluminum bronze.
3. 200 CWP, Iron, Single-Flange Butterfly Valves with EPDM Seat and Ductile-Iron Disc:
 - a. Description:
 - 1) Standard: MSS SP-67, Type I.
 - 2) CWP Rating: 200 psig (1380 kPa).
 - 3) Body Design: Lug type; suitable for bidirectional dead-end service at rated pressure without use of downstream flange.
 - 4) Body Material: ASTM A 126, cast iron or ASTM A 536, ductile iron.
 - 5) Seat: EPDM.
 - 6) Stem: One- or two-piece stainless steel.
 - 7) Disc: Nickel-plated or -coated, **as directed**, ductile iron.
4. 200 CWP, Iron, Single-Flange Butterfly Valves with NBR Seat and Ductile-Iron Disc:
 - a. Description:
 - 1) Standard: MSS SP-67, Type I.
 - 2) CWP Rating: 200 psig (1380 kPa).
 - 3) Body Design: Lug type; suitable for bidirectional dead-end service at rated pressure without use of downstream flange.
 - 4) Body Material: ASTM A 126, cast iron or ASTM A 536, ductile iron.
 - 5) Seat: NBR.
 - 6) Stem: One- or two-piece stainless steel.
 - 7) Disc: Nickel-plated or -coated, **as directed**, ductile iron.
5. 200 CWP, Iron, Single-Flange Butterfly Valves with EPDM Seat and Stainless-Steel Disc:
 - a. Description:
 - 1) Standard: MSS SP-67, Type I.
 - 2) CWP Rating: 200 psig (1380 kPa).
 - 3) Body Design: Lug type; suitable for bidirectional dead-end service at rated pressure without use of downstream flange.
 - 4) Body Material: ASTM A 126, cast iron or ASTM A 536, ductile iron.
 - 5) Seat: EPDM.
 - 6) Stem: One- or two-piece stainless steel.
 - 7) Disc: Stainless steel.
6. 200 CWP, Iron, Single-Flange Butterfly Valves with NBR Seat and Stainless-Steel Disc:
 - a. Description:
 - 1) Standard: MSS SP-67, Type I.
 - 2) CWP Rating: 200 psig (1380 kPa).

- 3) Body Design: Lug type; suitable for bidirectional dead-end service at rated pressure without use of downstream flange.
- 4) Body Material: ASTM A 126, cast iron or ASTM A 536, ductile iron.
- 5) Seat: NBR.
- 6) Stem: One- or two-piece stainless steel.
- 7) Disc: Stainless steel.

G. Iron, Grooved-End Butterfly Valves

1. 175 CWP, Iron, Grooved-End Butterfly Valves:
 - a. Description:
 - 1) Standard: MSS SP-67, Type I.
 - 2) CWP Rating: 175 psig (1200 kPa).
 - 3) Body Material: Coated, ductile iron.
 - 4) Stem: Two-piece stainless steel.
 - 5) Disc: Coated, ductile iron.
 - 6) Seal: EPDM.
2. 300 CWP, Iron, Grooved-End Butterfly Valves:
 - a. Description:
 - 1) Standard: MSS SP-67, Type I.
 - 2) NPS 8 (DN 200) and Smaller CWP Rating: 300 psig (2070 kPa).
 - 3) NPS 10 (DN 250) and Larger CWP Rating: 200 psig (1380 kPa).
 - 4) Body Material: Coated, ductile iron.
 - 5) Stem: Two-piece stainless steel.
 - 6) Disc: Coated, ductile iron.
 - 7) Seal: EPDM.

H. Bronze Lift Check Valves

1. Class 125, Lift Check Valves with Bronze Disc:
 - a. Description:
 - 1) Standard: MSS SP-80, Type 1.
 - 2) CWP Rating: 200 psig (1380 kPa).
 - 3) Body Design: Vertical flow.
 - 4) Body Material: ASTM B 61 or ASTM B 62, bronze.
 - 5) Ends: Threaded.
 - 6) Disc: Bronze.
2. Class 125, Lift Check Valves with Nonmetallic Disc:
 - a. Description:
 - 1) Standard: MSS SP-80, Type 2.
 - 2) CWP Rating: 200 psig (1380 kPa).
 - 3) Body Design: Vertical flow.
 - 4) Body Material: ASTM B 61 or ASTM B 62, bronze.
 - 5) Ends: Threaded.
 - 6) Disc: NBR, PTFE, or TFE.

I. Bronze Swing Check Valves

1. Class 125, Bronze Swing Check Valves with Bronze Disc:
 - a. Description:
 - 1) Standard: MSS SP-80, Type 3.
 - 2) CWP Rating: 200 psig (1380 kPa).
 - 3) Body Design: Horizontal flow.
 - 4) Body Material: ASTM B 62, bronze.
 - 5) Ends: Threaded.
 - 6) Disc: Bronze.
2. Class 125, Bronze Swing Check Valves with Nonmetallic Disc:
 - a. Description:

- 1) Standard: MSS SP-80, Type 4.
 - 2) CWP Rating: 200 psig (1380 kPa).
 - 3) Body Design: Horizontal flow.
 - 4) Body Material: ASTM B 62, bronze.
 - 5) Ends: Threaded.
 - 6) Disc: PTFE or TFE.
 3. Class 150, Bronze Swing Check Valves with Bronze Disc:
 - a. Description:
 - 1) Standard: MSS SP-80, Type 3.
 - 2) CWP Rating: 300 psig (2070 kPa).
 - 3) Body Design: Horizontal flow.
 - 4) Body Material: ASTM B 62, bronze.
 - 5) Ends: Threaded.
 - 6) Disc: Bronze.
 4. Class 150, Bronze Swing Check Valves with Nonmetallic Disc:
 - a. Description:
 - 1) Standard: MSS SP-80, Type 4.
 - 2) CWP Rating: 300 psig (2070 kPa).
 - 3) Body Design: Horizontal flow.
 - 4) Body Material: ASTM B 62, bronze.
 - 5) Ends: Threaded.
 - 6) Disc: PTFE or TFE.
- J. Iron Swing Check Valves
1. Class 125, Iron Swing Check Valves with Metal Seats:
 - a. Description:
 - 1) Standard: MSS SP-71, Type I.
 - 2) CWP Rating: 200 psig (1380 kPa).
 - 3) Body Design: Clear or full waterway.
 - 4) Body Material: ASTM A 126, gray iron with bolted bonnet.
 - 5) Ends: Flanged.
 - 6) Trim: Bronze.
 - 7) Gasket: Asbestos free.
 2. Class 125, Iron Swing Check Valves with Nonmetallic-to-Metal Seats:
 - a. Description:
 - 1) Standard: MSS SP-71, Type I.
 - 2) CWP Rating: 200 psig (1380 kPa).
 - 3) Body Design: Clear or full waterway.
 - 4) Body Material: ASTM A 126, gray iron with bolted bonnet.
 - 5) Ends: Flanged.
 - 6) Trim: Composition.
 - 7) Seat Ring: Bronze.
 - 8) Disc Holder: Bronze.
 - 9) Disc: PTFE or TFE.
 - 10) Gasket: Asbestos free.
 3. Class 250, Iron Swing Check Valves with Metal Seats:
 - a. Description:
 - 1) Standard: MSS SP-71, Type I.
 - 2) CWP Rating: 500 psig (3450 kPa).
 - 3) Body Design: Clear or full waterway.
 - 4) Body Material: ASTM A 126, gray iron with bolted bonnet.
 - 5) Ends: Flanged.
 - 6) Trim: Bronze.
 - 7) Gasket: Asbestos free.

K. Iron Swing Check Valves With Closure Control

1. Class 125, Iron Swing Check Valves with Lever- and Spring-Closure Control:
 - a. Description:
 - 1) Standard: MSS SP-71, Type I.
 - 2) CWP Rating: 200 psig (1380 kPa).
 - 3) Body Design: Clear or full waterway.
 - 4) Body Material: ASTM A 126, gray iron with bolted bonnet.
 - 5) Ends: Flanged.
 - 6) Trim: Bronze.
 - 7) Gasket: Asbestos free.
 - 8) Closure Control: Factory-installed, exterior lever and spring.
 2. Class 125, Iron Swing Check Valves with Lever- and Weight-Closure Control:
 - a. Description:
 - 1) Standard: MSS SP-71, Type I.
 - 2) CWP Rating: 200 psig (1380 kPa).
 - 3) Body Design: Clear or full waterway.
 - 4) Body Material: ASTM A 126, gray iron with bolted bonnet.
 - 5) Ends: Flanged.
 - 6) Trim: Bronze.
 - 7) Gasket: Asbestos free.
 - 8) Closure Control: Factory-installed, exterior lever and weight.
- L. Iron, Grooved-End Swing Check Valves
1. 300 CWP, Iron, Grooved-End Swing Check Valves:
 - a. Description:
 - 1) CWP Rating: 300 psig (2070 kPa).
 - 2) Body Material: ASTM A 536, ductile iron.
 - 3) Seal: EPDM.
 - 4) Disc: Spring-operated, ductile iron or stainless steel.
- M. Iron, Center-Guided Check Valves
1. Class 125, Iron, Compact-Wafer, Center-Guided Check Valves with Metal Seat:
 - a. Description:
 - 1) Standard: MSS SP-125.
 - 2) CWP Rating: 200 psig (1380 kPa).
 - 3) Body Material: ASTM A 126, gray iron.
 - 4) Style: Compact wafer.
 - 5) Seat: Bronze.
 2. Class 125, Iron, Globe, Center-Guided Check Valves with Metal Seat:
 - a. Description:
 - 1) Standard: MSS SP-125.
 - 2) CWP Rating: 200 psig (1380 kPa).
 - 3) Body Material: ASTM A 126, gray iron.
 - 4) Style: Globe, spring loaded.
 - 5) Ends: Flanged.
 - 6) Seat: Bronze.
 3. Class 150, Iron, Compact-Wafer, Center-Guided Check Valves with Metal Seat:
 - a. Description:
 - 1) Standard: MSS SP-125.
 - 2) CWP Rating: 300 psig (2070 kPa).
 - 3) Body Material: ASTM A 395/A 395M or ASTM A 536, ductile iron.
 - 4) Style: Compact wafer.
 - 5) Seat: Bronze.
 4. Class 150, Iron, Globe, Center-Guided Check Valves with Metal Seat:
 - a. Description:
 - 1) Standard: MSS SP-125.

- 2) CWP Rating: **300 psig (2070 kPa)**.
- 3) Body Material: ASTM A 395/A 395M or ASTM A 536, ductile iron.
- 4) Style: Globe, spring loaded.
- 5) Ends: Flanged.
- 6) Seat: Bronze.
5. Class 250, Iron, Compact-Wafer, Center-Guided Check Valves with Metal Seat:
 - a. Description:
 - 1) Standard: MSS SP-125.
 - 2) CWP Rating: **400 psig (2760 kPa)**.
 - 3) Body Material: ASTM A 126, gray iron.
 - 4) Style: Compact wafer, spring loaded.
 - 5) Seat: Bronze.
6. Class 250, Iron, Globe, Center-Guided Check Valves with Metal Seat:
 - a. Description:
 - 1) Standard: MSS SP-125.
 - 2) CWP Rating: **400 psig (2760 kPa)**.
 - 3) Body Material: ASTM A 126, gray iron.
 - 4) Style: Globe, spring loaded.
 - 5) Ends: Flanged.
 - 6) Seat: Bronze.
7. Class 300, Iron, Compact-Wafer, Center-Guided Check Valves with Metal Seat:
 - a. Description:
 - 1) Standard: MSS SP-125.
 - 2) CWP Rating: **500 psig (3450 kPa)**.
 - 3) Body Material: ASTM A 395/A 395M or ASTM A 536, ductile iron.
 - 4) Style: Compact wafer, spring loaded.
 - 5) Seat: Bronze.
8. Class 300, Iron, Globe, Center-Guided Check Valves with Metal Seat:
 - a. Description:
 - 1) Standard: MSS SP-125.
 - 2) CWP Rating: **500 psig (3450 kPa)**.
 - 3) Body Material: ASTM A 395/A 395M or ASTM A 536, ductile iron.
 - 4) Style: Globe, spring loaded.
 - 5) Ends: Flanged.
 - 6) Seat: Bronze.
9. Class 125, Iron, Compact-Wafer, Center-Guided Check Valves with Resilient Seat:
 - a. Description:
 - 1) Standard: MSS SP-125.
 - 2) CWP Rating: **200 psig (1380 kPa)**.
 - 3) Body Material: ASTM A 126, gray iron.
 - 4) Style: Compact wafer.
 - 5) Seat: EPDM **OR** NBR, **as directed**.
10. Class 125, Iron, Globe, Center-Guided Check Valves with Resilient Seat:
 - a. Description:
 - 1) Standard: MSS SP-125.
 - 2) CWP Rating: **200 psig (1380 kPa)**.
 - 3) Body Material: ASTM A 126, gray iron.
 - 4) Style: Globe, spring loaded.
 - 5) Ends: Flanged.
 - 6) Seat: EPDM **OR** NBR, **as directed**.
11. Class 150, Iron, Compact-Wafer, Center-Guided Check Valves with Resilient Seat:
 - a. Description:
 - 1) Standard: MSS SP-125.
 - 2) CWP Rating: **300 psig (2070 kPa)**.
 - 3) Body Material: ASTM A 395/A 395M or ASTM A 536, ductile iron.
 - 4) Style: Compact wafer.

- 5) Seat: EPDM **OR** NBR, **as directed**.
12. Class 150, Iron, Globe, Center-Guided Check Valves with Resilient Seat:
- a. Description:
- 1) Standard: MSS SP-125.
 - 2) CWP Rating: **300 psig** (2070 kPa).
 - 3) Body Material: ASTM A 395/A 395M or ASTM A 536, ductile iron.
 - 4) Style: Globe, spring loaded.
 - 5) Ends: Flanged.
 - 6) Seat: EPDM **OR** NBR, **as directed**.
13. Class 250, Iron, Compact-Wafer, Center-Guided Check Valves with Resilient Seat:
- a. Description:
- 1) Standard: MSS SP-125.
 - 2) CWP Rating: **400 psig** (2760 kPa).
 - 3) Body Material: ASTM A 126, gray iron.
 - 4) Style: Compact wafer, spring loaded.
 - 5) Seat: EPDM **OR** NBR, **as directed**.
14. Class 250, Iron, Globe, Center-Guided Check Valves with Resilient Seat:
- a. Description:
- 1) Standard: MSS SP-125.
 - 2) CWP Rating: **400 psig** (2760 kPa).
 - 3) Body Material: ASTM A 126, gray iron.
 - 4) Style: Globe, spring loaded.
 - 5) Ends: Flanged.
 - 6) Seat: EPDM **OR** NBR, **as directed**.
15. Class 300, Iron, Compact-Wafer, Center-Guided Check Valves with Resilient Seat:
- a. Description:
- 1) Standard: MSS SP-125.
 - 2) CWP Rating: **500 psig** (3450 kPa).
 - 3) Body Material: ASTM A 395/A 395M or ASTM A 536, ductile iron.
 - 4) Style: Compact wafer, spring loaded.
 - 5) Seat: EPDM **OR** NBR, **as directed**.
16. Class 300, Iron, Globe, Center-Guided Check Valves with Resilient Seat:
- a. Description:
- 1) Standard: MSS SP-125.
 - 2) CWP Rating: **500 psig** (3450 kPa).
 - 3) Body Material: ASTM A 395/A 395M or ASTM A 536, ductile iron.
 - 4) Style: Globe, spring loaded.
 - 5) Ends: Flanged.
 - 6) Seat: EPDM **OR** NBR, **as directed**.
- N. Iron, Plate-Type Check Valves
1. Class 125, Iron, Dual-Plate Check Valves with Metal Seat:
- a. Description:
- 1) Standard: API 594.
 - 2) CWP Rating: **200 psig** (1380 kPa).
 - 3) Body Design: Wafer, spring-loaded plates.
 - 4) Body Material: ASTM A 126, gray iron.
 - 5) Seat: Bronze.
2. Class 150, Iron, Dual-Plate Check Valves with Metal Seat:
- a. Description:
- 1) Standard: API 594.
 - 2) CWP Rating: **300 psig** (2070 kPa).
 - 3) Body Design: Wafer, spring-loaded plates.
 - 4) Body Material: ASTM A 395/A 395M or ASTM A 536, ductile iron.
 - 5) Seat: Bronze.

3. Class 250, Iron, Dual-Plate Check Valves with Metal Seat:
 - a. Description:
 - 1) Standard: API 594.
 - 2) CWP Rating: 400 psig (2760 kPa).
 - 3) Body Design: Wafer, spring-loaded plates.
 - 4) Body Material: ASTM A 126, gray iron.
 - 5) Seat: Bronze.
4. Class 300, Iron, Dual-Plate Check Valves with Metal Seat:
 - a. Description:
 - 1) Standard: API 594.
 - 2) CWP Rating: 500 psig (3450 kPa).
 - 3) Body Design: Wafer, spring-loaded plates.
 - 4) Body Material: ASTM A 395/A 395M or ASTM A 536, ductile iron.
 - 5) Seat: Bronze.
5. Class 125, Iron, Single-Plate Check Valves with Resilient Seat:
 - a. Description:
 - 1) Standard: API 594.
 - 2) CWP Rating: 200 psig (1380 kPa).
 - 3) Body Design: Wafer, spring-loaded plate.
 - 4) Body Material: ASTM A 126, gray iron.
 - 5) Seat: EPDM OR NBR, as directed.
6. Class 125, Iron, Dual-Plate Check Valves with Resilient Seat:
 - a. Description:
 - 1) Standard: API 594.
 - 2) CWP Rating: 200 psig (1380 kPa).
 - 3) Body Design: Wafer, spring-loaded plates.
 - 4) Body Material: ASTM A 126, gray iron.
 - 5) Seat: EPDM OR NBR, as directed.
7. Class 150, Iron, Dual-Plate Check Valves with Resilient Seat:
 - a. Description:
 - 1) Standard: API 594.
 - 2) CWP Rating: 300 psig (2070 kPa).
 - 3) Body Design: Wafer, spring-loaded plates.
 - 4) Body Material: ASTM A 395/A 395M or ASTM A 536, ductile iron.
 - 5) Seat: EPDM OR NBR, as directed.
8. Class 250, Iron, Wafer, Single-Plate Check Valves with Resilient Seat:
 - a. Description:
 - 1) Standard: API 594.
 - 2) CWP Rating: 400 psig (2760 kPa).
 - 3) Body Design: Wafer, spring-loaded plate.
 - 4) Body Material: ASTM A 126, gray iron.
 - 5) Seat: EPDM OR NBR, as directed.
9. Class 250, Iron, Dual-Plate Check Valves with Resilient Seat:
 - a. Description:
 - 1) Standard: API 594.
 - 2) CWP Rating: 400 psig (2760 kPa).
 - 3) Body Design: Wafer, spring-loaded plates.
 - 4) Body Material: ASTM A 126, gray iron.
 - 5) Seat: EPDM OR NBR, as directed.
10. Class 300, Iron, Dual-Plate Check Valves with Resilient Seat:
 - a. Description:
 - 1) Standard: API 594.
 - 2) CWP Rating: 500 psig (3450 kPa).
 - 3) Body Design: Wafer, spring-loaded plates.
 - 4) Body Material: ASTM A 395/A 395M or ASTM A 536, ductile iron.
 - 5) Seat: EPDM OR NBR, as directed.

O. Bronze Gate Valves**1. Class 125, NRS Bronze Gate Valves:****a. Description:**

- 1) Standard: MSS SP-80, Type 1.
- 2) CWP Rating: **200 psig** (1380 kPa).
- 3) Body Material: ASTM B 62, bronze with integral seat and screw-in bonnet.
- 4) Ends: Threaded or solder joint, **as directed**.
- 5) Stem: Bronze.
- 6) Disc: Solid wedge; bronze.
- 7) Packing: Asbestos free.
- 8) Handwheel: Malleable iron, bronze, or aluminum, **as directed**.

2. Class 125, RS Bronze Gate Valves:**a. Description:**

- 1) Standard: MSS SP-80, Type 2.
- 2) CWP Rating: **200 psig** (1380 kPa).
- 3) Body Material: ASTM B 62, bronze with integral seat and screw-in bonnet.
- 4) Ends: Threaded or solder joint, **as directed**.
- 5) Stem: Bronze.
- 6) Disc: Solid wedge; bronze.
- 7) Packing: Asbestos free.
- 8) Handwheel: Malleable iron, bronze, or aluminum, **as directed**.

3. Class 150, NRS Bronze Gate Valves:**a. Description:**

- 1) Standard: MSS SP-80, Type 1.
- 2) CWP Rating: **300 psig** (2070 kPa).
- 3) Body Material: ASTM B 62, bronze with integral seat and union-ring bonnet.
- 4) Ends: Threaded.
- 5) Stem: Bronze.
- 6) Disc: Solid wedge; bronze.
- 7) Packing: Asbestos free.
- 8) Handwheel: Malleable iron, bronze, or aluminum, **as directed**.

4. Class 150, RS Bronze Gate Valves:**a. Description:**

- 1) Standard: MSS SP-80, Type 2.
- 2) CWP Rating: **300 psig** (2070 kPa).
- 3) Body Material: ASTM B 62, bronze with integral seat and union-ring bonnet.
- 4) Ends: Threaded.
- 5) Stem: Bronze.
- 6) Disc: Solid wedge; bronze.
- 7) Packing: Asbestos free.
- 8) Handwheel: Malleable iron, bronze, or aluminum, **as directed**.

P. Iron Gate Valves**1. Class 125, NRS, Iron Gate Valves:****a. Description:**

- 1) Standard: MSS SP-70, Type I.
- 2) CWP Rating: **200 psig** (1380 kPa).
- 3) Body Material: ASTM A 126, gray iron with bolted bonnet.
- 4) Ends: Flanged.
- 5) Trim: Bronze.
- 6) Disc: Solid wedge.
- 7) Packing and Gasket: Asbestos free.

2. Class 125, OS&Y, Iron Gate Valves:**a. Description:**

- 1) Standard: MSS SP-70, Type I.

- 2) CWP Rating: **200 psig (1380 kPa)**.
 - 3) Body Material: ASTM A 126, gray iron with bolted bonnet.
 - 4) Ends: Flanged.
 - 5) Trim: Bronze.
 - 6) Disc: Solid wedge.
 - 7) Packing and Gasket: Asbestos free.
3. Class 250, NRS, Iron Gate Valves:
 - a. Description:
 - 1) Standard: MSS SP-70, Type I.
 - 2) CWP Rating: **500 psig (3450 kPa)**.
 - 3) Body Material: ASTM A 126, gray iron with bolted bonnet.
 - 4) Ends: Flanged.
 - 5) Trim: Bronze.
 - 6) Disc: Solid wedge.
 - 7) Packing and Gasket: Asbestos free.
 4. Class 250, OS&Y, Iron Gate Valves:
 - a. Description:
 - 1) Standard: MSS SP-70, Type I.
 - 2) CWP Rating: **500 psig (3450 kPa)**.
 - 3) Body Material: ASTM A 126, gray iron with bolted bonnet.
 - 4) Ends: Flanged.
 - 5) Trim: Bronze.
 - 6) Disc: Solid wedge.
 - 7) Packing and Gasket: Asbestos free.
- Q. Bronze Globe Valves
1. Class 125, Bronze Globe Valves with Bronze Disc:
 - a. Description:
 - 1) Standard: MSS SP-80, Type 1.
 - 2) CWP Rating: **200 psig (1380 kPa)**.
 - 3) Body Material: ASTM B 62, bronze with integral seat and screw-in bonnet.
 - 4) Ends: Threaded or solder joint, **as directed**.
 - 5) Stem and Disc: Bronze.
 - 6) Packing: Asbestos free.
 - 7) Handwheel: Malleable iron, bronze, or aluminum, **as directed**.
 2. Class 125, Bronze Globe Valves with Nonmetallic Disc:
 - a. Description:
 - 1) Standard: MSS SP-80, Type 2.
 - 2) CWP Rating: **200 psig (1380 kPa)**.
 - 3) Body Material: ASTM B 62, bronze with integral seat and screw-in bonnet.
 - 4) Ends: Threaded or solder joint, **as directed**.
 - 5) Stem: Bronze.
 - 6) Disc: PTFE or TFE.
 - 7) Packing: Asbestos free.
 - 8) Handwheel: Malleable iron, bronze, or aluminum, **as directed**.
 3. Class 150, Bronze Globe Valves with Nonmetallic Disc:
 - a. Description:
 - 1) Standard: MSS SP-80, Type 2.
 - 2) CWP Rating: **300 psig (2070 kPa)**.
 - 3) Body Material: ASTM B 62, bronze with integral seat and union-ring bonnet.
 - 4) Ends: Threaded.
 - 5) Stem: Bronze.
 - 6) Disc: PTFE or TFE.
 - 7) Packing: Asbestos free.
 - 8) Handwheel: Malleable iron, bronze, or aluminum, **as directed**.

R. Iron Globe Valves

1. Class 125, Iron Globe Valves:
 - a. Description:
 - 1) Standard: MSS SP-85, Type I.
 - 2) CWP Rating: 200 psig (1380 kPa).
 - 3) Body Material: ASTM A 126, gray iron with bolted bonnet.
 - 4) Ends: Flanged.
 - 5) Trim: Bronze.
 - 6) Packing and Gasket: Asbestos free.
2. Class 250, Iron Globe Valves:
 - a. Description:
 - 1) Standard: MSS SP-85, Type I.
 - 2) CWP Rating: 500 psig (3450 kPa).
 - 3) Body Material: ASTM A 126, gray iron with bolted bonnet.
 - 4) Ends: Flanged.
 - 5) Trim: Bronze.
 - 6) Packing and Gasket: Asbestos free.

S. Lubricated Plug Valves

1. Class 125, Regular-Gland, Lubricated Plug Valves with Threaded Ends:
 - a. Description:
 - 1) Standard: MSS SP-78, Type II.
 - 2) CWP Rating: 200 psig (1380 kPa).
 - 3) Body Material: ASTM A 48/A 48M or ASTM A 126, cast iron with lubrication-sealing system.
 - 4) Pattern: Regular or short **OR** Venturi, **as directed**.
 - 5) Plug: Cast iron or bronze with sealant groove.
2. Class 125, Regular-Gland, Lubricated Plug Valves with Flanged Ends:
 - a. Description:
 - 1) Standard: MSS SP-78, Type II.
 - 2) CWP Rating: 200 psig (1380 kPa).
 - 3) Body Material: ASTM A 48/A 48M or ASTM A 126, cast iron with lubrication-sealing system.
 - 4) Pattern: Regular or short **OR** Venturi, **as directed**.
 - 5) Plug: Cast iron or bronze with sealant groove.
3. Class 125, Cylindrical, Lubricated Plug Valves with Threaded Ends:
 - a. Description:
 - 1) Standard: MSS SP-78, Type IV.
 - 2) CWP Rating: 200 psig (1380 kPa).
 - 3) Body Material: ASTM A 48/A 48M or ASTM A 126, cast iron with lubrication-sealing system.
 - 4) Pattern: Regular or short **OR** Venturi, **as directed**.
 - 5) Plug: Cast iron or bronze with sealant groove.
4. Class 125, Cylindrical, Lubricated Plug Valves with Flanged Ends:
 - a. Description:
 - 1) Standard: MSS SP-78, Type IV.
 - 2) CWP Rating: 200 psig (1380 kPa).
 - 3) Body Material: ASTM A 48/A 48M or ASTM A 126, cast iron with lubrication-sealing system.
 - 4) Pattern: Regular or short **OR** Venturi, **as directed**.
 - 5) Plug: Cast iron or bronze with sealant groove.
5. Class 250, Regular-Gland, Lubricated Plug Valves with Threaded Ends:
 - a. Description:
 - 1) Standard: MSS SP-78, Type II.
 - 2) CWP Rating: 400 psig (2760 kPa).

- 3) Body Material: ASTM A 48/A 48M or ASTM A 126, cast iron with lubrication-sealing system.
- 4) Pattern: Regular or short **OR** Venturi, **as directed**.
- 5) Plug: Cast iron or bronze with sealant groove.
6. Class 250, Regular-Gland, Lubricated Plug Valves with Flanged Ends:
 - a. Description:
 - 1) Standard: MSS SP-78, Type II.
 - 2) CWP Rating: **400 psig (2760 kPa)**.
 - 3) Body Material: ASTM A 48/A 48M or ASTM A 126, cast iron with lubrication-sealing system.
 - 4) Pattern: Regular or short **OR** Venturi, **as directed**.
 - 5) Plug: Cast iron or bronze with sealant groove.
7. Class 250, Cylindrical, Lubricated Plug Valves with Threaded Ends:
 - a. Description:
 - 1) Standard: MSS SP-78, Type IV.
 - 2) CWP Rating: **400 psig (2760 kPa)**.
 - 3) Body Material: ASTM A 48/A 48M or ASTM A 126, cast iron with lubrication-sealing system.
 - 4) Pattern: Regular or short **OR** Venturi, **as directed**.
 - 5) Plug: Cast iron or bronze with sealant groove.
8. Class 250, Cylindrical, Lubricated Plug Valves with Flanged Ends:
 - a. Description:
 - 1) Standard: MSS SP-78, Type IV.
 - 2) CWP Rating: **400 psig (2760 kPa)**.
 - 3) Body Material: ASTM A 48/A 48M or ASTM A 126, Grade 40 cast iron with lubrication-sealing system.
 - 4) Pattern: Regular or short **OR** Venturi, **as directed**.
 - 5) Plug: Cast iron or bronze with sealant groove.

T. Chainwheels

1. Description: Valve actuation assembly with sprocket rim, brackets, and chain.
 - a. Brackets: Type, number, size, and fasteners required to mount actuator on valve.
 - b. Attachment: For connection to ball **OR** butterfly **OR** plug, **as directed**, valve stems.
 - c. Sprocket Rim with Chain Guides: Ductile iron **OR** Cast iron **OR** Aluminum **OR** Bronze, **as directed**, of type and size required for valve. Include zinc coating, **as directed**.
 - d. Chain: Hot-dip, galvanized steel **OR** Brass **OR** Stainless steel, **as directed**, of size required to fit sprocket rim.

1.3 EXECUTION

A. Valve Installation

1. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.
2. Locate valves for easy access and provide separate support where necessary.
3. Install valves in horizontal piping with stem at or above center of pipe.
4. Install valves in position to allow full stem movement.
5. Install chainwheels on operators for ball **OR** butterfly **OR** gate **OR** globe **OR** plug, **as directed**, valves **NPS 4 (DN 100)** and larger and more than **96 inches (2400 mm)** above floor. Extend chains to **60 inches (1520 mm)** above finished floor.
6. Install check valves for proper direction of flow and as follows:
 - a. Swing Check Valves: In horizontal position with hinge pin level.
 - b. Center-Guided and Plate-Type Check Valves: In horizontal or vertical position, between flanges.
 - c. Lift Check Valves: With stem upright and plumb.



- B. Adjusting
1. Adjust or replace valve packing after piping systems have been tested and put into service but before final adjusting and balancing. Replace valves if persistent leaking occurs.
- C. General Requirements For Valve Applications
1. If valve applications are not indicated, use the following:
 - a. Shutoff Service: Ball **OR** butterfly **OR** gate **OR** plug, **as directed**, valves.
 - b. Butterfly Valve Dead-End Service: Single-flange (lug) type.
 - c. Throttling Service: Globe **OR** angle **OR** ball **OR** butterfly, **as directed**, valves.
 - d. Pump-Discharge Check Valves:
 - 1) **NPS 2 (DN 50)** and Smaller: Bronze swing check valves with bronze **OR** nonmetallic, **as directed**, disc.
 - 2) **NPS 2-1/2 (DN 65)** and Larger for Domestic Water: Iron swing check valves with lever and weight or with spring or iron, center-guided, metal **OR** resilient, **as directed**, -seat check valves.
 - 3) **NPS 2-1/2 (DN 65)** and Larger for Sanitary Waste and Storm Drainage: Iron swing check valves with lever and weight or spring.
 2. If valves with specified SWP classes or CWP ratings are not available, the same types of valves with higher SWP classes or CWP ratings may be substituted.
 3. Select valves, except wafer types, with the following end connections:
 - a. For Copper Tubing, **NPS 2 (DN 50)** and Smaller: Threaded ends except where solder-joint valve-end option is indicated in valve schedules below.
 - b. For Copper Tubing, **NPS 2-1/2 to NPS 4 (DN 65 to DN 100)**: Flanged ends except where threaded valve-end option is indicated in valve schedules below.
 - c. For Copper Tubing, **NPS 5 (DN 125)** and Larger: Flanged ends.
 - d. For Steel Piping, **NPS 2 (DN 50)** and Smaller: Threaded ends.
 - e. For Steel Piping, **NPS 2-1/2 to NPS 4 (DN 65 to DN 100)**: Flanged ends except where threaded valve-end option is indicated in valve schedules below.
 - f. For Steel Piping, **NPS 5 (DN 125)** and Larger: Flanged ends.
 - g. For Grooved-End Copper Tubing and Steel Piping: Valve ends may be grooved.
- D. Low-Pressure, Compressed-Air Valve Schedule (**150 psig (1035 kPa)** Or Less)
1. Pipe **NPS 2 (DN 50)** and Smaller:
 - a. Bronze and Brass Valves: May be provided with solder-joint ends instead of threaded ends.
 - b. Ball Valves: One **OR** Two **OR** Three, **as directed**, piece, full **OR** regular **OR** reduced, **as directed**, port, brass **OR** bronze, **as directed**, with brass **OR** bronze **OR** stainless-steel, **as directed**, trim.
 - c. Bronze Lift Check Valves: Class 125, bronze **OR** nonmetallic, **as directed**, disc.
 - d. Bronze Swing Check Valves: Class 125 **OR** Class 150, **as directed**, bronze **OR** nonmetallic, **as directed**, disc.
 - e. Bronze Gate Valves: Class 125 **OR** Class 150, **as directed**, NRS **OR** RS, **as directed**.
 2. Pipe **NPS 2-1/2 (DN 65)** and Larger:
 - a. Iron Valves, **NPS 2-1/2 to NPS 4 (DN 65 to DN 100)**: May be provided with threaded ends instead of flanged ends.
 - b. Iron, Single-Flange Butterfly Valves: 200 CWP, NBR seat, aluminum-bronze **OR** ductile-iron **OR** stainless-steel, **as directed**, disc.
 - c. Iron, Grooved-End Butterfly Valves: 175 **OR** 300, **as directed**, CWP.
 - d. Iron Swing Check Valves: Class 125 **OR** Class 250, **as directed**, metal **OR** nonmetallic-to-metal, **as directed**, seats.
 - e. Iron, Grooved-End Swing Check Valves: 300 CWP.
 - f. Iron, Center-Guided Check Valves: Class 125 **OR** Class 150 **OR** Class 250 **OR** Class 300, **as directed**, compact-wafer **OR** globe, **as directed**, metal **OR** resilient, **as directed**, seat.
 - g. Iron, Plate-Type Check Valves: Class 125 **OR** Class 150 **OR** Class 250 **OR** Class 300, **as directed**; single **OR** dual, **as directed**, plate; metal **OR** resilient, **as directed**, seat.

- h. Iron Gate Valves: Class 125 **OR** Class 250, **as directed**, NRS **OR** OS&Y, **as directed**.
- E. High-Pressure, Compressed-Air Valve Schedule (150 to 200 psig (1035 to 1380 kPa))
1. Pipe NPS 2 (DN 50) and Smaller:
 - a. Bronze and Brass Valves: May be provided with solder-joint ends instead of threaded ends.
 - b. Ball Valves: One **OR** Two **OR** Three, **as directed**, piece, full **OR** regular **OR** reduced, **as directed**, port, brass **OR** bronze, **as directed**, with brass **OR** bronze **OR** stainless-steel, **as directed**, trim.
 - c. Bronze Lift Check Valves: Class 125, bronze **OR** nonmetallic, **as directed**, disc.
 - d. Bronze Swing Check Valves: Class 125 **OR** Class 150, **as directed**, bronze **OR** nonmetallic, **as directed**, disc.
 - e. Bronze Gate Valves: Class 125 **OR** Class 150, **as directed**, NRS **OR** RS, **as directed**.
 2. Pipe NPS 2-1/2 (DN 65) and Larger:
 - a. Iron Valves, NPS 2-1/2 to NPS 4 (DN 65 to DN 100): May be provided with threaded ends instead of flanged ends.
 - b. Iron, Single-Flange Butterfly Valves: 200 CWP, NBR seat, aluminum-bronze **OR** ductile-iron **OR** stainless-steel, **as directed**, disc.
 - c. Iron, Grooved-End Butterfly Valves: 175 **OR** 300, **as directed**, CWP.
 - d. Iron Swing Check Valves: Class 125 **OR** Class 250, **as directed**, metal **OR** nonmetallic-to-metal, **as directed**, seats.
 - e. Iron, Grooved-End Swing Check Valves: 300 CWP.
 - f. Iron, Center-Guided Check Valves: Class 125 **OR** Class 150 **OR** Class 250 **OR** Class 300, **as directed**, compact-wafer **OR** globe, **as directed**, metal **OR** resilient, **as directed**, seat.
 - g. Iron, Plate-Type Check Valves: Class 125 **OR** Class 150 **OR** Class 250 **OR** Class 300, **as directed**; single **OR** dual, **as directed**, plate; metal **OR** resilient, **as directed**, seat.
 - h. Iron Gate Valves: Class 125 **OR** Class 250, **as directed**, NRS **OR** OS&Y, **as directed**.
- F. Domestic, Hot- And Cold-Water Valve Schedule
1. Pipe NPS 2 (DN 50) and Smaller:
 - a. Bronze and Brass Valves: May be provided with solder-joint ends instead of threaded ends.
 - b. Bronze Angle Valves: Class 125 **OR** Class 150, **as directed**, bronze **OR** nonmetallic, **as directed**, disc.
 - c. Ball Valves: One **OR** Two **OR** Three, **as directed**, piece, full **OR** regular **OR** reduced, **as directed**, port, brass **OR** bronze, **as directed**, with brass **OR** bronze **OR** stainless-steel, **as directed**, trim.
 - d. Bronze Swing Check Valves: Class 125 **OR** Class 150, **as directed**, bronze **OR** nonmetallic, **as directed**, disc.
 - e. Bronze Gate Valves: Class 125 **OR** Class 150, **as directed**, NRS **OR** RS, **as directed**.
 - f. Bronze Globe Valves: Class 125 **OR** Class 150, **as directed**, bronze **OR** nonmetallic, **as directed**, disc.
 2. Pipe NPS 2-1/2 (DN 65) and Larger:
 - a. Iron Valves, NPS 2-1/2 to NPS 4 (DN 65 to DN 100): May be provided with threaded ends instead of flanged ends.
 - b. Iron Ball Valves: Class 150.
 - c. Iron, Single-Flange Butterfly Valves: 200 CWP, EPDM **OR** NBR, **as directed**, seat, aluminum-bronze **OR** ductile-iron **OR** stainless-steel, **as directed**, disc.
 - d. Iron, Grooved-End Butterfly Valves: 175 **OR** 300, **as directed**, CWP.
 - e. Iron Swing Check Valves: Class 125 **OR** Class 250, **as directed**, metal **OR** nonmetallic-to-metal, **as directed**, seats.
 - f. Iron Swing Check Valves with Closure Control: Class 125, lever and spring **OR** weight, **as directed**.
 - g. Iron, Grooved-End Swing Check Valves: 300 CWP.
 - h. Iron, Center-Guided Check Valves: Class 125 **OR** Class 150 **OR** Class 250 **OR** Class 300, **as directed**, compact-wafer **OR** globe, **as directed**, metal **OR** resilient, **as directed**, seat.



- i. Iron, Plate-Type Check Valves: Class 125 **OR** Class 150 **OR** Class 250 **OR** Class 300, **as directed**; single **OR** dual, **as directed**, plate; metal **OR** resilient, **as directed**, seat.
- j. Iron Gate Valves: Class 125 **OR** Class 250, **as directed**, NRS **OR** OS&Y, **as directed**.
- k. Iron Globe Valves: Class 125 **OR** Class 250, **as directed**.

G. Sanitary-Waste And Storm-Drainage Valve Schedule

- 1. Pipe **NPS 2 (DN 50)** and Smaller:
 - a. Bronze and Brass Valves: May be provided with solder-joint ends instead of threaded ends.
 - b. Bronze Angle Valves: Class 125 **OR** Class 150, **as directed**, bronze **OR** nonmetallic **OR** stainless-steel, **as directed**, disc.
 - c. Ball Valves: One **OR** Two **OR** Three, **as directed**, piece, full **OR** regular **OR** reduced, **as directed**, port, brass **OR** bronze, **as directed**, with brass **OR** bronze **OR** stainless-steel, **as directed**, trim.
 - d. Bronze Swing Check Valves: Class 125 **OR** Class 150, **as directed**, bronze **OR** nonmetallic, **as directed**, disc.
 - e. Bronze Gate Valves: Class 125 **OR** Class 150, **as directed**, NRS **OR** RS, **as directed**.
 - f. Bronze Globe Valves: Class 125 **OR** Class 150, **as directed**, bronze **OR** nonmetallic, **as directed**, disc.
- 2. Pipe **NPS 2-1/2 (DN 65)** and Larger:
 - a. Iron Valves, **NPS 2-1/2 to NPS 4 (DN 65 to DN 100)**: May be provided with threaded ends instead of flanged ends.
 - b. Iron Ball Valves: Class 150.
 - c. Iron Swing Check Valves: Class 125 **OR** Class 250, **as directed**, metal **OR** nonmetallic-to-metal, **as directed**, seats.
 - d. Iron Swing Check Valves with Closure Control: Class 125, lever and spring **OR** weight, **as directed**.
 - e. Iron, Grooved-End Swing Check Valves: 300 CWP.
 - f. Iron Gate Valves: Class 125 **OR** Class 250, **as directed**, NRS **OR** OS&Y, **as directed**.
 - g. Iron Globe Valves: Class 125 **OR** Class 250, **as directed**.
 - h. Lubricated Plug Valves: Class 125 **OR** Class 250, **as directed**, regular gland **OR** cylindrical, **as directed**, threaded **OR** flanged, **as directed**.

END OF SECTION 21 05 23 00a

SECTION 21 05 23 00b - GENERAL-DUTY VALVES FOR HVAC PIPING

1.1 GENERAL

A. Description Of Work

1. This specification covers the furnishing and installation of general-duty valves for HVAC piping. Products shall be as follows or as directed by the Owner. Installation procedures shall be in accordance with the products manufacturer's recommendations. Demolition and removal of materials shall be as required to support the work.

B. Summary

1. Section Includes:
 - a. Bronze angle valves.
 - b. Brass ball valves.
 - c. Bronze ball valves.
 - d. Iron ball valves.
 - e. Iron, single-flange butterfly valves.
 - f. Iron, grooved-end butterfly valves.
 - g. High-performance butterfly valves.
 - h. Bronze lift check valves.
 - i. Bronze swing check valves.
 - j. Iron swing check valves.
 - k. Iron swing check valves with closure control.
 - l. Iron, grooved-end swing-check valves.
 - m. Iron, center-guided check valves.
 - n. Iron, plate-type check valves.
 - o. Bronze gate valves.
 - p. Iron gate valves.
 - q. Bronze globe valves.
 - r. Iron globe valves.
 - s. Lubricated plug valves.
 - t. Eccentric plug valves.
 - u. Chainwheels.

C. Definitions

1. CWP: Cold working pressure.
2. EPDM: Ethylene propylene copolymer rubber.
3. NBR: Acrylonitrile-butadiene, Buna-N, or nitrile rubber.
4. NRS: Nonrising stem.
5. OS&Y: Outside screw and yoke.
6. RS: Rising stem.
7. SWP: Steam working pressure.

D. Submittals

1. Product Data: For each type of valve indicated.

E. Quality Assurance

1. Source Limitations for Valves: Obtain each type of valve from single source from single manufacturer.
2. ASME Compliance:
 - a. ASME B16.10 and ASME B16.34 for ferrous valve dimensions and design criteria.
 - b. ASME B31.1 for power piping valves.
 - c. ASME B31.9 for building services piping valves.



F. Delivery, Storage, And Handling

1. Prepare valves for shipping as follows:
 - a. Protect internal parts against rust and corrosion.
 - b. Protect threads, flange faces, grooves, and weld ends.
 - c. Set angle, gate, and globe valves closed to prevent rattling.
 - d. Set ball and plug valves open to minimize exposure of functional surfaces.
 - e. Set butterfly valves closed or slightly open.
 - f. Block check valves in either closed or open position.
2. Use the following precautions during storage:
 - a. Maintain valve end protection.
 - b. Store valves indoors and maintain at higher than ambient dew point temperature. If outdoor storage is necessary, store valves off the ground in watertight enclosures.
3. Use sling to handle large valves; rig sling to avoid damage to exposed parts. Do not use handwheels or stems as lifting or rigging points.

1.2 PRODUCTS

A. General Requirements For Valves

1. Refer to HVAC valve schedule articles for applications of valves.
2. Valve Pressure and Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.
3. Valve Sizes: Same as upstream piping unless otherwise indicated.
4. Valve Actuator Types:
 - a. Gear Actuator: For quarter-turn valves **NPS 8 (DN 200)** and larger.
 - b. Handwheel: For valves other than quarter-turn types.
 - c. Handlever: For quarter-turn valves **NPS 6 (DN 150)** and smaller except plug valves, **as directed**.
 - d. Wrench: For plug valves with square heads. Furnish the Owner with 1 wrench for every 5 **OR 10, as directed**, plug valves, for each size square plug-valve head.
 - e. Chainwheel: Device for attachment to valve handwheel, stem, or other actuator; of size and with chain for mounting height, as indicated in the "Valve Installation" Article.
5. Valves in Insulated Piping: With **2-inch (50-mm)** stem extensions and the following features:
 - a. Gate Valves: With rising stem.
 - b. Ball Valves: With extended operating handle of non-thermal-conductive material, and protective sleeve that allows operation of valve without breaking the vapor seal or disturbing insulation.
 - c. Butterfly Valves: With extended neck.
6. Valve-End Connections:
 - a. Flanged: With flanges according to ASME B16.1 for iron valves.
 - b. Grooved: With grooves according to AWWA C606.
 - c. Solder Joint: With sockets according to ASME B16.18.
 - d. Threaded: With threads according to ASME B1.20.1.
7. Valve Bypass and Drain Connections: MSS SP-45.

B. Bronze Angle Valves

1. Class 125, Bronze Angle Valves with Bronze Disc:
 - a. Description:
 - 1) Standard: MSS SP-80, Type 1.
 - 2) CWP Rating: **200 psig (1380 kPa)**.
 - 3) Body Material: ASTM B 62, bronze with integral seat and screw-in bonnet.
 - 4) Ends: Threaded.
 - 5) Stem and Disc: Bronze.
 - 6) Packing: Asbestos free.
 - 7) Handwheel: Malleable iron, bronze, or aluminum, **as directed**.

2. Class 125, Bronze Angle Valves with Nonmetallic Disc:
 - a. Description:
 - 1) Standard: MSS SP-80, Type 2.
 - 2) CWP Rating: 200 psig (1380 kPa).
 - 3) Body Material: ASTM B 62, bronze with integral seat and screw-in bonnet.
 - 4) Ends: Threaded.
 - 5) Stem: Bronze.
 - 6) Disc: PTFE or TFE.
 - 7) Packing: Asbestos free.
 - 8) Handwheel: Malleable iron, bronze, or aluminum, **as directed**.
 3. Class 150, Bronze Angle Valves with Bronze Disc:
 - a. Description:
 - 1) Standard: MSS SP-80, Type 1.
 - 2) CWP Rating: 300 psig (2070 kPa).
 - 3) Body Material: ASTM B 62, bronze with integral seat and union-ring bonnet.
 - 4) Ends: Threaded.
 - 5) Stem and Disc: Bronze.
 - 6) Packing: Asbestos free.
 - 7) Handwheel: Malleable iron, bronze, or aluminum, **as directed**.
 4. Class 150, Bronze Angle Valves with Nonmetallic Disc:
 - a. Description:
 - 1) Standard: MSS SP-80, Type 2.
 - 2) CWP Rating: 300 psig (2070 kPa).
 - 3) Body Material: ASTM B 62, bronze with integral seat and union-ring bonnet.
 - 4) Ends: Threaded.
 - 5) Stem: Bronze.
 - 6) Disc: PTFE or TFE.
 - 7) Packing: Asbestos free.
 - 8) Handwheel: Malleable iron, bronze, or aluminum, **as directed**.
- C. Brass Ball Valves
1. One-Piece, Reduced-Port, Brass Ball Valves with Brass Trim:
 - a. Description:
 - 1) Standard: MSS SP-110.
 - 2) CWP Rating: 400 psig (2760 kPa).
 - 3) Body Design: One piece.
 - 4) Body Material: Forged brass.
 - 5) Ends: Threaded.
 - 6) Seats: PTFE or TFE.
 - 7) Stem: Brass.
 - 8) Ball: Chrome-plated brass.
 - 9) Port: Reduced.
 2. Two-Piece, Full-Port, Brass Ball Valves with Brass Trim:
 - a. Description:
 - 1) Standard: MSS SP-110.
 - 2) SWP Rating: 150 psig (1035 kPa).
 - 3) CWP Rating: 600 psig (4140 kPa).
 - 4) Body Design: Two piece.
 - 5) Body Material: Forged brass.
 - 6) Ends: Threaded.
 - 7) Seats: PTFE or TFE.
 - 8) Stem: Brass.
 - 9) Ball: Chrome-plated brass.
 - 10) Port: Full.
 3. Two-Piece, Full-Port, Brass Ball Valves with Stainless-Steel Trim:
 - a. Description:

- 1) Standard: MSS SP-110.
 - 2) SWP Rating: 150 psig (1035 kPa).
 - 3) CWP Rating: 600 psig (4140 kPa).
 - 4) Body Design: Two piece.
 - 5) Body Material: Forged brass.
 - 6) Ends: Threaded.
 - 7) Seats: PTFE or TFE.
 - 8) Stem: Stainless steel.
 - 9) Ball: Stainless steel, vented.
 - 10) Port: Full.
4. Two-Piece, Regular-Port, Brass Ball Valves with Brass Trim:
- a. Description:
 - 1) Standard: MSS SP-110.
 - 2) SWP Rating: 150 psig (1035 kPa).
 - 3) CWP Rating: 600 psig (4140 kPa).
 - 4) Body Design: Two piece.
 - 5) Body Material: Forged brass.
 - 6) Ends: Threaded.
 - 7) Seats: PTFE or TFE.
 - 8) Stem: Brass.
 - 9) Ball: Chrome-plated brass.
 - 10) Port: Regular.
5. Two-Piece, Regular-Port, Brass Ball Valves with Stainless-Steel Trim:
- a. Description:
 - 1) Standard: MSS SP-110.
 - 2) SWP Rating: 150 psig (1035 kPa).
 - 3) CWP Rating: 600 psig (4140 kPa).
 - 4) Body Design: Two piece.
 - 5) Body Material: Brass or bronze.
 - 6) Ends: Threaded.
 - 7) Seats: PTFE or TFE.
 - 8) Stem: Stainless steel.
 - 9) Ball: Stainless steel, vented.
 - 10) Port: Regular.
6. Three-Piece, Full-Port, Brass Ball Valves with Brass Trim:
- a. Description:
 - 1) Standard: MSS SP-110.
 - 2) SWP Rating: 150 psig (1035 kPa).
 - 3) CWP Rating: 600 psig (4140 kPa).
 - 4) Body Design: Three piece.
 - 5) Body Material: Forged brass.
 - 6) Ends: Threaded.
 - 7) Seats: PTFE or TFE.
 - 8) Stem: Brass.
 - 9) Ball: Chrome-plated brass.
 - 10) Port: Full.
7. Three-Piece, Full-Port, Brass Ball Valves with Stainless-Steel Trim:
- a. Description:
 - 1) Standard: MSS SP-110.
 - 2) SWP Rating: 150 psig (1035 kPa).
 - 3) CWP Rating: 600 psig (4140 kPa).
 - 4) Body Design: Three piece.
 - 5) Body Material: Forged brass.
 - 6) Ends: Threaded.
 - 7) Seats: PTFE or TFE.

- 8) Stem: Stainless steel.
- 9) Ball: Stainless steel, vented.
- 10) Port: Full.

D. Bronze Ball Valves

1. One-Piece, Reduced-Port, Bronze Ball Valves with Bronze Trim:
 - a. Description:
 - 1) Standard: MSS SP-110.
 - 2) CWP Rating: 400 psig (2760 kPa).
 - 3) Body Design: One piece.
 - 4) Body Material: Bronze.
 - 5) Ends: Threaded.
 - 6) Seats: PTFE or TFE.
 - 7) Stem: Bronze.
 - 8) Ball: Chrome-plated brass.
 - 9) Port: Reduced.
2. One-Piece, Reduced-Port, Bronze Ball Valves with Stainless-Steel Trim:
 - a. Description:
 - 1) Standard: MSS SP-110.
 - 2) CWP Rating: 600 psig (4140 kPa).
 - 3) Body Design: One piece.
 - 4) Body Material: Bronze.
 - 5) Ends: Threaded.
 - 6) Seats: PTFE or TFE.
 - 7) Stem: Stainless steel.
 - 8) Ball: Stainless steel, vented.
 - 9) Port: Reduced.
3. Two-Piece, Full-Port, Bronze Ball Valves with Bronze Trim:
 - a. Description:
 - 1) Standard: MSS SP-110.
 - 2) SWP Rating: 150 psig (1035 kPa).
 - 3) CWP Rating: 600 psig (4140 kPa).
 - 4) Body Design: Two piece.
 - 5) Body Material: Bronze.
 - 6) Ends: Threaded.
 - 7) Seats: PTFE or TFE.
 - 8) Stem: Bronze.
 - 9) Ball: Chrome-plated brass.
 - 10) Port: Full.
4. Two-Piece, Full-Port, Bronze Ball Valves with Stainless-Steel Trim:
 - a. Description:
 - 1) Standard: MSS SP-110.
 - 2) SWP Rating: 150 psig (1035 kPa).
 - 3) CWP Rating: 600 psig (4140 kPa).
 - 4) Body Design: Two piece.
 - 5) Body Material: Bronze.
 - 6) Ends: Threaded.
 - 7) Seats: PTFE or TFE.
 - 8) Stem: Stainless steel.
 - 9) Ball: Stainless steel, vented.
 - 10) Port: Full.
5. Two-Piece, Regular-Port, Bronze Ball Valves with Bronze Trim:
 - a. Description:
 - 1) Standard: MSS SP-110.
 - 2) SWP Rating: 150 psig (1035 kPa).
 - 3) CWP Rating: 600 psig (4140 kPa).

- 4) Body Design: Two piece.
 - 5) Body Material: Bronze.
 - 6) Ends: Threaded.
 - 7) Seats: PTFE or TFE.
 - 8) Stem: Bronze.
 - 9) Ball: Chrome-plated brass.
 - 10) Port: Regular.
6. Two-Piece, Regular-Port, Bronze Ball Valves with Stainless-Steel Trim:
- a. Description:
 - 1) Standard: MSS SP-110.
 - 2) SWP Rating: 150 psig (1035 kPa).
 - 3) CWP Rating: 600 psig (4140 kPa).
 - 4) Body Design: Two piece.
 - 5) Body Material: Bronze.
 - 6) Ends: Threaded.
 - 7) Seats: PTFE or TFE.
 - 8) Stem: Stainless steel.
 - 9) Ball: Stainless steel, vented.
 - 10) Port: Regular.
7. Three-Piece, Full-Port, Bronze Ball Valves with Bronze Trim:
- a. Description:
 - 1) Standard: MSS SP-110.
 - 2) SWP Rating: 150 psig (1035 kPa).
 - 3) CWP Rating: 600 psig (4140 kPa).
 - 4) Body Design: Three piece.
 - 5) Body Material: Bronze.
 - 6) Ends: Threaded.
 - 7) Seats: PTFE or TFE.
 - 8) Stem: Bronze.
 - 9) Ball: Chrome-plated brass.
 - 10) Port: Full.
8. Three-Piece, Full-Port, Bronze Ball Valves with Stainless-Steel Trim:
- a. Description:
 - 1) Standard: MSS SP-110.
 - 2) SWP Rating: 150 psig (1035 kPa).
 - 3) CWP Rating: 600 psig (4140 kPa).
 - 4) Body Design: Three piece.
 - 5) Body Material: Bronze.
 - 6) Ends: Threaded.
 - 7) Seats: PTFE or TFE.
 - 8) Stem: Stainless steel.
 - 9) Ball: Stainless steel, vented.
 - 10) Port: Full.
- E. Iron Ball Valves
1. Class 125, Iron Ball Valves:
 - a. Description:
 - 1) Standard: MSS SP-72.
 - 2) CWP Rating: 200 psig (1380 kPa).
 - 3) Body Design: Split body.
 - 4) Body Material: ASTM A 126, gray iron.
 - 5) Ends: Flanged.
 - 6) Seats: PTFE or TFE.
 - 7) Stem: Stainless steel.
 - 8) Ball: Stainless steel.

9) Port: Full.

F. Iron, Single-Flange Butterfly Valves

1. 150 CWP, Iron, Single-Flange Butterfly Valves with EPDM Seat and Aluminum-Bronze Disc:
 - a. Description:
 - 1) Standard: MSS SP-67, Type I.
 - 2) CWP Rating: 150 psig (1035 kPa).
 - 3) Body Design: Lug type; suitable for bidirectional dead-end service at rated pressure without use of downstream flange.
 - 4) Body Material: ASTM A 126, cast iron or ASTM A 536, ductile iron.
 - 5) Seat: EPDM.
 - 6) Stem: One- or two-piece stainless steel.
 - 7) Disc: Aluminum bronze.
2. 150 CWP, Iron, Single-Flange Butterfly Valves with NBR Seat and Aluminum-Bronze Disc:
 - a. Description:
 - 1) Standard: MSS SP-67, Type I.
 - 2) CWP Rating: 150 psig (1035 kPa).
 - 3) Body Design: Lug type; suitable for bidirectional dead-end service at rated pressure without use of downstream flange.
 - 4) Body Material: ASTM A 126, cast iron or ASTM A 536, ductile iron.
 - 5) Seat: NBR.
 - 6) Stem: One- or two-piece stainless steel.
 - 7) Disc: Aluminum bronze.
3. 150 CWP, Iron, Single-Flange Butterfly Valves with EPDM Seat and Ductile-Iron Disc:
 - a. Description:
 - 1) Standard: MSS SP-67, Type I.
 - 2) CWP Rating: 150 psig (1035 kPa).
 - 3) Body Design: Lug type; suitable for bidirectional dead-end service at rated pressure without use of downstream flange.
 - 4) Body Material: ASTM A 126, cast iron or ASTM A 536, ductile iron.
 - 5) Seat: EPDM.
 - 6) Stem: One- or two-piece stainless steel.
 - 7) Disc: Nickel-plated or -coated, **as directed**, ductile iron.
4. 150 CWP, Iron, Single-Flange Butterfly Valves with NBR Seat and Ductile-Iron Disc:
 - a. Description:
 - 1) Standard: MSS SP-67, Type I.
 - 2) CWP Rating: 150 psig (1035 kPa).
 - 3) Body Design: Lug type; suitable for bidirectional dead-end service at rated pressure without use of downstream flange.
 - 4) Body Material: ASTM A 126, cast iron or ASTM A 536, ductile iron.
 - 5) Seat: NBR.
 - 6) Stem: One- or two-piece stainless steel.
 - 7) Disc: Nickel-plated or -coated, **as directed**, ductile iron.
5. 150 CWP, Iron, Single-Flange Butterfly Valves with EPDM Seat and Stainless-Steel Disc:
 - a. Description:
 - 1) Standard: MSS SP-67, Type I.
 - 2) CWP Rating: 150 psig (1035 kPa).
 - 3) Body Design: Lug type; suitable for bidirectional dead-end service at rated pressure without use of downstream flange.
 - 4) Body Material: ASTM A 126, cast iron or ASTM A 536, ductile iron.
 - 5) Seat: EPDM.
 - 6) Stem: One- or two-piece stainless steel.
 - 7) Disc: Stainless steel.
6. 150 CWP, Iron, Single-Flange Butterfly Valves with NBR Seat and Stainless-Steel Disc:
 - a. Description:
 - 1) Standard: MSS SP-67, Type I.

- 2) CWP Rating: **150 psig (1035 kPa)**.
 - 3) Body Design: Lug type; suitable for bidirectional dead-end service at rated pressure without use of downstream flange.
 - 4) Body Material: ASTM A 126, cast iron or ASTM A 536, ductile iron.
 - 5) Seat: NBR.
 - 6) Stem: One- or two-piece stainless steel.
 - 7) Disc: Stainless steel.
7. 200 CWP, Iron, Single-Flange Butterfly Valves with EPDM Seat and Aluminum-Bronze Disc:
- a. Description:
 - 1) Standard: MSS SP-67, Type I.
 - 2) CWP Rating: **200 psig (1380 kPa)**.
 - 3) Body Design: Lug type; suitable for bidirectional dead-end service at rated pressure without use of downstream flange.
 - 4) Body Material: ASTM A 126, cast iron or ASTM A 536, ductile iron.
 - 5) Seat: EPDM.
 - 6) Stem: One- or two-piece stainless steel.
 - 7) Disc: Aluminum bronze.
8. 200 CWP, Iron, Single-Flange Butterfly Valves with NBR Seat and Aluminum-Bronze Disc:
- a. Description:
 - 1) Standard: MSS SP-67, Type I.
 - 2) CWP Rating: **200 psig (1380 kPa)**.
 - 3) Body Design: Lug type; suitable for bidirectional dead-end service at rated pressure without use of downstream flange.
 - 4) Body Material: ASTM A 126, cast iron or ASTM A 536, ductile iron.
 - 5) Seat: NBR.
 - 6) Stem: One- or two-piece stainless steel.
 - 7) Disc: Aluminum bronze.
9. 200 CWP, Iron, Single-Flange Butterfly Valves with EPDM Seat and Ductile-Iron Disc:
- a. Description:
 - 1) Standard: MSS SP-67, Type I.
 - 2) CWP Rating: **200 psig (1380 kPa)**.
 - 3) Body Design: Lug type; suitable for bidirectional dead-end service at rated pressure without use of downstream flange.
 - 4) Body Material: ASTM A 126, cast iron or ASTM A 536, ductile iron.
 - 5) Seat: EPDM.
 - 6) Stem: One- or two-piece stainless steel.
 - 7) Disc: Nickel-plated or -coated, **as directed**, ductile iron.
10. 200 CWP, Iron, Single-Flange Butterfly Valves with NBR Seat and Ductile-Iron Disc:
- a. Description:
 - 1) Standard: MSS SP-67, Type I.
 - 2) CWP Rating: **200 psig (1380 kPa)**.
 - 3) Body Design: Lug type; suitable for bidirectional dead-end service at rated pressure without use of downstream flange.
 - 4) Body Material: ASTM A 126, cast iron or ASTM A 536, ductile iron.
 - 5) Seat: NBR.
 - 6) Stem: One- or two-piece stainless steel.
 - 7) Disc: Nickel-plated or -coated, **as directed**, ductile iron.
11. 200 CWP, Iron, Single-Flange Butterfly Valves with EPDM Seat and Stainless-Steel Disc:
- a. Description:
 - 1) Standard: MSS SP-67, Type I.
 - 2) CWP Rating: **200 psig (1380 kPa)**.
 - 3) Body Design: Lug type; suitable for bidirectional dead-end service at rated pressure without use of downstream flange.
 - 4) Body Material: ASTM A 126, cast iron or ASTM A 536, ductile iron.
 - 5) Seat: EPDM.

- 6) Stem: One- or two-piece stainless steel.
- 7) Disc: Stainless steel.
12. 200 CWP, Iron, Single-Flange Butterfly Valves with NBR Seat and Stainless-Steel Disc:
 - a. Description:
 - 1) Standard: MSS SP-67, Type I.
 - 2) CWP Rating: 200 psig (1380 kPa).
 - 3) Body Design: Lug type; suitable for bidirectional dead-end service at rated pressure without use of downstream flange.
 - 4) Body Material: ASTM A 126, cast iron or ASTM A 536, ductile iron.
 - 5) Seat: NBR.
 - 6) Stem: One- or two-piece stainless steel.
 - 7) Disc: Stainless steel.
- G. Iron, Grooved-End Butterfly Valves
 1. 175 CWP, Iron, Grooved-End Butterfly Valves:
 - a. Description:
 - 1) Standard: MSS SP-67, Type I.
 - 2) CWP Rating: 175 psig (1200 kPa).
 - 3) Body Material: Coated, ductile iron.
 - 4) Stem: Two-piece stainless steel.
 - 5) Disc: Coated, ductile iron.
 - 6) Seal: EPDM.
 2. 300 CWP, Iron, Grooved-End Butterfly Valves:
 - a. Description:
 - 1) Standard: MSS SP-67, Type I.
 - 2) NPS 8 (DN 50) and Smaller CWP Rating: 300 psig (2070 kPa).
 - 3) NPS 10 (DN 250) and Larger CWP Rating: 200 psig (1380 kPa).
 - 4) Body Material: Coated, ductile iron.
 - 5) Stem: Two-piece stainless steel.
 - 6) Disc: Coated, ductile iron.
 - 7) Seal: EPDM.
- H. High-Performance Butterfly Valves
 1. Class 150, Single-Flange, High-Performance Butterfly Valves:
 - a. Description:
 - 1) Standard: MSS SP-68.
 - 2) CWP Rating: 285 psig (1965 kPa) at 100 deg F (38 deg C).
 - 3) Body Design: Lug type; suitable for bidirectional dead-end service at rated pressure without use of downstream flange.
 - 4) Body Material: Carbon steel, cast iron, ductile iron, or stainless steel.
 - 5) Seat: Reinforced PTFE or metal.
 - 6) Stem: Stainless steel; offset from seat plane.
 - 7) Disc: Carbon steel.
 - 8) Service: Bidirectional.
 2. Class 300, Single-Flange, High-Performance Butterfly Valves:
 - a. Description:
 - 1) Standard: MSS SP-68.
 - 2) CWP Rating: 720 psig (4965 kPa) at 100 deg F (38 deg C).
 - 3) Body Design: Lug type; suitable for bidirectional dead-end service at rated pressure without use of downstream flange.
 - 4) Body Material: Carbon steel, cast iron, or ductile iron.
 - 5) Seat: Reinforced PTFE or metal.
 - 6) Stem: Stainless steel; offset from seat plane.
 - 7) Disc: Carbon steel.
 - 8) Service: Bidirectional.

I. Bronze Lift Check Valves

1. Class 125, Lift Check Valves with Bronze Disc:
 - a. Description:
 - 1) Standard: MSS SP-80, Type 1.
 - 2) CWP Rating: 200 psig (1380 kPa).
 - 3) Body Design: Vertical flow.
 - 4) Body Material: ASTM B 61 or ASTM B 62, bronze.
 - 5) Ends: Threaded.
 - 6) Disc: Bronze.
2. Class 125, Lift Check Valves with Nonmetallic Disc:
 - a. Description:
 - 1) Standard: MSS SP-80, Type 2.
 - 2) CWP Rating: 200 psig (1380 kPa).
 - 3) Body Design: Vertical flow.
 - 4) Body Material: ASTM B 61 or ASTM B 62, bronze.
 - 5) Ends: Threaded.
 - 6) Disc: NBR, PTFE, or TFE.

J. Bronze Swing Check Valves

1. Class 125, Bronze Swing Check Valves with Bronze Disc:
 - a. Description:
 - 1) Standard: MSS SP-80, Type 3.
 - 2) CWP Rating: 200 psig (1380 kPa).
 - 3) Body Design: Horizontal flow.
 - 4) Body Material: ASTM B 62, bronze.
 - 5) Ends: Threaded.
 - 6) Disc: Bronze.
2. Class 125, Bronze Swing Check Valves with Nonmetallic Disc:
 - a. Description:
 - 1) Standard: MSS SP-80, Type 4.
 - 2) CWP Rating: 200 psig (1380 kPa).
 - 3) Body Design: Horizontal flow.
 - 4) Body Material: ASTM B 62, bronze.
 - 5) Ends: Threaded.
 - 6) Disc: PTFE or TFE.
3. Class 150, Bronze Swing Check Valves with Bronze Disc:
 - a. Description:
 - 1) Standard: MSS SP-80, Type 3.
 - 2) CWP Rating: 300 psig (2070 kPa).
 - 3) Body Design: Horizontal flow.
 - 4) Body Material: ASTM B 62, bronze.
 - 5) Ends: Threaded.
 - 6) Disc: Bronze.
4. Class 150, Bronze Swing Check Valves with Nonmetallic Disc:
 - a. Description:
 - 1) Standard: MSS SP-80, Type 4.
 - 2) CWP Rating: 300 psig (2070 kPa).
 - 3) Body Design: Horizontal flow.
 - 4) Body Material: ASTM B 62, bronze.
 - 5) Ends: Threaded.
 - 6) Disc: PTFE or TFE.

K. Iron Swing Check Valves

1. Class 125, Iron Swing Check Valves with Metal Seats:
 - a. Description:

- 1) Standard: MSS SP-71, Type I.
- 2) NPS 2-1/2 to NPS 12 (DN 65 to DN 300), CWP Rating: 200 psig (1380 kPa).
- 3) NPS 14 to NPS 24 (DN 350 to DN 600), CWP Rating: 150 psig (1035 kPa).
- 4) Body Design: Clear or full waterway.
- 5) Body Material: ASTM A 126, gray iron with bolted bonnet.
- 6) Ends: Flanged.
- 7) Trim: Bronze.
- 8) Gasket: Asbestos free.
2. Class 125, Iron Swing Check Valves with Nonmetallic-to-Metal Seats:
 - a. Description:
 - 1) Standard: MSS SP-71, Type I.
 - 2) NPS 2-1/2 to NPS 12 (DN 65 to DN 300), CWP Rating: 200 psig (1380 kPa).
 - 3) NPS 14 to NPS 24 (DN 350 to DN 600), CWP Rating: 150 psig (1035 kPa).
 - 4) Body Design: Clear or full waterway.
 - 5) Body Material: ASTM A 126, gray iron with bolted bonnet.
 - 6) Ends: Flanged.
 - 7) Trim: Composition.
 - 8) Seat Ring: Bronze.
 - 9) Disc Holder: Bronze.
 - 10) Disc: PTFE or TFE.
 - 11) Gasket: Asbestos free.
3. Class 250, Iron Swing Check Valves with Metal Seats:
 - a. Description:
 - 1) Standard: MSS SP-71, Type I.
 - 2) NPS 2-1/2 to NPS 12 (DN 65 to DN 300), CWP Rating: 500 psig (3450 kPa).
 - 3) NPS 14 to NPS 24 (DN 350 to DN 600), CWP Rating: 300 psig (2070 kPa).
 - 4) Body Design: Clear or full waterway.
 - 5) Body Material: ASTM A 126, gray iron with bolted bonnet.
 - 6) Ends: Flanged.
 - 7) Trim: Bronze.
 - 8) Gasket: Asbestos free.
- L. Iron Swing Check Valves With Closure Control
 1. Class 125, Iron Swing Check Valves with Lever- and Spring-Closure Control:
 - a. Description:
 - 1) Standard: MSS SP-71, Type I.
 - 2) NPS 2-1/2 to NPS 12 (DN 65 to DN 300), CWP Rating: 200 psig (1380 kPa).
 - 3) NPS 14 to NPS 24 (DN 350 to DN 600), CWP Rating: 150 psig (1035 kPa).
 - 4) Body Design: Clear or full waterway.
 - 5) Body Material: ASTM A 126, gray iron with bolted bonnet.
 - 6) Ends: Flanged.
 - 7) Trim: Bronze.
 - 8) Gasket: Asbestos free.
 - 9) Closure Control: Factory-installed, exterior lever and spring.
 2. Class 125, Iron Swing Check Valves with Lever and Weight-Closure Control:
 - a. Description:
 - 1) Standard: MSS SP-71, Type I.
 - 2) NPS 2-1/2 to NPS 12 (DN 65 to DN 300), CWP Rating: 200 psig (1380 kPa).
 - 3) NPS 14 to NPS 24 (DN 350 to DN 600), CWP Rating: 150 psig (1035 kPa).
 - 4) Body Design: Clear or full waterway.
 - 5) Body Material: ASTM A 126, gray iron with bolted bonnet.
 - 6) Ends: Flanged.
 - 7) Trim: Bronze.
 - 8) Gasket: Asbestos free.
 - 9) Closure Control: Factory-installed, exterior lever and weight.

- M. Iron, Grooved-End Swing Check Valves
1. 300 CWP, Iron, Grooved-End Swing Check Valves:
 - a. Description:
 - 1) CWP Rating: 300 psig (2070 kPa).
 - 2) Body Material: ASTM A 536, ductile iron.
 - 3) Seal: EPDM.
 - 4) Disc: Spring operated, ductile iron or stainless steel.
- N. Iron, Center-Guided Check Valves
1. Class 125, Iron, Compact-Wafer, Center-Guided Check Valves with Metal Seat:
 - a. Description:
 - 1) Standard: MSS SP-125.
 - 2) NPS 2-1/2 to NPS 12 (DN 65 to DN 300), CWP Rating: 200 psig (1380 kPa).
 - 3) NPS 14 to NPS 24 (DN 350 to DN 600), CWP Rating: 150 psig (1035 kPa).
 - 4) Body Material: ASTM A 126, gray iron.
 - 5) Style: Compact wafer.
 - 6) Seat: Bronze.
 2. Class 125, Iron, Globe, Center-Guided Check Valves with Metal Seat:
 - a. Description:
 - 1) Standard: MSS SP-125.
 - 2) NPS 2-1/2 to NPS 12 (DN 65 to DN 300), CWP Rating: 200 psig (1380 kPa).
 - 3) NPS 14 to NPS 24 (DN 350 to DN 600), CWP Rating: 150 psig (1035 kPa).
 - 4) Body Material: ASTM A 126, gray iron.
 - 5) Style: Globe, spring loaded.
 - 6) Ends: Flanged.
 - 7) Seat: Bronze.
 3. Class 150, Iron, Compact-Wafer, Center-Guided Check Valves with Metal Seat:
 - a. Description:
 - 1) Standard: MSS SP-125.
 - 2) NPS 2-1/2 to NPS 12 (DN 65 to DN 300), CWP Rating: 300 psig (2070 kPa).
 - 3) NPS 14 to NPS 24 (DN 350 to DN 600), CWP Rating: 250 psig (1725 kPa).
 - 4) Body Material: ASTM A 395/A 395M or ASTM A 536, ductile iron.
 - 5) Style: Compact wafer.
 - 6) Seat: Bronze.
 4. Class 150, Iron, Globe, Center-Guided Check Valves with Metal Seat:
 - a. Description:
 - 1) Standard: MSS SP-125.
 - 2) NPS 2-1/2 to NPS 12 (DN 65 to DN 300), CWP Rating: 300 psig (2070 kPa).
 - 3) NPS 14 to NPS 24 (DN 350 to DN 600), CWP Rating: 250 psig (1725 kPa).
 - 4) Body Material: ASTM A 395/A 395M or ASTM A 536, ductile iron.
 - 5) Style: Globe, spring loaded.
 - 6) Ends: Flanged.
 - 7) Seat: Bronze.
 5. Class 250, Iron, Compact-Wafer, Center-Guided Check Valves with Metal Seat:
 - a. Description:
 - 1) Standard: MSS SP-125.
 - 2) NPS 2-1/2 to NPS 12 (DN 65 to DN 300), CWP Rating: 400 psig (2760 kPa).
 - 3) NPS 14 to NPS 24 (DN 350 to DN 600), CWP Rating: 300 psig (2070 kPa).
 - 4) Body Material: ASTM A 126, gray iron.
 - 5) Style: Compact wafer, spring loaded.
 - 6) Seat: Bronze.
 6. Class 250, Iron, Globe, Center-Guided Check Valves with Metal Seat:
 - a. Description:
 - 1) Standard: MSS SP-125.
 - 2) NPS 2-1/2 to NPS 12 (DN 65 to DN 300), CWP Rating: 400 psig (2760 kPa).

- 3) NPS 14 to NPS 24 (DN 350 to DN 600), CWP Rating: 300 psig (2070 kPa).
- 4) Body Material: ASTM A 126, gray iron.
- 5) Style: Globe, spring loaded.
- 6) Ends: Flanged.
- 7) Seat: Bronze.
7. Class 300, Iron, Compact-Wafer, Center-Guided Check Valves with Metal Seat:
 - a. Description:
 - 1) Standard: MSS SP-125.
 - 2) NPS 2-1/2 to NPS 12 (DN 65 to DN 300), CWP Rating: 500 psig (3450 kPa).
 - 3) NPS 14 to NPS 24 (DN 350 to DN 600), CWP Rating: 400 psig (2760 kPa).
 - 4) Body Material: ASTM A 395/A 395M or ASTM A 536, ductile iron.
 - 5) Style: Compact wafer, spring loaded.
 - 6) Seat: Bronze.
8. Class 300, Iron, Globe, Center-Guided Check Valves with Metal Seat:
 - a. Description:
 - 1) Standard: MSS SP-125.
 - 2) NPS 2-1/2 to NPS 12 (DN 65 to DN 300), CWP Rating: 500 psig (3450 kPa).
 - 3) NPS 14 to NPS 24 (DN 350 to DN 600), CWP Rating: 400 psig (2760 kPa).
 - 4) Body Material: ASTM A 395/A 395M or ASTM A 536, ductile iron.
 - 5) Style: Globe, spring loaded.
 - 6) Ends: Flanged.
 - 7) Seat: Bronze.
9. Class 125, Iron, Compact-Wafer, Center-Guided Check Valves with Resilient Seat:
 - a. Description:
 - 1) Standard: MSS SP-125.
 - 2) NPS 2-1/2 to NPS 12 (DN 65 to DN 300), CWP Rating: 200 psig (1380 kPa).
 - 3) NPS 14 to NPS 24 (DN 350 to DN 600), CWP Rating: 150 psig (1035 kPa).
 - 4) Body Material: ASTM A 126, gray iron.
 - 5) Style: Compact wafer.
 - 6) Seat: EPDM OR BR, as directed.
10. Class 125, Iron, Globe, Center-Guided Check Valves with Resilient Seat:
 - a. Description:
 - 1) Standard: MSS SP-125.
 - 2) NPS 2-1/2 to NPS 12 (DN 65 to DN 300), CWP Rating: 200 psig (1380 kPa).
 - 3) NPS 14 to NPS 24 (DN 350 to DN 600), CWP Rating: 150 psig (1035 kPa).
 - 4) Body Material: ASTM A 126, gray iron.
 - 5) Style: Globe, spring loaded.
 - 6) Ends: Flanged.
 - 7) Seat: EPDM OR NBR, as directed.
11. Class 150, Iron, Compact-Wafer, Center-Guided Check Valves with Resilient Seat:
 - a. Description:
 - 1) Standard: MSS SP-125.
 - 2) NPS 2-1/2 to NPS 12 (DN 65 to DN 300), CWP Rating: 300 psig (2070 kPa).
 - 3) NPS 14 to NPS 24 (DN 350 to DN 600), CWP Rating: 250 psig (1725 kPa).
 - 4) Body Material: ASTM A 395/A 395M or ASTM A 536, ductile iron.
 - 5) Style: Compact wafer.
 - 6) Seat: EPDM OR NBR, as directed.
12. Class 150, Iron, Globe, Center-Guided Check Valves with Resilient Seat:
 - a. Description:
 - 1) Standard: MSS SP-125.
 - 2) NPS 2-1/2 to NPS 12 (DN 65 to DN 300), CWP Rating: 300 psig (2070 kPa).
 - 3) NPS 14 to NPS 24 (DN 350 to DN 600), CWP Rating: 250 psig (1725 kPa).
 - 4) Body Material: ASTM A 395/A 395M or ASTM A 536, ductile iron.
 - 5) Style: Globe, spring loaded.
 - 6) Ends: Flanged.
 - 7) Seat: EPDM OR NBR, as directed.

13. Class 250, Iron, Compact-Wafer, Center-Guided Check Valves with Resilient Seat:
 - a. Description:
 - 1) Standard: MSS SP-125.
 - 2) **NPS 2-1/2 to NPS 12 (DN 65 to DN 300)**, CWP Rating: **400 psig (2760 kPa)**.
 - 3) **NPS 14 to NPS 24 (DN 350 to DN 600)**, CWP Rating: **300 psig (2070 kPa)**.
 - 4) Body Material: ASTM A 126, gray iron.
 - 5) Style: Compact wafer, spring loaded.
 - 6) Seat: EPDM **OR** NBR, **as directed**.
14. Class 250, Iron, Globe, Center-Guided Check Valves with Resilient Seat:
 - a. Description:
 - 1) Standard: MSS SP-125.
 - 2) **NPS 2-1/2 to NPS 12 (DN 65 to DN 300)**, CWP Rating: **400 psig (2760 kPa)**.
 - 3) **NPS 14 to NPS 24 (DN 350 to DN 600)**, CWP Rating: **300 psig (2070 kPa)**.
 - 4) Body Material: ASTM A 126, gray iron.
 - 5) Style: Globe, spring loaded.
 - 6) Ends: Flanged.
 - 7) Seat: EPDM **OR** NBR, **as directed**.
15. Class 300, Iron, Compact-Wafer, Center-Guided Check Valves with Resilient Seat:
 - a. Description:
 - 1) Standard: MSS SP-125.
 - 2) **NPS 2-1/2 to NPS 12 (DN 65 to DN 300)**, CWP Rating: **500 psig (3450 kPa)**.
 - 3) **NPS 14 to NPS 24 (DN 350 to DN 600)**, CWP Rating: **400 psig (2760 kPa)**.
 - 4) Body Material: ASTM A 395/A 395M or ASTM A 536, ductile iron.
 - 5) Style: Compact wafer, spring loaded.
 - 6) Seat: EPDM **OR** NBR, **as directed**.
16. Class 300, Iron, Globe, Center-Guided Check Valves with Resilient Seat:
 - a. Description:
 - 1) Standard: MSS SP-125.
 - 2) **NPS 2-1/2 to NPS 12 (DN 65 to DN 300)**, CWP Rating: **500 psig (3450 kPa)**.
 - 3) **NPS 14 to NPS 24 (DN 350 to DN 600)**, CWP Rating: **400 psig (2760 kPa)**.
 - 4) Body Material: ASTM A 395/A 395M or ASTM A 536, ductile iron.
 - 5) Style: Globe, spring loaded.
 - 6) Ends: Flanged.
 - 7) Seat: EPDM **OR** NBR, **as directed**.

O. Iron, Plate-Type Check Valves

1. Class 125, Iron, Dual-Plate Check Valves with Metal Seat:
 - a. Description:
 - 1) Standard: API 594.
 - 2) **NPS 2-1/2 to NPS 12 (DN 65 to DN 300)**, CWP Rating: **200 psig (1380 kPa)**.
 - 3) **NPS 14 to NPS 24 (DN 350 to DN 600)**, CWP Rating: **150 psig (1035 kPa)**.
 - 4) Body Design: Wafer, spring-loaded plates.
 - 5) Body Material: ASTM A 126, gray iron.
 - 6) Seat: Bronze.
2. Class 150, Iron, Dual-Plate Check Valves with Metal Seat:
 - a. Description:
 - 1) Standard: API 594.
 - 2) **NPS 2-1/2 to NPS 12 (DN 65 to DN 300)**, CWP Rating: **300 psig (2070 kPa)**.
 - 3) **NPS 14 to NPS 24 (DN 350 to DN 600)**, CWP Rating: **250 psig (1725 kPa)**.
 - 4) Body Design: Wafer, spring-loaded plates.
 - 5) Body Material: ASTM A 395/A 395M or ASTM A 536, ductile iron.
 - 6) Seat: Bronze.
3. Class 250, Iron, Dual-Plate Check Valves with Metal Seat:
 - a. Description:
 - 1) Standard: API 594.

- 2) NPS 2-1/2 to NPS 12 (DN 65 to DN 300), CWP Rating: 400 psig (2760 kPa).
- 3) NPS 14 to NPS 24 (DN 350 to DN 600), CWP Rating: 300 psig (2070 kPa).
- 4) Body Design: Wafer, spring-loaded plates.
- 5) Body Material: ASTM A 126, gray iron.
- 6) Seat: Bronze.
4. Class 300, Iron, Dual-Plate Check Valves with Metal Seat:
 - a. Description:
 - 1) Standard: API 594.
 - 2) NPS 2-1/2 to NPS 12 (DN 65 to DN 300), CWP Rating: 500 psig (3450 kPa).
 - 3) NPS 14 to NPS 24 (DN 350 to DN 600), CWP Rating: 400 psig (2760 kPa).
 - 4) Body Design: Wafer, spring-loaded plates.
 - 5) Body Material: ASTM A 395/A 395M or ASTM A 536, ductile iron.
 - 6) Seat: Bronze.
5. Class 125, Iron, Single-Plate Check Valves with Resilient Seat:
 - a. Description:
 - 1) Standard: API 594.
 - 2) NPS 2-1/2 to NPS 12 (DN 65 to DN 300), CWP Rating: 200 psig (1380 kPa).
 - 3) NPS 14 to NPS 24 (DN 350 to DN 600), CWP Rating: 150 psig (1035 kPa).
 - 4) Body Design: Wafer, spring-loaded plate.
 - 5) Body Material: ASTM A 126, gray iron.
 - 6) Seat: EPDM OR NBR, as directed.
6. Class 125, Iron, Dual-Plate Check Valves with Resilient Seat:
 - a. Description:
 - 1) Standard: API 594.
 - 2) NPS 2-1/2 to NPS 12 (DN 65 to DN 300), CWP Rating: 200 psig (1380 kPa).
 - 3) NPS 14 to NPS 24 (DN 350 to DN 600), CWP Rating: 150 psig (1035 kPa).
 - 4) Body Design: Wafer, spring-loaded plates.
 - 5) Body Material: ASTM A 126, gray iron.
 - 6) Seat: EPDM OR NBR, as directed.
7. Class 150, Iron, Dual-Plate Check Valves with Resilient Seat:
 - a. Description:
 - 1) Standard: API 594.
 - 2) NPS 2-1/2 to NPS 12 (DN 65 to DN 300), CWP Rating: 300 psig (2070 kPa).
 - 3) NPS 14 to NPS 24 (DN 350 to DN 600), CWP Rating: 250 psig (1725 kPa).
 - 4) Body Design: Wafer, spring-loaded plates.
 - 5) Body Material: ASTM A 395/A 395M or ASTM A 536, ductile iron.
 - 6) Seat: EPDM OR NBR, as directed.
8. Class 250, Iron, Wafer, Single-Plate Check Valves with Resilient Seat:
 - a. Description:
 - 1) Standard: API 594.
 - 2) NPS 2-1/2 to NPS 12 (DN 65 to DN 300), CWP Rating: 400 psig (2760 kPa).
 - 3) NPS 14 to NPS 24 (DN 350 to DN 600), CWP Rating: 300 psig (2070 kPa).
 - 4) Body Design: Wafer, spring-loaded plate.
 - 5) Body Material: ASTM A 126, gray iron.
 - 6) Seat: EPDM OR NBR, as directed.
9. Class 250, Iron, Dual-Plate Check Valves with Resilient Seat:
 - a. Description:
 - 1) Standard: API 594.
 - 2) NPS 2-1/2 to NPS 12 (DN 65 to DN 300), CWP Rating: 400 psig (2760 kPa).
 - 3) NPS 14 to NPS 24 (DN 350 to DN 600), CWP Rating: 300 psig (2070 kPa).
 - 4) Body Design: Wafer, spring-loaded plates.
 - 5) Body Material: ASTM A 126, gray iron.
 - 6) Seat: EPDM OR NBR, as directed.
10. Class 300, Iron, Dual-Plate Check Valves with Resilient Seat:
 - a. Description:
 - 1) Standard: API 594.

- 2) **NPS 2-1/2 to NPS 12 (DN 65 to DN 300)**, CWP Rating: **500 psig (3450 kPa)**.
- 3) **NPS 14 to NPS 24 (DN 350 to DN 600)**, CWP Rating: **400 psig (2760 kPa)**.
- 4) Body Design: Wafer, spring-loaded plates.
- 5) Body Material: ASTM A 395/A 395M or ASTM A 536, ductile iron.
- 6) Seat: EPDM **OR** NBR, **as directed**.

P. Bronze Gate Valves

1. Class 125, NRS Bronze Gate Valves:
 - a. Description:
 - 1) Standard: MSS SP-80, Type 1.
 - 2) CWP Rating: **200 psig (1380 kPa)**.
 - 3) Body Material: ASTM B 62, bronze with integral seat and screw-in bonnet.
 - 4) Ends: Threaded or solder joint, **as directed**.
 - 5) Stem: Bronze.
 - 6) Disc: Solid wedge; bronze.
 - 7) Packing: Asbestos free.
 - 8) Handwheel: Malleable iron, bronze, or aluminum, **as directed**.
2. Class 125, RS Bronze Gate Valves:
 - a. Description:
 - 1) Standard: MSS SP-80, Type 2.
 - 2) CWP Rating: **200 psig (1380 kPa)**.
 - 3) Body Material: ASTM B 62, bronze with integral seat and screw-in bonnet.
 - 4) Ends: Threaded or solder joint, **as directed**.
 - 5) Stem: Bronze.
 - 6) Disc: Solid wedge; bronze.
 - 7) Packing: Asbestos free.
 - 8) Handwheel: Malleable iron, bronze, or aluminum, **as directed**.
3. Class 150, NRS Bronze Gate Valves:
 - a. Description:
 - 1) Standard: MSS SP-80, Type 1.
 - 2) CWP Rating: **300 psig (2070 kPa)**.
 - 3) Body Material: ASTM B 62, bronze with integral seat and union-ring bonnet.
 - 4) Ends: Threaded.
 - 5) Stem: Bronze.
 - 6) Disc: Solid wedge; bronze.
 - 7) Packing: Asbestos free.
 - 8) Handwheel: Malleable iron, bronze, or aluminum, **as directed**.
4. Class 150, RS Bronze Gate Valves:
 - a. Description:
 - 1) Standard: MSS SP-80, Type 2.
 - 2) CWP Rating: **300 psig (2070 kPa)**.
 - 3) Body Material: ASTM B 62, bronze with integral seat and union-ring bonnet.
 - 4) Ends: Threaded.
 - 5) Stem: Bronze.
 - 6) Disc: Solid wedge; bronze.
 - 7) Packing: Asbestos free.
 - 8) Handwheel: Malleable iron, bronze, or aluminum, **as directed**.

Q. Iron Gate Valves

1. Class 125, NRS, Iron Gate Valves:
 - a. Description:
 - 1) Standard: MSS SP-70, Type I.
 - 2) **NPS 2-1/2 to NPS 12 (DN 65 to DN 300)**, CWP Rating: **200 psig (1380 kPa)**.
 - 3) **NPS 14 to NPS 24 (DN 350 to DN 600)**, CWP Rating: **150 psig (1035 kPa)**.
 - 4) Body Material: ASTM A 126, gray iron with bolted bonnet.

- 5) Ends: Flanged.
- 6) Trim: Bronze.
- 7) Disc: Solid wedge.
- 8) Packing and Gasket: Asbestos free.
2. Class 125, OS&Y, Iron Gate Valves:
 - a. Description:
 - 1) Standard: MSS SP-70, Type I.
 - 2) NPS 2-1/2 to NPS 12 (DN 65 to DN 300), CWP Rating: 200 psig (1380 kPa).
 - 3) NPS 14 to NPS 24 (DN 350 to DN 600), CWP Rating: 150 psig (1035 kPa).
 - 4) Body Material: ASTM A 126, gray iron with bolted bonnet.
 - 5) Ends: Flanged.
 - 6) Trim: Bronze.
 - 7) Disc: Solid wedge.
 - 8) Packing and Gasket: Asbestos free.
3. Class 250, NRS, Iron Gate Valves:
 - a. Description:
 - 1) Standard: MSS SP-70, Type I.
 - 2) NPS 2-1/2 to NPS 12 (DN 65 to DN 300), CWP Rating: 500 psig (3450 kPa).
 - 3) NPS 14 to NPS 24 (DN 350 to DN 600), CWP Rating: 300 psig (2070 kPa).
 - 4) Body Material: ASTM A 126, gray iron with bolted bonnet.
 - 5) Ends: Flanged.
 - 6) Trim: Bronze.
 - 7) Disc: Solid wedge.
 - 8) Packing and Gasket: Asbestos free.
4. Class 250, OS&Y, Iron Gate Valves:
 - a. Description:
 - 1) Standard: MSS SP-70, Type I.
 - 2) NPS 2-1/2 to NPS 12 (DN 65 to DN 300), CWP Rating: 500 psig (3450 kPa).
 - 3) NPS 14 to NPS 24 (DN 350 to DN 600), CWP Rating: 300 psig (2070 kPa).
 - 4) Body Material: ASTM A 126, gray iron with bolted bonnet.
 - 5) Ends: Flanged.
 - 6) Trim: Bronze.
 - 7) Disc: Solid wedge.
 - 8) Packing and Gasket: Asbestos free.
- R. Bronze Globe Valves
 1. Class 125, Bronze Globe Valves with Bronze Disc:
 - a. Description:
 - 1) Standard: MSS SP-80, Type 1.
 - 2) CWP Rating: 200 psig (1380 kPa).
 - 3) Body Material: ASTM B 62, bronze with integral seat and screw-in bonnet.
 - 4) Ends: Threaded or solder joint, **as directed**.
 - 5) Stem and Disc: Bronze.
 - 6) Packing: Asbestos free.
 - 7) Handwheel: Malleable iron, bronze, or aluminum, **as directed**.
 2. Class 125, Bronze Globe Valves with Nonmetallic Disc:
 - a. Description:
 - 1) Standard: MSS SP-80, Type 2.
 - 2) CWP Rating: 200 psig (1380 kPa).
 - 3) Body Material: ASTM B 62, bronze with integral seat and screw-in bonnet.
 - 4) Ends: Threaded or solder joint, **as directed**.
 - 5) Stem: Bronze.
 - 6) Disc: PTFE or TFE.
 - 7) Packing: Asbestos free.
 - 8) Handwheel: Malleable iron, bronze, or aluminum, **as directed**.
 3. Class 150, Bronze Globe Valves with Nonmetallic Disc:

- a. Description:
 - 1) Standard: MSS SP-80, Type 2.
 - 2) CWP Rating: 300 psig (2070 kPa).
 - 3) Body Material: ASTM B 62, bronze with integral seat and union-ring bonnet.
 - 4) Ends: Threaded.
 - 5) Stem: Bronze.
 - 6) Disc: PTFE or TFE.
 - 7) Packing: Asbestos free.
 - 8) Handwheel: Malleable iron, bronze, or aluminum, **as directed**.

S. Iron Globe Valves

- 1. Class 125, Iron Globe Valves:
 - a. Description:
 - 1) Standard: MSS SP-85, Type I.
 - 2) CWP Rating: 200 psig (1380 kPa).
 - 3) Body Material: ASTM A 126, gray iron with bolted bonnet.
 - 4) Ends: Flanged.
 - 5) Trim: Bronze.
 - 6) Packing and Gasket: Asbestos free.
- 2. Class 250, Iron Globe Valves:
 - a. Description:
 - 1) Standard: MSS SP-85, Type I.
 - 2) CWP Rating: 500 psig (3450 kPa).
 - 3) Body Material: ASTM A 126, gray iron with bolted bonnet.
 - 4) Ends: Flanged.
 - 5) Trim: Bronze.
 - 6) Packing and Gasket: Asbestos free.

T. Lubricated Plug Valves

- 1. Class 125, Regular-Gland, Lubricated Plug Valves with Threaded Ends:
 - a. Description:
 - 1) Standard: MSS SP-78, Type II.
 - 2) NPS 2-1/2 to NPS 12 (DN 65 to DN 300), CWP Rating: 200 psig (1380 kPa).
 - 3) NPS 14 to NPS 24 (DN 350 to DN 600), CWP Rating: 150 psig (1035 kPa).
 - 4) Body Material: ASTM A 48/A 48M or ASTM A 126, cast iron with lubrication-sealing system.
 - 5) Pattern: Regular or short **OR** Venturi, **as directed**.
 - 6) Plug: Cast iron or bronze with sealant groove.
- 2. Class 125, Regular-Gland, Lubricated Plug Valves with Flanged Ends:
 - a. Description:
 - 1) Standard: MSS SP-78, Type II.
 - 2) NPS 2-1/2 to NPS 12 (DN 65 to DN 300), CWP Rating: 200 psig (1380 kPa).
 - 3) NPS 14 to NPS 24 (DN 350 to DN 600), CWP Rating: 150 psig (1035 kPa).
 - 4) Body Material: ASTM A 48/A 48M or ASTM A 126, cast iron with lubrication-sealing system.
 - 5) Pattern: Regular or short **OR** Venturi, **as directed**.
 - 6) Plug: Cast iron or bronze with sealant groove.
- 3. Class 125, Cylindrical, Lubricated Plug Valves with Threaded Ends:
 - a. Description:
 - 1) Standard: MSS SP-78, Type IV.
 - 2) NPS 2-1/2 to NPS 12 (DN 65 to DN 300), CWP Rating: 200 psig (1380 kPa).
 - 3) NPS 14 to NPS 24 (DN 350 to DN 600), CWP Rating: 150 psig (1035 kPa).
 - 4) Body Material: ASTM A 48/A 48M or ASTM A 126, cast iron with lubrication-sealing system.
 - 5) Pattern: Regular or short **OR** Venturi, **as directed**.

- 6) Plug: Cast iron or bronze with sealant groove.
4. Class 125, Cylindrical, Lubricated Plug Valves with Flanged Ends:
 - a. Description:
 - 1) Standard: MSS SP-78, Type IV.
 - 2) NPS 2-1/2 to NPS 12 (DN 65 to DN 300), CWP Rating: 200 psig (1380 kPa).
 - 3) NPS 14 to NPS 24 (DN 350 to DN 600), CWP Rating: 150 psig (1035 kPa).
 - 4) Body Material: ASTM A 48/A 48M or ASTM A 126, cast iron with lubrication-sealing system.
 - 5) Pattern: Regular or short **OR** Venturi, **as directed**.
 - 6) Plug: Cast iron or bronze with sealant groove.
5. Class 250, Regular-Gland, Lubricated Plug Valves with Threaded Ends:
 - a. Description:
 - 1) Standard: MSS SP-78, Type II.
 - 2) NPS 2-1/2 to NPS 12 (DN 65 to DN 300), CWP Rating: 400 psig (2760 kPa).
 - 3) NPS 14 to NPS 24 (DN 350 to DN 600), CWP Rating: 300 psig (2070 kPa).
 - 4) Body Material: ASTM A 48/A 48M or ASTM A 126, cast iron with lubrication-sealing system.
 - 5) Pattern: Regular or short **OR** Venturi, **as directed**.
 - 6) Plug: Cast iron or bronze with sealant groove.
6. Class 250, Regular-Gland, Lubricated Plug Valves with Flanged Ends:
 - a. Description:
 - 1) Standard: MSS SP-78, Type II.
 - 2) NPS 2-1/2 to NPS 12 (DN 65 to DN 300), CWP Rating: 400 psig (2760 kPa).
 - 3) NPS 14 to NPS 24 (DN 350 to DN 600), CWP Rating: 300 psig (2070 kPa).
 - 4) Body Material: ASTM A 48/A 48M or ASTM A 126, cast iron with lubrication-sealing system.
 - 5) Pattern: Regular or short **OR** Venturi, **as directed**.
 - 6) Plug: Cast iron or bronze with sealant groove.
7. Class 250, Cylindrical, Lubricated Plug Valves with Threaded Ends:
 - a. Description:
 - 1) Standard: MSS SP-78, Type IV.
 - 2) NPS 2-1/2 to NPS 12 (DN 65 to DN 300), CWP Rating: 400 psig (2760 kPa).
 - 3) NPS 14 to NPS 24 (DN 350 to DN 600), CWP Rating: 300 psig (2070 kPa).
 - 4) Body Material: ASTM A 48/A 48M or ASTM A 126, cast iron with lubrication-sealing system.
 - 5) Pattern: Regular or short **OR** Venturi, **as directed**.
 - 6) Plug: Cast iron or bronze with sealant groove.
8. Class 250, Cylindrical, Lubricated Plug Valves with Flanged Ends:
 - a. Description:
 - 1) Standard: MSS SP-78, Type IV.
 - 2) NPS 2-1/2 to NPS 12 (DN 65 to DN 300), CWP Rating: 400 psig (2760 kPa).
 - 3) NPS 14 to NPS 24 (DN 350 to DN 600), CWP Rating: 300 psig (2070 kPa).
 - 4) Body Material: ASTM A 48/A 48M or ASTM A 126, Grade 40 cast iron with lubrication-sealing system.
 - 5) Pattern: Regular or short **OR** Venturi, **as directed**.
 - 6) Plug: Cast iron or bronze with sealant groove.

U. Eccentric Plug Valves

1. 175 CWP, Eccentric Plug Valves with Resilient Seating.
 - a. Description:
 - 1) Standard: MSS SP-108.
 - 2) CWP Rating: 175 psig (1200 kPa) minimum.
 - 3) Body and Plug: ASTM A 48/A 48M, gray iron; ASTM A 126, gray iron; or ASTM A 536, ductile iron.
 - 4) Bearings: Oil-impregnated bronze or stainless steel.
 - 5) Ends: Flanged.



- 6) Stem-Seal Packing: Asbestos free.
- 7) Plug, Resilient-Seating Material: Suitable for potable-water service unless otherwise indicated.

V. Chainwheels

1. Description: Valve actuation assembly with sprocket rim, brackets, and chain.
 - a. Brackets: Type, number, size, and fasteners required to mount actuator on valve.
 - b. Attachment: For connection to ball **OR** butterfly **OR** plug, **as directed**, valve stems.
 - c. Sprocket Rim with Chain Guides: Ductile iron **OR** Cast iron **OR** Aluminum **OR** Bronze, **as directed**, of type and size required for valve. Include zinc coating, **as directed**.
 - d. Chain: Hot-dip, galvanized steel **OR** Brass **OR** Stainless steel, **as directed**, of size required to fit sprocket rim.

1.3 EXECUTION

A. Valve Installation

1. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.
2. Locate valves for easy access and provide separate support where necessary.
3. Install valves in horizontal piping with stem at or above center of pipe.
4. Install valves in position to allow full stem movement.
5. Install chainwheels on operators for ball **OR** butterfly **OR** gate **OR** globe **OR** plug, **as directed**, valves **NPS 4 (DN 100)** and larger and more than **96 inches (2400 mm)** above floor. Extend chains to **60 inches (1520 mm)** above finished floor.
6. Install check valves for proper direction of flow and as follows:
 - a. Swing Check Valves: In horizontal position with hinge pin level.
 - b. Center-Guided and Plate-Type Check Valves: In horizontal or vertical position, between flanges.
 - c. Lift Check Valves: With stem upright and plumb.

B. Adjusting

1. Adjust or replace valve packing after piping systems have been tested and put into service but before final adjusting and balancing. Replace valves if persistent leaking occurs.

C. General Requirements For Valve Applications

1. If valve applications are not indicated, use the following:
 - a. Shutoff Service: Ball, butterfly **OR** gate **OR** plug, **as directed**, valves.
 - b. Butterfly Valve Dead-End Service: Single-flange (lug) type.
 - c. Throttling Service except Steam: Globe **OR** angle **OR** ball **OR** butterfly, **as directed**, valves.
 - d. Throttling Service, Steam: Globe **OR** angle **OR** butterfly, **as directed**, valves.
 - e. Pump-Discharge Check Valves:
 - 1) **NPS 2 (DN 50)** and Smaller: Bronze swing check valves with bronze **OR** nonmetallic, **as directed**, disc.
 - 2) **NPS 2-1/2 (DN 65)** and Larger: Iron swing check valves with lever and weight or with spring or iron, center-guided, metal **OR** resilient, **as directed**, seat check valves.
2. If valves with specified SWP classes or CWP ratings are not available, the same types of valves with higher SWP classes or CWP ratings may be substituted.
3. Select valves, except wafer types, with the following end connections:
 - a. For Copper Tubing, **NPS 2 (DN 50)** and Smaller: Threaded ends except where solder-joint valve-end option is indicated in valve schedules below.
 - b. For Copper Tubing, **NPS 2-1/2 to NPS 4 (DN 65 to DN 100)**: Flanged ends except where threaded valve-end option is indicated in valve schedules below.

- c. For Copper Tubing, **NPS 5 (DN 125)** and Larger: Flanged ends.
- d. For Steel Piping, **NPS 2 (DN 50)** and Smaller: Threaded ends.
- e. For Steel Piping, **NPS 2-1/2 to NPS 4 (DN 65 to DN 100)**: Flanged ends except where threaded valve-end option is indicated in valve schedules below.
- f. For Steel Piping, **NPS 5 (DN 125)** and Larger: Flanged ends.
- g. For Grooved-End Copper Tubing and Steel Piping except Steam and Steam Condensate Piping: Valve ends may be grooved.

D. Chilled-Water Valve Schedule

- 1. Pipe **NPS 2 (DN 50)** and Smaller:
 - a. Bronze and Brass Valves: May be provided with solder-joint ends instead of threaded ends.
 - b. Bronze Angle Valves: Class 125 **OR** Class 150, **as directed**, bronze **OR** nonmetallic, **as directed**, disc.
 - c. Ball Valves: One **OR** Two **OR** Three, **as directed**, piece, full **OR** regular **OR** reduced, **as directed**, port, brass **OR** bronze, **as directed**, with brass **OR** bronze **OR** stainless-steel, **as directed**, trim.
 - d. Bronze Swing Check Valves: Class 125 **OR** Class 150, **as directed**, bronze **OR** nonmetallic, **as directed**, disc.
 - e. Bronze Gate Valves: Class 125 **OR** Class 150, **as directed**, NRS **OR** RS, **as directed**, bronze.
 - f. Bronze Globe Valves: Class 125 **OR** Class 150, **as directed**, bronze **OR** nonmetallic, **as directed**, disc.
- 2. Pipe **NPS 2-1/2 (DN 65)** and Larger:
 - a. Iron Valves, **NPS 2-1/2 to NPS 4 (DN 65 to DN 100)**: May be provided with threaded ends instead of flanged ends.
 - b. Iron Ball Valves, **NPS 2-1/2 to NPS 10 (DN 65 to DN 250)**: Class 150.
 - c. Iron, Single-Flange Butterfly Valves, **NPS 2-1/2 to NPS 12 (DN 65 to DN 300)**: 200 CWP, EPDM **OR** NBR, **as directed**, seat, aluminum-bronze **OR** ductile-iron **OR** stainless-steel, **as directed**, disc.
 - d. Iron, Single-Flange Butterfly Valves, **NPS 14 to NPS 24 (DN 350 to DN 600)**: 150 CWP, EPDM **OR** NBR, **as directed**, seat, aluminum-bronze **OR** ductile-iron **OR** stainless-steel, **as directed**, disc.
 - e. Iron, Grooved-End Butterfly Valves, **NPS 2-1/2 to NPS 12 (DN 65 to DN 300)**: 175 **OR** 300, **as directed**, CWP.
 - f. High-Performance Butterfly Valves: Class 150 **OR** Class 300, **as directed**, single flange.
 - g. Iron Swing Check Valves: Class 125 **OR** Class 250, **as directed**, metal **OR** nonmetallic-to-metal, **as directed**, seats.
 - h. Iron Swing Check Valves with Closure Control, **NPS 2-1/2 to NPS 12 (DN 65 to DN 300)**: Class 125, lever and spring **OR** weight, **as directed**.
 - i. Iron, Grooved-End Check Valves, **NPS 3 to NPS 12 (DN 80 to DN 300)**: 300 CWP.
 - j. Iron, Center-Guided Check Valves: Class 125 **OR** Class 150 **OR** Class 250 **OR** Class 300, **as directed**, compact-wafer **OR** globe, **as directed**, metal **OR** resilient, **as directed**, seat.
 - k. Iron, Plate-Type Check Valves: Class 125 **OR** Class 150 **OR** Class 250 **OR** Class 300, **as directed**; single **OR** dual, **as directed**, plate; metal **OR** resilient, **as directed**, seat.
 - l. Iron Gate Valves: Class 125 **OR** Class 250, **as directed**, NRS **OR** OS&Y, **as directed**.
 - m. Iron Globe Valves: Class 125 **OR** Class 250, **as directed**.
 - n. Lubricated Plug Valves: Class 125 **OR** Class 250, **as directed**, regular gland **OR** cylindrical, **as directed**, threaded **OR** flanged, **as directed**.
 - o. Eccentric Plug Valves: 175 CWP, resilient seating.

E. Condenser-Water Valve Schedule

- 1. Pipe **NPS 2 (DN 50)** and Smaller:
 - a. Bronze and Brass Valves: May be provided with solder-joint ends instead of threaded ends.



- b. Bronze Angle Valves: Class 125 **OR** Class 150, **as directed**, bronze **OR** nonmetallic, **as directed**, disc.
 - c. Ball Valves: One **OR** Two **OR** Three, **as directed**, piece, full **OR** regular **OR** reduced, **as directed**, port, brass **OR** bronze, **as directed**, with brass **OR** bronze **OR** stainless-steel, **as directed**, trim.
 - d. Bronze Swing Check Valves: Class 125 **OR** Class 150, **as directed**, bronze **OR** nonmetallic, **as directed**, disc.
 - e. Bronze Gate Valves: Class 125 **OR** Class 150, **as directed**, NRS **OR** RS, **as directed**.
 - f. Bronze Globe Valves: Class 125 **OR** Class 150, **as directed**, bronze **OR** nonmetallic, **as directed**, disc.
2. Pipe **NPS 2-1/2 (DN 65)** and Larger:
- a. Iron Valves, **NPS 2-1/2 to NPS 4 (DN 65 to DN 100)**: May be provided with threaded ends instead of flanged ends.
 - b. Iron Ball Valves, **NPS 2-1/2 to NPS 10 (DN 65 to DN 250)**: Class 150.
 - c. Iron, Single-Flange Butterfly Valves, **NPS 2-1/2 to NPS 12 (DN 65 to DN 300)**: 200 CWP, EPDM **OR** NBR, **as directed**, seat, aluminum-bronze **OR** ductile-iron **OR** stainless-steel, **as directed**, disc.
 - d. Iron, Single-Flange Butterfly Valves, **NPS 14 to NPS 24 (DN 350 to DN 600)**: 150 CWP, EPDM **OR** NBR, **as directed**, seat, aluminum-bronze **OR** ductile-iron **OR** stainless-steel, **as directed**, disc.
 - e. Iron, Grooved-End Butterfly Valves, **NPS 2-1/2 to NPS 12 (DN 65 to DN 300)**: 175 **OR** 300, **as directed**, CWP.
 - f. High-Performance Butterfly Valves: Class 150 **OR** Class 300, **as directed**, single flange.
 - g. Iron Swing Check Valves: Class 125 **OR** Class 250, **as directed**, metal **OR** nonmetallic-to-metal, **as directed**, seats.
 - h. Iron Swing Check Valves with Closure Control, **NPS 2-1/2 to NPS 12 (DN 65 to DN 300)**: Class 125, lever and spring **OR** weight, **as directed**.
 - i. Iron, Grooved-End Check Valves, **NPS 3 to NPS 12 (DN 80 to DN 300)**: 300 CWP.
 - j. Iron, Center-Guided Check Valves, **NPS 2-1/2 to NPS 24 (DN 65 to DN 600)**: Class 125 **OR** Class 150 **OR** Class 250 **OR** Class 300, **as directed**, metal **OR** resilient, **as directed**, seat.
 - k. Iron, Plate-Type Check Valves: Class 125 **OR** Class 150 **OR** Class 250 **OR** Class 300, **as directed**; single **OR** dual, **as directed**, plate; metal **OR** resilient, **as directed**, seat.
 - l. Iron Gate Valves: Class 125 **OR** Class 250, **as directed**, NRS **OR** OS&Y, **as directed**.
 - m. Iron Globe Valves, **NPS 2-1/2 to NPS 12 (DN 65 to DN 300)**: Class 125 **OR** Class 250, **as directed**.
 - n. Lubricated Plug Valves: Class 125 **OR** Class 250, **as directed**, regular gland **OR** cylindrical, **as directed**, threaded **OR** flanged, **as directed**.
- F. Heating-Water Valve Schedule
1. Pipe **NPS 2 (DN 50)** and Smaller:
- a. Bronze and Brass Valves: May be provided with solder-joint ends instead of threaded ends.
 - b. Bronze Angle Valves: Class 125 **OR** Class 150, **as directed**, bronze **OR** nonmetallic, **as directed**, disc.
 - c. Ball Valves: One **OR** Two **OR** Three, **as directed**, piece, full **OR** regular **OR** reduced, **as directed**, port, brass **OR** bronze, **as directed**, with brass **OR** bronze **OR** stainless-steel, **as directed**, trim.
 - d. Bronze Swing Check Valves: Class 125 **OR** Class 150, **as directed**, bronze **OR** nonmetallic, **as directed**, disc.
 - e. Bronze Gate Valves: Class 125 **OR** Class 150, **as directed**, NRS **OR** RS, **as directed**.
 - f. Bronze Globe Valves: Class 125 **OR** Class 150, **as directed**, bronze **OR** nonmetallic, **as directed**, disc.
2. Pipe **NPS 2-1/2 (DN 65)** and Larger:

- a. Iron Valves, **NPS 2-1/2 to NPS 4 (DN 65 to DN 100)**: May be provided with threaded ends instead of flanged ends.
 - b. Iron Ball Valves, **NPS 2-1/2 to NPS 10 (DN 65 to DN 250)**: Class 150.
 - c. Iron, Single-Flange Butterfly Valves, **NPS 2-1/2 to NPS 12 (DN 65 to DN 300)**: 200 CWP, EPDM **OR** NBR, **as directed**, seat, aluminum-bronze **OR** ductile-iron **OR** stainless-steel, **as directed**, disc.
 - d. Iron, Single-Flange Butterfly Valves, **NPS 14 to NPS 24 (DN 350 to DN 600)**: 150 CWP, EPDM **OR** NBR, **as directed**, seat, aluminum-bronze **OR** ductile-iron **OR** stainless-steel, **as directed**, disc.
 - e. Iron, Grooved-End Butterfly Valves, **NPS 2-1/2 to NPS 12 (DN 65 to DN 300)**: 175 **OR** 300, **as directed**, CWP.
 - f. High-Performance Butterfly Valves: Class 150 **OR** Class 300, **as directed**, single flange.
 - g. Iron Swing Check Valves: Class 125 **OR** Class 250, **as directed**, metal **OR** nonmetallic-to-metal, **as directed**, seats.
 - h. Iron Swing Check Valves with Closure Control, **NPS 2-1/2 to NPS 12 (DN 65 to DN 300)**: Class 125, lever and spring **OR** weight, **as directed**.
 - i. Iron, Grooved-End Check Valves, **NPS 3 to NPS 12 (DN 80 to DN 300)**: 300 CWP.
 - j. Iron, Center-Guided Check Valves: Class 125 **OR** Class 150 **OR** Class 250 **OR** Class 300, **as directed**, compact-wafer **OR** globe, **as directed**, metal **OR** resilient, **as directed**, seat.
 - k. Iron, Plate-Type Check Valves: Class 125 **OR** Class 150 **OR** Class 250 **OR** Class 300, **as directed**; single **OR** dual, **as directed**, plate; metal **OR** resilient, **as directed**, seat.
 - l. Iron Gate Valves: Class 125 **OR** Class 250, **as directed**, NRS **OR** OS&Y, **as directed**.
 - m. Iron Globe Valves, **NPS 2-1/2 to NPS 12 (DN 65 to DN 300)**: Class 125 **OR** Class 250, **as directed**.
- G. Low-Pressure Steam Valve Schedule (**15 psig (104 kPa)** Or Less)
1. Pipe **NPS 2 (DN 50)** and Smaller:
 - a. Bronze Angle Valves: Class 125 **OR** Class 150, **as directed**, bronze **OR** nonmetallic, **as directed**, disc.
 - b. Ball Valves: One **OR** Two **OR** Three, **as directed**, piece, full **OR** regular **OR** reduced, **as directed**, port, brass **OR** bronze, **as directed**, with brass **OR** bronze **OR** stainless-steel, **as directed**, trim.
 - c. Bronze Swing Check Valves: Class 125 **OR** Class 150, **as directed**, bronze **OR** nonmetallic, **as directed**, disc.
 - d. Bronze Gate Valves: Class 125 **OR** Class 150, **as directed**, NRS **OR** RS, **as directed**.
 - e. Bronze Globe Valves: Class 125 **OR** Class 150, **as directed**, bronze **OR** nonmetallic, **as directed**, disc.
 2. Pipe **NPS 2-1/2 (DN 65)** and Larger:
 - a. Iron Valves, **NPS 2-1/2 to NPS 4 (DN 65 to DN 100)**: May be provided with threaded ends instead of flanged ends.
 - b. Iron Ball Valves, **NPS 2-1/2 to NPS 10 (DN 65 to DN 250)**: Class 150.
 - c. High-Performance Butterfly Valves: Class 150 **OR** Class 300, **as directed**, single flange.
 - d. Iron Swing Check Valves: Class 125 **OR** Class 250, **as directed**, metal **OR** nonmetallic-to-metal, **as directed**, seats.
 - e. Iron Swing Check Valves with Closure Control, **NPS 2-1/2 to NPS 12 (DN 65 to DN 300)**: Class 125, lever and spring **OR** weight, **as directed**.
 - f. Iron Gate Valves: Class 125 **OR** Class 250, **as directed**, NRS **OR** OS&Y, **as directed**.
 - g. Iron Globe Valves, **NPS 2-1/2 to NPS 12 (DN 65 to DN 300)**: Class 125 **OR** Class 250, **as directed**.
- H. High-Pressure Steam Valve Schedule (More Than **15 psig (104 kPa)**)
1. Pipe **NPS 2 (DN 50)** and Smaller:
 - a. Bronze Angle Valves: Class 125 **OR** Class 150, **as directed**, bronze **OR** nonmetallic, **as directed**, disc.



- b. Ball Valves: One **OR** Two **OR** Three, **as directed**, piece, full **OR** regular **OR** reduced, **as directed**, port, brass **OR** bronze, **as directed**, with brass **OR** bronze **OR** stainless-steel, **as directed**, trim.
- c. Bronze Swing Check Valves: Class 125 **OR** Class 150, **as directed**, bronze **OR** nonmetallic, **as directed**, disc.
- d. Bronze Gate Valves: Class 125 **OR** Class 150, **as directed**, NRS **OR** RS, **as directed**, bronze.
- e. Globe Valves: Class 125 **OR** 150, **as directed**, bronze, bronze **OR** nonmetallic, **as directed**, disc.
- 2. Pipe Sizes **NPS 2-1/2 (DN 65)** and Larger:
 - a. Iron Valves, **NPS 2-1/2 to NPS 4 (DN 65 to DN 100)**: May be provided with threaded ends instead of flanged ends.
 - b. Ball Valves, **NPS 2-1/2 to NPS 10 (DN 65 to DN 250)**: Class 150, iron.
 - c. High-Performance Butterfly Valves: Class 150 **OR** Class 300, **as directed**, single flange.
 - d. Iron Swing Check Valves: Class 125 **OR** Class 250, **as directed**, metal **OR** nonmetallic-to-metal, **as directed**, seats.
 - e. Iron Swing Check Valves with Closure Control, **NPS 2-1/2 to NPS 12 (DN 65 to DN 300)**: Class 125, lever and spring **OR** weight, **as directed**.
 - f. Iron Gate Valves: Class 125 **OR** Class 250, **as directed**, NRS **OR** OS&Y, **as directed**.
 - g. Iron Globe Valves, **NPS 2-1/2 to NPS 12 (DN 65 to DN 300)**: Class 125 **OR** Class 250, **as directed**.
- I. Steam-Condensate Valve Schedule
 - 1. Pipe **NPS 2 (DN 50)** and Smaller:
 - a. Bronze Angle Valves: Class 125 **OR** Class 150, **as directed**, bronze **OR** nonmetallic, **as directed**, disc.
 - b. Ball Valves: One **OR** Two **OR** Three, **as directed**, piece, full **OR** regular **OR** reduced, **as directed**, port, brass **OR** bronze, **as directed**, with brass **OR** bronze **OR** stainless-steel, **as directed**, trim.
 - c. Bronze Swing Check Valves: Class 125 **OR** Class 150, **as directed**, bronze **OR** nonmetallic, **as directed**, disc.
 - d. Bronze Gate Valves: Class 125 **OR** Class 150, **as directed**, NRS **OR** RS, **as directed**.
 - e. Bronze Globe Valves: Class 125 **OR** Class 150, **as directed**, bronze **OR** nonmetallic, **as directed**, disc.
 - 2. Pipe **NPS 2-1/2 (DN 65)** and Larger:
 - a. Iron Valves, **NPS 2-1/2 to NPS 4 (DN 65 to DN 100)**: May be provided with threaded ends instead of flanged ends.
 - b. Iron Ball Valves, **NPS 2-1/2 to NPS 10 (DN 65 to DN 250)**: Class 150.
 - c. High-Performance Butterfly Valves: Class 150 **OR** Class 300, **as directed**, single flange.
 - d. Iron Swing Check Valves: Class 125 **OR** Class 250, **as directed**, metal **OR** nonmetallic-to-metal, **as directed**, seats.
 - e. Iron Swing Check Valves with Closure Control: Class 125, lever and spring **OR** weight, **as directed**.
 - f. Iron Gate Valves: Class 125 **OR** Class 250, **as directed**, NRS **OR** OS&Y, **as directed**.
 - g. Iron Globe Valves, **NPS 2-1/2 to NPS 12 (DN 65 to DN 300)**: Class 125 **OR** Class 250, **as directed**.
 - h. Lubricated Plug Valves: Class 125 **OR** Class 250, **as directed**, regular gland **OR** cylindrical, **as directed**, threaded **OR** flanged, **as directed**.

END OF SECTION 21 05 23 00b



Task	Specification	Specification Description
21 05 23 00	07 63 00 00	Common Work Results for Fire Suppression

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SECTION 21 05 48 13 - VIBRATION AND SEISMIC CONTROLS FOR FIRE-SUPPRESSION PIPING AND EQUIPMENT

1.1 GENERAL

A. Description Of Work

1. This specification covers the furnishing and installation of vibration and seismic controls for fire-suppression piping and equipment. Products shall be as follows or as directed by the Owner. Installation procedures shall be in accordance with the products manufacturer's recommendations. Demolition and removal of materials shall be as required to support the work.

B. Summary

1. This Section includes the following:
 - a. Isolation pads.
 - b. Isolation mounts.
 - c. Restrained elastomeric isolation mounts.
 - d. Restraining braces.

C. Definitions

1. IBC: International Building Code.
2. ICC-ES: ICC-Evaluation Service.
3. OSHPD: Office of Statewide Health Planning and Development for the State of California.

D. Performance Requirements

1. Seismic-Restraint Loading:
 - a. Site Class as Defined in the IBC: **A OR B OR C OR D OR E OR F, as directed.**
 - b. Assigned Seismic Use Group or Building Category as Defined in the IBC: **I OR II OR III, as directed.**
 - 1) Component Importance Factor: **1.0 OR 1.5, as directed.**
 - 2) Component Response Modification Factor: **1.5 OR 2.5 OR 3.5 OR 5.0, as directed.**
 - 3) Component Amplification Factor: **1.0 OR 2.5, as directed.**
 - c. Design Spectral Response Acceleration at Short Periods (0.2 Second): As required to meet Project requirements.
 - d. Design Spectral Response Acceleration at 1-Second Period: As required to meet Project requirements.

E. Submittals

1. Product Data: For each product indicated.
2. Delegated-Design Submittal: For vibration isolation and seismic-restraint calculations and details indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
3. Welding certificates.
4. Qualification Data: For professional engineer.

F. Quality Assurance

1. Comply with seismic-restraint requirements in the IBC and NFPA 13 unless requirements in this Section are more stringent.
2. Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
3. Seismic-restraint devices shall have horizontal and vertical load testing and analysis and shall bear anchorage preapproval OPA number from OSHPD, preapproval by ICC-ES, or preapproval by another agency acceptable to authorities having jurisdiction, showing maximum seismic-restraint ratings. Ratings based on independent testing are preferred to ratings based on

Vibration And Seismic Controls For Fire-Suppression Piping And Equipment



calculations. If preapproved ratings are not available, submittals based on independent testing are preferred. Calculations (including combining shear and tensile loads) to support seismic-restraint designs must be signed and sealed by a qualified professional engineer.

1.2 PRODUCTS

A. Vibration Isolators

1. Pads: Arranged in single or multiple layers of sufficient stiffness for uniform loading over pad area, molded with a nonslip pattern and galvanized-steel baseplates, and factory cut to sizes that match requirements of supported equipment.
 - a. Resilient Material: Oil- and water-resistant neoprene **OR** rubber **OR** hermetically sealed compressed fiberglass, **as directed**.
2. Mounts: Double-deflection type, with molded, oil-resistant rubber, hermetically sealed compressed fiberglass, or neoprene isolator elements with factory-drilled, encapsulated top plate for bolting to equipment and with baseplate for bolting to structure. Color-code or otherwise identify to indicate capacity range.
 - a. Materials: Cast-ductile-iron or welded steel housing containing two separate and opposing, oil-resistant rubber or neoprene elements that prevent central threaded element and attachment hardware from contacting the housing during normal operation.
 - b. Neoprene: Shock-absorbing materials compounded according to the standard for bridge-bearing neoprene as defined by AASHTO.
3. Restrained Mounts: All-directional mountings with seismic restraint.
 - a. Materials: Cast-ductile-iron or welded steel housing containing two separate and opposing, oil-resistant rubber or neoprene elements that prevent central threaded element and attachment hardware from contacting the housing during normal operation.
 - b. Neoprene: Shock-absorbing materials compounded according to the standard for bridge-bearing neoprene as defined by AASHTO.

B. Seismic-Restraint Devices

1. General Requirements for Restraint Components: Rated strengths, features, and applications shall be as defined in reports by an evaluation service member of ICC-ES **OR** OSHPD **OR** an agency acceptable to authorities having jurisdiction, **as directed**.
 - a. Structural Safety Factor: Allowable strength in tension, shear, and pullout force of components shall be at least four times the maximum seismic forces to which they will be subjected.
2. Channel Support System: MFMA-3, shop- or field-fabricated support assembly made of slotted steel channels with accessories for attachment to braced component at one end and to building structure at the other end and other matching components and with corrosion-resistant coating; and rated in tension, compression, and torsion forces.
3. Hanger Rod Stiffener: Steel tube or steel slotted-support-system sleeve with internally bolted connections **OR** Reinforcing steel angle clamped, **as directed**, to hanger rod.
4. Bushings for Floor-Mounted Equipment Anchor Bolts: Neoprene bushings designed for rigid equipment mountings, and matched to type and size of anchor bolts and studs.
5. Bushing Assemblies for Wall-Mounted Equipment Anchorage: Assemblies of neoprene elements and steel sleeves designed for rigid equipment mountings and matched to type and size of attachment devices used.
6. Resilient Isolation Washers and Bushings: One-piece, molded, oil- and water-resistant neoprene, with a flat washer face.
7. Mechanical Anchor Bolts: Drilled-in and stud-wedge or female-wedge type in zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchor bolts with strength required for anchor and as tested according to ASTM E 488. Minimum length of eight times diameter.

8. Adhesive Anchor Bolts: Drilled-in and capsule anchor system containing polyvinyl or urethane methacrylate-based resin and accelerator, or injected polymer or hybrid mortar adhesive. Provide anchor bolts and hardware with zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchor bolts with strength required for anchor and as tested according to ASTM E 488.

C. Factory Finishes

1. Finish
 - a. Manufacturer's standard prime-coat finish ready for field painting.
OR
Manufacturer's standard paint applied to factory-assembled and -tested equipment before shipping.
 - 1) Powder coating on springs and housings.
 - 2) All hardware shall be galvanized. Hot-dip galvanize metal components for exterior use.
 - 3) Baked enamel or powder coat for metal components on isolators for interior use.
 - 4) Color-code or otherwise mark vibration isolation and seismic-control devices to indicate capacity range.

1.3 EXECUTION

A. Applications

1. Multiple Pipe Supports: Secure pipes to trapeze member with clamps approved for application by an evaluation service member of ICC-ES **OR** OSHPD **OR** an agency acceptable to authorities having jurisdiction, **as directed**.
2. Hanger Rod Stiffeners: Install hanger rod stiffeners where indicated or scheduled on Drawings to receive them and where required to prevent buckling of hanger rods due to seismic forces.
3. Strength of Support and Seismic-Restraint Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static and seismic loads within specified loading limits.

B. Vibration-Control And Seismic-Restraint Device Installation

1. Equipment Restraints:
 - a. Install resilient bolt isolation washers on equipment anchor bolts where clearance between anchor and adjacent surface exceeds **0.125 inch (3.2 mm)**.
 - b. Install seismic-restraint devices using methods approved by an evaluation service member of ICC-ES **OR** OSHPD **OR** an agency acceptable to authorities having jurisdiction, **as directed**, providing required submittals for component.
2. Piping Restraints:
 - a. Comply with requirements in MSS SP-127 and NFPA 13.
 - b. Space lateral supports a maximum of **40 feet (12 m)** o.c., and longitudinal supports a maximum of **80 feet (24 m)** o.c.
 - c. Brace a change of direction longer than **12 feet (3.7 m)**.
3. Install cables so they do not bend across edges of adjacent equipment or building structure.
4. Install seismic-restraint devices using methods approved by an evaluation service member of ICC-ES **OR** OSHPD **OR** an agency acceptable to authorities having jurisdiction, **as directed**, providing required submittals for component.
5. Install bushing assemblies for anchor bolts for floor-mounted equipment, arranged to provide resilient media between anchor bolt and mounting hole in concrete base.
6. Install bushing assemblies for mounting bolts for wall-mounted equipment, arranged to provide resilient media where equipment or equipment-mounting channels are attached to wall.
7. Attachment to Structure: If specific attachment is not indicated, anchor bracing to structure at flanges of beams, at upper truss chords of bar joists, or at concrete members.
8. Drilled-in Anchors:

- a. Identify position of reinforcing steel and other embedded items prior to drilling holes for anchors. Do not damage existing reinforcing or embedded items during coring or drilling. Notify the structural engineer if reinforcing steel or other embedded items are encountered during drilling. Locate and avoid prestressed tendons, electrical and telecommunications conduit, and gas lines.
- b. Do not drill holes in concrete or masonry until concrete, mortar, or grout has achieved full design strength.
- c. Wedge Anchors: Protect threads from damage during anchor installation. Heavy-duty sleeve anchors shall be installed with sleeve fully engaged in the structural element to which anchor is to be fastened.
- d. Adhesive Anchors: Clean holes to remove loose material and drilling dust prior to installation of adhesive. Place adhesive in holes proceeding from the bottom of the hole and progressing toward the surface in such a manner as to avoid introduction of air pockets in the adhesive.
- e. Set anchors to manufacturer's recommended torque, using a torque wrench.
- f. Install zinc-coated steel anchors for interior and stainless-steel anchors for exterior applications.

C. Accommodation Of Differential Seismic Motion

1. Install flexible connections in piping where they cross seismic joints, where adjacent sections or branches are supported by different structural elements, and where the connections terminate with connection to equipment that is anchored to a different structural element from the one supporting the connections as they approach equipment. Comply with requirements in Division 21 Section "Wet-pipe Sprinkler Systems" for piping flexible connections.

END OF SECTION 21 05 48 13

SECTION 21 07 00 00 - FIRE-SUPPRESSION SYSTEMS INSULATION

1.1 GENERAL

A. Description Of Work

1. This specification covers the furnishing and installation of materials for fire-suppression systems insulation. Products shall be as follows or as directed by the Owner. Installation procedures shall be in accordance with the products manufacturer's recommendations. Demolition and removal of materials shall be as required to support the work.

B. Summary

1. Section Includes:
 - a. Insulation Materials:
 - 1) Calcium silicate.
 - 2) Cellular glass.
 - 3) Flexible elastomeric.
 - 4) Mineral fiber.
 - 5) Phenolic.
 - 6) Polyisocyanurate.
 - 7) Polyolefin.
 - 8) Polystyrene.
 - b. Insulating cements.
 - c. Adhesives.
 - d. Mastics.
 - e. Lagging adhesives.
 - f. Sealants.
 - g. Factory-applied jackets.
 - h. Field-applied fabric-reinforcing mesh.
 - i. Field-applied cloths.
 - j. Field-applied jackets.
 - k. Tapes.
 - l. Securements.
 - m. Corner angles.

C. Submittals

1. Product Data: For each type of product indicated.
2. LEED Submittal:
 - a. Product Data for Credit EQ 4.1: For adhesives and sealants, including printed statement of VOC content.
3. Shop Drawings:
 - a. Detail application of protective shields, saddles, and inserts at hangers for each type of insulation and hanger.
 - b. Detail attachment and covering of heat tracing inside insulation.
 - c. Detail insulation application at pipe expansion joints for each type of insulation.
 - d. Detail insulation application at elbows, fittings, flanges, valves, and specialties for each type of insulation.
 - e. Detail removable insulation at piping specialties and equipment connections.
 - f. Detail application of field-applied jackets.
 - g. Detail application at linkages of control devices.
 - h. Detail field application for fire-suppression water storage tanks.
4. Field quality-control reports.

D. Quality Assurance

1. Fire-Test-Response Characteristics: Insulation and related materials shall have fire-test-response characteristics indicated, as determined by testing identical products per ASTM E 84, by a testing and inspecting agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, and cement material containers, with appropriate markings of applicable testing and inspecting agency.
 - a. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.
 - b. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 or less.

E. Delivery, Storage, And Handling

1. Packaging: Insulation material containers shall be marked by manufacturer with appropriate ASTM standard designation, type and grade, and maximum use temperature.

1.2 PRODUCTS

A. Insulation Materials

1. Comply with requirements in Part 1.3 schedule articles for where insulating materials shall be applied.
2. Products shall not contain asbestos, lead, mercury, or mercury compounds.
3. Products that come in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C 871.
4. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.
5. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.
6. Calcium Silicate:
 - a. Preformed Pipe Sections: Flat-, curved-, and grooved-block sections of noncombustible, inorganic, hydrous calcium silicate with a non-asbestos fibrous reinforcement. Comply with ASTM C 533, Type I.
 - b. Prefabricated Fitting Covers: Comply with ASTM C 450 and ASTM C 585 for dimensions used in preforming insulation to cover valves, elbows, tees, and flanges.
7. Cellular Glass: Inorganic, incombustible, foamed or cellulated glass with annealed, rigid, hermetically sealed cells. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
 - a. Block Insulation: ASTM C 552, Type I.
 - b. Special-Shaped Insulation: ASTM C 552, Type III.
 - c. Board Insulation: ASTM C 552, Type IV.
 - d. Preformed Pipe Insulation without Jacket: Comply with ASTM C 552, Type II, Class 1.
 - e. Preformed Pipe Insulation with Factory-Applied ASJ **OR** ASJ-SSL, **as directed**: Comply with ASTM C 552, Type II, Class 2.
 - f. Factory fabricate shapes according to ASTM C 450 and ASTM C 585.
8. Flexible Elastomeric: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C 534, Type I for tubular materials and Type II for sheet materials.
9. Mineral-Fiber Blanket Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 553, Type II and ASTM C 1290, Type I. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
10. Mineral-Fiber Board Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 612, Type IA or Type IB. For equipment applications, provide insulation without factory-applied jacket **OR** with factory-applied ASJ **OR** with factory-applied FSK jacket, **as directed**. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
11. Mineral-Fiber, Preformed Pipe Insulation:
 - a. Type I, **850 deg F (454 deg C)** Materials: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 547, Type I, Grade A, without factory-applied

- jacket **OR** with factory-applied ASJ **OR** with factory-applied ASJ-SSL, **as directed**. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
- b. Type II, 1200 deg F (649 deg C) Materials: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 547, Type II, Grade A, without factory-applied jacket **OR** with factory-applied ASJ **OR** with factory-applied ASJ-SSL, **as directed**. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
12. Mineral-Fiber, Pipe and Tank Insulation: Mineral or glass fibers bonded with a thermosetting resin. Semirigid board material with factory-applied ASJ **OR** FSK jacket, **as directed**, complying with ASTM C 1393, Type II or Type IIIA Category 2, or with properties similar to ASTM C 612, Type IB. Nominal density is 2.5 lb/cu. ft. (40 kg/cu. m) or more. Thermal conductivity (k-value) at 100 deg F (55 deg C) is 0.29 Btu x in./h x sq. ft. x deg F (0.042 W/m x K) or less. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
 13. Phenolic:
 - a. Preformed pipe insulation of rigid, expanded, closed-cell structure. Comply with ASTM C 1126, Type III, Grade 1.
 - b. Block insulation of rigid, expanded, closed-cell structure. Comply with ASTM C 1126, Type II, Grade 1.
 - c. Factory fabricate shapes according to ASTM C 450 and ASTM C 585.
 - d. Factory-Applied Jacket: Requirements are specified in "Factory-Applied Jackets" Article.
 - 1) Preformed Pipe Insulation: None **OR** ASJ, **as directed**.
 - 2) Board for Equipment Applications: None **OR** ASJ, **as directed**.
 14. Polyisocyanurate: Unfaced, preformed, rigid cellular polyisocyanurate material intended for use as thermal insulation.
 - a. Comply with ASTM C 591, Type I or Type IV, except thermal conductivity (k-value) shall not exceed 0.19 Btu x in./h x sq. ft. x deg F (0.027 W/m x K) at 75 deg F (24 deg C) after 180 days of aging.
 - b. Flame-spread index shall be 25 or less and smoke-developed index shall be 50 or less for thickness up to 1-1/2 inches (38 mm) as tested by ASTM E 84.
 - c. Fabricate shapes according to ASTM C 450 and ASTM C 585.
 - d. Factory-Applied Jacket: Requirements are specified in "Factory-Applied Jackets" Article.
 - 1) Pipe Applications: None **OR** ASJ **OR** ASJ-SSL **OR** PVDC **OR** PVDC-SSL, **as directed**.
 - 2) Equipment Applications: None **OR** ASJ **OR** ASJ-SSL **OR** PVDC **OR** PVDC-SSL, **as directed**.
 15. Polyolefin: Unicellular, polyethylene thermal plastic insulation. Comply with ASTM C 534 or ASTM C 1427, Type I, Grade 1 for tubular materials and Type II, Grade 1 for sheet materials.
 16. Polystyrene: Rigid, extruded cellular polystyrene intended for use as thermal insulation. Comply with ASTM C 578, Type IV or Type XIII, except thermal conductivity (k-value) shall not exceed 0.26 Btu x in./h x sq. ft. x deg F (0.038 W/m x K) after 180 days of aging. Fabricate shapes according to ASTM C 450 and ASTM C 585.
- B. Insulating Cements
1. Mineral-Fiber Insulating Cement: Comply with ASTM C 195.
 2. Expanded or Exfoliated Vermiculite Insulating Cement: Comply with ASTM C 196.
 3. Mineral-Fiber, Hydraulic-Setting Insulating and Finishing Cement: Comply with ASTM C 449/C 449M.
- C. Adhesives
1. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated, unless otherwise indicated.
 2. Calcium Silicate Adhesive: Fibrous, sodium-silicate-based adhesive with a service temperature range of 50 to 800 deg F (10 to 427 deg C).
 - a. For indoor applications, use adhesive that has a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).



3. Cellular-Glass, Phenolic, Polyisocyanurate, and Polystyrene Adhesive: Solvent-based resin adhesive, with a service temperature range of **minus 75 to plus 300 deg F** (**minus 59 to plus 149 deg C**).
 - a. For indoor applications, use adhesive that has a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
4. Flexible Elastomeric and Polyolefin Adhesive: Comply with MIL-A-24179A, Type II, Class I.
 - a. For indoor applications, use adhesive that has a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
5. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.
 - a. For indoor applications, use adhesive that has a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
6. Polystyrene Adhesive: Solvent- or water-based, synthetic resin adhesive with a service temperature range of **minus 20 to plus 140 deg F** (**29 to plus 60 deg C**).
7. ASJ Adhesive, and FSK and PVDC Jacket Adhesive: Comply with MIL-A-3316C, Class 2, Grade A, for bonding insulation jacket lap seams and joints.
 - a. For indoor applications, use adhesive that has a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
8. PVC Jacket Adhesive: Compatible with PVC jacket.
 - a. For indoor applications, use adhesive that has a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

D. Mastics

1. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL-C-19565C, Type II.
 - a. For indoor applications, use mastics that have a VOC content of **<Insert value>** g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
2. Vapor-Barrier Mastic: Water based; suitable for indoor and outdoor use on below ambient services.
 - a. Water-Vapor Permeance: ASTM E 96, Procedure B, **0.013 perm** (**0.009 metric perm**) at **43-mil (1.09-mm)** dry film thickness.
 - b. Service Temperature Range: **Minus 20 to plus 180 deg F** (**Minus 29 to plus 82 deg C**).
 - c. Solids Content: ASTM D 1644, 59 percent by volume and 71 percent by weight.
 - d. Color: White.
3. Vapor-Barrier Mastic: Solvent based; suitable for outdoor use on below ambient services.
 - a. Water-Vapor Permeance: ASTM F 1249, **0.05 perm** (**0.033 metric perm**) at **30-mil (0.8-mm)** dry film thickness.
 - b. Service Temperature Range: **Minus 50 to plus 220 deg F** (**Minus 46 to plus 104 deg C**).
 - c. Solids Content: ASTM D 1644, 33 percent by volume and 46 percent by weight.
 - d. Color: White.
4. Breather Mastic: Water based; suitable for indoor and outdoor use on above ambient services.
 - a. Water-Vapor Permeance: ASTM F 1249, **3 perms** (**2 metric perms**) at **0.0625-inch (1.6-mm)** dry film thickness.
 - b. Service Temperature Range: **Minus 20 to plus 200 deg F** (**Minus 29 to plus 93 deg C**).
 - c. Solids Content: 63 percent by volume and 73 percent by weight.
 - d. Color: White.

E. Lagging Adhesives

1. Description: Comply with MIL-A-3316C, Class I, Grade A, and shall be compatible with insulation materials, jackets, and substrates.
 - a. For indoor applications, use lagging adhesives that have a VOC content of **<Insert value>** g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 - b. Fire-resistant, water-based lagging adhesive and coating for use indoors to adhere fire-resistant lagging cloths over equipment and pipe insulation.
 - c. Service Temperature Range: **Minus 50 to plus 180 deg F** (**Minus 46 to plus 82 deg C**).
 - d. Color: White.

F. Sealants

1. Joint Sealants:

- a. Materials shall be compatible with insulation materials, jackets, and substrates.
- b. Permanently flexible, elastomeric sealant.
- c. Service Temperature Range: **Minus 100 to plus 300 deg F** (Minus 73 to plus 149 deg C).
- d. Color: White or gray.
- e. For indoor applications, use sealants that have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2. FSK and Metal Jacket Flashing Sealants:

- a. Materials shall be compatible with insulation materials, jackets, and substrates.
- b. Fire- and water-resistant, flexible, elastomeric sealant.
- c. Service Temperature Range: **Minus 40 to plus 250 deg F** (Minus 40 to plus 121 deg C).
- d. Color: Aluminum.
- e. For indoor applications, use sealants that have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

3. ASJ Flashing Sealants, and Vinyl, PVDC, and PVC Jacket Flashing Sealants:

- a. Materials shall be compatible with insulation materials, jackets, and substrates.
- b. Fire- and water-resistant, flexible, elastomeric sealant.
- c. Service Temperature Range: **Minus 40 to plus 250 deg F** (Minus 40 to plus 121 deg C).
- d. Color: White.
- e. For indoor applications, use sealants that have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

G. Factory-Applied Jackets

1. Insulation system schedules indicate factory-applied jackets on various applications. When factory-applied jackets are indicated, comply with the following:

- a. ASJ: White, kraft-paper, fiberglass-reinforced scrim with aluminum-foil backing; complying with ASTM C 1136, Type I.
- b. ASJ-SSL: ASJ with self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip; complying with ASTM C 1136, Type I.
- c. FSK Jacket: Aluminum-foil, fiberglass-reinforced scrim with kraft-paper backing; complying with ASTM C 1136, Type II.
- d. PVDC Jacket for Indoor Applications: **4-mil- (0.10-mm-)** thick, white PVDC biaxially oriented barrier film with a permeance at **0.02 perms (0.013 metric perms)** when tested according to ASTM E 96 and with a flame-spread index of 5 and a smoke-developed index of 20 when tested according to ASTM E 84.
- e. PVDC Jacket for Outdoor Applications: **6-mil- (0.15-mm-)** thick, white PVDC biaxially oriented barrier film with a permeance at **0.01 perms (0.007 metric perms)** when tested according to ASTM E 96 and with a flame-spread index of 5 and a smoke-developed index of 25 when tested according to ASTM E 84.
- f. PVDC-SSL Jacket: PVDC jacket with a self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip.

H. Field-Applied Fabric-Reinforcing Mesh

1. Woven Glass-Fiber Fabric for Pipe Insulation: Approximately **2 oz./sq. yd. (68 g/sq. m)** with a thread count of **10 strands by 10 strands/sq. inch (4 strands by 4 strands/sq. mm)** for covering pipe and pipe fittings.
2. Woven Glass-Fiber Fabric for Equipment Insulation: Approximately **6 oz./sq. yd. (203 g/sq. m)** with a thread count of **5 strands by 5 strands/sq. inch (2 strands by 2 strands/sq. mm)** for covering equipment.
3. Woven Polyester Fabric: Approximately **1 oz./sq. yd. (34 g/sq. m)** with a thread count of **10 strands by 10 strands/sq. inch (4 strands by 4 strands/sq. mm)**, in a Leno weave.

I. Field-Applied Cloths

1. Woven Glass-Fiber Fabric: Comply with MIL-C-20079H, Type I, plain weave, and presized a minimum of **8 oz./sq. yd. (271 g/sq. m)**.



J. Field-Applied Jackets

1. Field-applied jackets shall comply with ASTM C 921, Type I, unless otherwise indicated.
2. PVC Jacket: High-impact-resistant, UV-resistant PVC complying with ASTM D 1784, Class 16354-C; thickness as scheduled; roll stock ready for shop or field cutting and forming. Thickness is indicated in field-applied jacket schedules.
 - a. Adhesive: As recommended by jacket material manufacturer.
 - b. Color: White **OR** Color-code jackets based on system. Color as selected by the Owner, **as directed**.
 - c. Factory-fabricated fitting covers to match jacket if available; otherwise, field fabricate.
 - 1) Shapes: 45- and 90-degree, short- and long-radius elbows, tees, valves, flanges, unions, reducers, end caps, soil-pipe hubs, traps, mechanical joints, and P-trap and supply covers for lavatories.
 - d. Factory-fabricated tank heads and tank side panels.
3. Metal Jacket:
 - a. Aluminum Jacket: Comply with **ASTM B 209 (ASTM B 209M)**, Alloy 3003, 3005, 3105 or 5005, Temper H-14.
 - 1) Sheet and roll stock ready for shop or field sizing **OR** Factory cut and rolled to size, **as directed**.
 - 2) Finish and thickness are indicated in field-applied jacket schedules.
 - 3) Moisture Barrier for Indoor Applications: **1-mil- (0.025-mm-)** thick, heat-bonded polyethylene and kraft paper **OR 3-mil- (0.075-mm-)** thick, heat-bonded polyethylene and kraft paper **OR 2.5-mil- (0.063-mm-)** thick Polysurlyn, **as directed**.
 - 4) Moisture Barrier for Outdoor Applications: **3-mil- (0.075-mm-)** thick, heat-bonded polyethylene and kraft paper **OR 2.5-mil- (0.063-mm-)** thick Polysurlyn, **as directed**.
 - 5) Factory-Fabricated Fitting Covers:
 - a) Same material, finish, and thickness as jacket.
 - b) Preformed 2-piece or gore, 45- and 90-degree, short- and long-radius elbows.
 - c) Tee covers.
 - d) Flange and union covers.
 - e) End caps.
 - f) Beveled collars.
 - g) Valve covers.
 - h) Field fabricate fitting covers only if factory-fabricated fitting covers are not available.
 - b. Stainless-Steel Jacket: ASTM A 167 or ASTM A 240/A 240M.
 - 1) Sheet and roll stock ready for shop or field sizing **OR** Factory cut and rolled to size, **as directed**.
 - 2) Material, finish, and thickness are indicated in field-applied jacket schedules.
 - 3) Moisture Barrier for Indoor Applications: **1-mil- (0.025-mm-)** thick, heat-bonded polyethylene and kraft paper **OR 3-mil- (0.075-mm-)** thick, heat-bonded polyethylene and kraft paper **OR 2.5-mil- (0.063-mm-)** thick Polysurlyn, **as directed**.
 - 4) Moisture Barrier for Outdoor Applications: **3-mil- (0.075-mm-)** thick, heat-bonded polyethylene and kraft paper **OR 2.5-mil- (0.063-mm-)** thick Polysurlyn, **as directed**.
 - 5) Factory-Fabricated Fitting Covers:
 - a) Same material, finish, and thickness as jacket.
 - b) Preformed 2-piece or gore, 45- and 90-degree, short- and long-radius elbows.
 - c) Tee covers.
 - d) Flange and union covers.
 - e) End caps.
 - f) Beveled collars.
 - g) Valve covers.
 - h) Field fabricate fitting covers only if factory-fabricated fitting covers are not available.

K. Tapes

1. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C 1136.
 - a. Width: **3 inches** (75 mm).
 - b. Thickness: **11.5 mils** (0.29 mm).
 - c. Adhesion: **90 ounces force/inch** (1.0 N/mm) in width.
 - d. Elongation: 2 percent.
 - e. Tensile Strength: **40 lbf/inch** (7.2 N/mm) in width.
 - f. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.
2. FSK Tape: Foil-face, vapor-retarder tape matching factory-applied jacket with acrylic adhesive; complying with ASTM C 1136.
 - a. Width: **3 inches** (75 mm).
 - b. Thickness: **6.5 mils** (0.16 mm).
 - c. Adhesion: **90 ounces force/inch** (1.0 N/mm) in width.
 - d. Elongation: 2 percent.
 - e. Tensile Strength: **40 lbf/inch** (7.2 N/mm) in width.
 - f. FSK Tape Disks and Squares: Precut disks or squares of FSK tape.
3. PVC Tape: White vapor-retarder tape matching field-applied PVC jacket with acrylic adhesive. Suitable for indoor and outdoor applications.
 - a. Width: **2 inches** (50 mm).
 - b. Thickness: **6 mils** (0.15 mm).
 - c. Adhesion: **64 ounces force/inch** (0.7 N/mm) in width.
 - d. Elongation: 500 percent.
 - e. Tensile Strength: **18 lbf/inch** (3.3 N/mm) in width.
4. Aluminum-Foil Tape: Vapor-retarder tape with acrylic adhesive.
 - a. Width: **2 inches** (50 mm).
 - b. Thickness: **3.7 mils** (0.093 mm).
 - c. Adhesion: **100 ounces force/inch** (1.1 N/mm) in width.
 - d. Elongation: 5 percent.
 - e. Tensile Strength: **34 lbf/inch** (6.2 N/mm) in width.
5. PVDC Tape for Indoor Applications: White vapor-retarder PVDC tape with acrylic adhesive.
 - a. Width: **3 inches** (75 mm).
 - b. Film Thickness: **4 mils** (0.10 mm).
 - c. Adhesive Thickness: **1.5 mils** (0.04 mm).
 - d. Elongation at Break: 145 percent.
 - e. Tensile Strength: **55 lbf/inch** (10.1 N/mm) in width.
6. PVDC Tape for Outdoor Applications: White vapor-retarder PVDC tape with acrylic adhesive.
 - a. Width: **3 inches** (75 mm).
 - b. Film Thickness: **6 mils** (0.15 mm).
 - c. Adhesive Thickness: **1.5 mils** (0.04 mm).
 - d. Elongation at Break: 145 percent.
 - e. Tensile Strength: **55 lbf/inch** (10.1 N/mm) in width.

L. Securements

1. Bands:
 - a. Stainless Steel: ASTM A 167 or ASTM A 240/A 240M, Type 304 **OR** Type 316, **as directed**; **0.015 inch** (0.38 mm) thick, **1/2 inch** (13 mm) **OR** **3/4 inch** (19 mm), **as directed**, wide with wing seal **OR** closed seal, **as directed**.
 - b. Aluminum: **ASTM B 209** (ASTM B 209M), Alloy 3003, 3005, 3105, or 5005; Temper H-14, **0.020 inch** (0.51 mm) thick, **1/2 inch** (13 mm) **OR** **3/4 inch** (19 mm), **as directed**, wide with wing seal **OR** closed seal, **as directed**.
 - c. Springs: Twin spring set constructed of stainless steel with ends flat and slotted to accept metal bands. Spring size determined by manufacturer for application.
2. Insulation Pins and Hangers:
 - a. Metal, Adhesively Attached, Perforated-Base Insulation Hangers: Baseplate welded to projecting spindle that is capable of holding insulation, of thickness indicated, securely in

position indicated when self-locking washer is in place. Comply with the following requirements:

- 1) Baseplate: Perforated, galvanized carbon-steel sheet, **0.030 inch (0.76 mm)** thick by **2 inches (50 mm)** square.
- 2) Spindle: Copper- or zinc-coated, low carbon steel **OR** Aluminum **OR** Stainless steel, **as directed**, fully annealed, **0.106-inch- (2.6-mm-)** diameter shank, length to suit depth of insulation indicated.
- 3) Adhesive: Recommended by hanger manufacturer. Product with demonstrated capability to bond insulation hanger securely to substrates indicated without damaging insulation, hangers, and substrates.
- b. Self-Sticking-Base Insulation Hangers: Baseplate welded to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place. Comply with the following requirements:
 - 1) Baseplate: Galvanized carbon-steel sheet, **0.030 inch (0.76 mm)** thick by **2 inches (50 mm)** square.
 - 2) Spindle: Copper- or zinc-coated, low carbon steel **OR** Aluminum **OR** Stainless steel, **as directed**, fully annealed, **0.106-inch- (2.6-mm-)** diameter shank, length to suit depth of insulation indicated.
 - 3) Adhesive-backed base with a peel-off protective cover.
- c. Insulation-Retaining Washers: Self-locking washers formed from **0.016-inch- (0.41-mm-)** thick, galvanized-steel **OR** aluminum **OR** stainless-steel, **as directed**, sheet, with beveled edge sized as required to hold insulation securely in place but not less than **1-1/2 inches (38 mm)** in diameter.
 - 1) Protect ends with capped self-locking washers incorporating a spring steel insert to ensure permanent retention of cap in exposed locations.
3. Staples: Outward-clinching insulation staples, nominal **3/4-inch- (19-mm-)** wide, stainless steel or Monel.
4. Wire: **0.080-inch (2.0-mm)** nickel-copper alloy **OR** **0.062-inch (1.6-mm)** soft-annealed, stainless steel **OR** **0.062-inch (1.6-mm)** soft-annealed, galvanized steel, **as directed**.

1.3 EXECUTION

A. Preparation

1. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.
OR
Surface Preparation: Clean and prepare surfaces to be insulated. Before insulating, apply a corrosion coating to insulated surfaces as follows:
 - a. Stainless Steel: Coat 300 series stainless steel with an epoxy primer **5 mils (0.127 mm)** thick and an epoxy finish **5 mils (0.127 mm)** thick if operating in a temperature range between **140 and 300 deg F (60 and 149 deg C)**. Consult coating manufacturer for appropriate coating materials and application methods for operating temperature range.
 - b. Carbon Steel: Coat carbon steel operating at a service temperature between **32 and 300 deg F (0 and 149 deg C)** with an epoxy coating. Consult coating manufacturer for appropriate coating materials and application methods for operating temperature range.
2. Coordinate insulation installation with the trade installing heat tracing. Comply with requirements for heat tracing that apply to insulation.
3. Mix insulating cements with clean potable water; if insulating cements are to be in contact with stainless-steel surfaces, use demineralized water.

B. General Installation Requirements

1. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of equipment and piping including fittings, valves, and specialties.

2. Install insulation materials, forms, vapor barriers or retarders, jackets, and thicknesses required for each item of equipment and pipe system as specified in insulation system schedules.
3. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.
4. Install insulation with longitudinal seams at top and bottom of horizontal runs.
5. Install multiple layers of insulation with longitudinal and end seams staggered.
6. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.
7. Keep insulation materials dry during application and finishing.
8. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.
9. Install insulation with least number of joints practical.
10. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.
 - a. Install insulation continuously through hangers and around anchor attachments.
 - b. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends at attachment to structure with vapor-barrier mastic.
 - c. Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.
 - d. Cover inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect jacket from tear or puncture by hanger, support, and shield.
11. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.
12. Install insulation with factory-applied jackets as follows:
 - a. Draw jacket tight and smooth.
 - b. Cover circumferential joints with **3-inch- (75-mm-)** wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced **4 inches (100 mm)** o.c.
 - c. Overlap jacket longitudinal seams at least **1-1/2 inches (38 mm)**. Install insulation with longitudinal seams at bottom of pipe. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at **2 inches (50 mm) OR 4 inches (100 mm), as directed**, o.c.
 - 1) For below ambient services, apply vapor-barrier mastic over staples.
 - d. Cover joints and seams with tape as recommended by insulation material manufacturer to maintain vapor seal.
 - e. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to pipe flanges and fittings.
13. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.
14. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.
15. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least **4 inches (100 mm)** beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.
16. For above ambient services, do not install insulation to the following:
 - a. Vibration-control devices.
 - b. Testing agency labels and stamps.
 - c. Nameplates and data plates.
 - d. Manholes.
 - e. Handholes.
 - f. Cleanouts.

C. Penetrations

1. Insulation Installation at Roof Penetrations: Install insulation continuously through roof penetrations.
 - a. Seal penetrations with flashing sealant.
 - b. For applications requiring only indoor insulation, terminate insulation above roof surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
 - c. Extend jacket of outdoor insulation outside roof flashing at least **2 inches (50 mm)** below top of roof flashing.
 - d. Seal jacket to roof flashing with flashing sealant.
2. Insulation Installation at Below-Grade Exterior Wall Penetrations: Terminate insulation flush with sleeve seal. Seal terminations with flashing sealant.
3. Insulation Installation at Aboveground Exterior Wall Penetrations: Install insulation continuously through wall penetrations.
 - a. Seal penetrations with flashing sealant.
 - b. For applications requiring only indoor insulation, terminate insulation inside wall surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
 - c. Extend jacket of outdoor insulation outside wall flashing and overlap wall flashing at least **2 inches (50 mm)**.
 - d. Seal jacket to wall flashing with flashing sealant.
4. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.
5. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Install insulation continuously through penetrations of fire-rated walls and partitions.
 - a. Comply with requirements in Division 07 Section "Penetration Firestopping" for firestopping and fire-resistive joint sealers.
6. Insulation Installation at Floor Penetrations:
 - a. Pipe: Install insulation continuously through floor penetrations.
 - b. Seal penetrations through fire-rated assemblies. Comply with requirements in Division 07 Section "Penetration Firestopping".

D. Equipment, Tank, And Vessel Insulation Installation

1. Secure insulation with adhesive and anchor pins and speed washers.
 - a. Apply adhesives according to manufacturer's recommended coverage rates per unit area, for 100 **OR** 50, **as directed**, percent coverage of tank and vessel surfaces.
 - b. Groove and score insulation materials to fit as closely as possible to equipment, including contours. Bevel insulation edges for cylindrical surfaces for tight joints. Stagger end joints.
 - c. Protect exposed corners with secured corner angles.
 - d. Install adhesively attached or self-sticking insulation hangers and speed washers on sides of tanks and vessels as follows:
 - 1) Do not weld anchor pins to ASME-labeled pressure vessels.
 - 2) Select insulation hangers and adhesive that are compatible with service temperature and with substrate.
 - 3) On tanks and vessels, maximum anchor-pin spacing is **3 inches (75 mm)** from insulation end joints, and **16 inches (400 mm)** o.c. in both directions.
 - 4) Do not overcompress insulation during installation.
 - 5) Cut and miter insulation segments to fit curved sides and domed heads of tanks and vessels.
 - 6) Impale insulation over anchor pins and attach speed washers.
 - 7) Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.

- e. Secure each layer of insulation with stainless-steel or aluminum bands. Select band material compatible with insulation materials.
- f. Where insulation hangers on equipment and vessels are not permitted or practical and where insulation support rings are not provided, install a girdle network for securing insulation. Stretch prestressed aircraft cable around the diameter of vessel and make taut with clamps, turnbuckles, or breather springs. Place one circumferential girdle around equipment approximately 6 inches (150 mm) from each end. Install wire or cable between two circumferential girdles 12 inches (300 mm) o.c. Install a wire ring around each end and around outer periphery of center openings, and stretch prestressed aircraft cable radially from the wire ring to nearest circumferential girdle. Install additional circumferential girdles along the body of equipment or tank at a minimum spacing of 48 inches (1200 mm) o.c. Use this network for securing insulation with tie wire or bands.
- g. Stagger joints between insulation layers at least 3 inches (75 mm).
- h. Install insulation in removable segments on equipment access doors, manholes, handholes, and other elements that require frequent removal for service and inspection.
- i. Bevel and seal insulation ends around manholes, handholes, ASME stamps, and nameplates.
- j. For equipment with surface temperatures below ambient, apply mastic to open ends, joints, seams, breaks, and punctures in insulation.
- 2. Flexible Elastomeric Thermal Insulation Installation for Tanks and Vessels: Install insulation over entire surface of tanks and vessels.
 - a. Apply 100 percent coverage of adhesive to surface with manufacturer's recommended adhesive.
 - b. Seal longitudinal seams and end joints.
- E. General Pipe Insulation Installation
 - 1. Requirements in this article generally apply to all insulation materials except where more specific requirements are specified in various pipe insulation material installation articles.
 - 2. Insulation Installation on Fittings, Valves, Strainers, Flanges, and Unions:
 - a. Install insulation over fittings, valves, strainers, flanges, unions, and other specialties with continuous thermal and vapor-retarder integrity, unless otherwise indicated.
 - b. Insulate pipe elbows using preformed fitting insulation or mitered fittings made from same material and density as adjacent pipe insulation. Each piece shall be butted tightly against adjoining piece and bonded with adhesive. Fill joints, seams, voids, and irregular surfaces with insulating cement finished to a smooth, hard, and uniform contour that is uniform with adjoining pipe insulation.
 - c. Insulate tee fittings with preformed fitting insulation or sectional pipe insulation of same material and thickness as used for adjacent pipe. Cut sectional pipe insulation to fit. Butt each section closely to the next and hold in place with tie wire. Bond pieces with adhesive.
 - d. Insulate valves using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. For valves, insulate up to and including the bonnets, valve stuffing-box studs, bolts, and nuts. Fill joints, seams, and irregular surfaces with insulating cement.
 - e. Insulate strainers using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. Fill joints, seams, and irregular surfaces with insulating cement. Insulate strainers so strainer basket flange or plug can be easily removed and replaced without damaging the insulation and jacket. Provide a removable reusable insulation cover. For below ambient services, provide a design that maintains vapor barrier.
 - f. Insulate flanges and unions using a section of oversized preformed pipe insulation. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker.
 - g. Cover segmented insulated surfaces with a layer of finishing cement and coat with a mastic. Install vapor-barrier mastic for below ambient services and a breather mastic for

above ambient services. Reinforce the mastic with fabric-reinforcing mesh. Trowel the mastic to a smooth and well-shaped contour.

- h. For services not specified to receive a field-applied jacket except for flexible elastomeric and polyolefin, install fitted PVC cover over elbows, tees, strainers, valves, flanges, and unions. Terminate ends with PVC end caps. Tape PVC covers to adjoining insulation facing using PVC tape.
 - i. Stencil or label the outside insulation jacket of each union with the word "UNION." Match size and color of pipe labels.
3. Insulate instrument connections for thermometers, pressure gages, pressure temperature taps, test connections, flow meters, sensors, switches, and transmitters on insulated pipes, vessels, and equipment. Shape insulation at these connections by tapering it to and around the connection with insulating cement and finish with finishing cement, mastic, and flashing sealant.
4. Install removable insulation covers at locations indicated. Installation shall conform to the following:
- a. Make removable flange and union insulation from sectional pipe insulation of same thickness as that on adjoining pipe. Install same insulation jacket as adjoining pipe insulation.
 - b. When flange and union covers are made from sectional pipe insulation, extend insulation from flanges or union long at least two times the insulation thickness over adjacent pipe insulation on each side of flange or union. Secure flange cover in place with stainless-steel or aluminum bands. Select band material compatible with insulation and jacket.
 - c. Construct removable valve insulation covers in same manner as for flanges except divide the two-part section on the vertical center line of valve body.
 - d. When covers are made from block insulation, make two halves, each consisting of mitered blocks wired to stainless-steel fabric. Secure this wire frame, with its attached insulation, to flanges with tie wire. Extend insulation at least **2 inches (50 mm)** over adjacent pipe insulation on each side of valve. Fill space between flange or union cover and pipe insulation with insulating cement. Finish cover assembly with insulating cement applied in two coats. After first coat is dry, apply and trowel second coat to a smooth finish.
 - e. Unless a PVC jacket is indicated in field-applied jacket schedules, finish exposed surfaces with a metal jacket.

F. Calcium Silicate Insulation Installation

- 1. Insulation Installation on Straight Pipes and Tubes:
 - a. Secure single-layer insulation with stainless-steel bands at **12-inch (300-mm)** intervals and tighten bands without deforming insulation materials.
 - b. Install 2-layer insulation with joints tightly butted and staggered at least **3 inches (75 mm)**. Secure inner layer with wire spaced at **12-inch (300-mm)** intervals. Secure outer layer with stainless-steel bands at **12-inch (300-mm)** intervals.
 - c. Apply a skim coat of mineral-fiber, hydraulic-setting cement to insulation surface. When cement is dry, apply flood coat of lagging adhesive and press on one layer of glass cloth or tape. Overlap edges at least **1 inch (25 mm)**. Apply finish coat of lagging adhesive over glass cloth or tape. Thin finish coat to achieve smooth, uniform finish.
- 2. Insulation Installation on Pipe Flanges:
 - a. Install preformed pipe insulation to outer diameter of pipe flange.
 - b. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
 - c. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of block insulation of same material and thickness as pipe insulation.
 - d. Finish flange insulation same as pipe insulation.
- 3. Insulation Installation on Pipe Fittings and Elbows:
 - a. Install preformed sections of same material as straight segments of pipe insulation when available.

- b. When preformed insulation sections of insulation are not available, install mitered sections of calcium silicate insulation. Secure insulation materials with wire or bands.
 - c. Finish fittings insulation same as pipe insulation.
 - 4. Insulation Installation on Valves and Pipe Specialties:
 - a. Install mitered segments of calcium silicate insulation to valve body. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
 - b. Install insulation to flanges as specified for flange insulation application.
 - c. Finish valve and specialty insulation same as pipe insulation.
- G. Cellular-Glass Insulation Installation
 - 1. Insulation Installation on Straight Pipes and Tubes:
 - a. Secure each layer of insulation to pipe with wire or bands and tighten bands without deforming insulation materials.
 - b. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and applicable insulation joint sealant.
 - c. For insulation with factory-applied jackets on above ambient services, secure laps with outward clinched staples at **6 inches (150 mm)** o.c.
 - d. For insulation with factory-applied jackets on below ambient services, do not staple longitudinal tabs but secure tabs with additional adhesive as recommended by insulation material manufacturer and seal with vapor-barrier mastic and flashing sealant.
 - 2. Insulation Installation on Pipe Flanges:
 - a. Install preformed pipe insulation to outer diameter of pipe flange.
 - b. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
 - c. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of cellular-glass block insulation of same thickness as pipe insulation.
 - d. Install jacket material with manufacturer's recommended adhesive, overlap seams at least **1 inch (25 mm)**, and seal joints with flashing sealant.
 - 3. Insulation Installation on Pipe Fittings and Elbows:
 - a. Install preformed sections of same material as straight segments of pipe insulation when available.
 - b. When preformed sections of insulation are not available, install mitered sections of cellular-glass insulation. Secure insulation materials with wire or bands.
 - 4. Insulation Installation on Valves and Pipe Specialties:
 - a. Install preformed sections of cellular-glass insulation to valve body.
 - b. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
 - c. Install insulation to flanges as specified for flange insulation application.
- H. Flexible Elastomeric Insulation Installation
 - 1. Seal longitudinal seams and end joints with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.
 - 2. Insulation Installation on Pipe Flanges:
 - a. Install pipe insulation to outer diameter of pipe flange.
 - b. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
 - c. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of sheet insulation of same thickness as pipe insulation.
 - d. Secure insulation to flanges and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.
 - 3. Insulation Installation on Pipe Fittings and Elbows:
 - a. Install mitered sections of pipe insulation.
 - b. Secure insulation materials and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

4. Insulation Installation on Valves and Pipe Specialties:
 - a. Install preformed valve covers manufactured of same material as pipe insulation when available.
 - b. When preformed valve covers are not available, install cut sections of pipe and sheet insulation to valve body. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
 - c. Install insulation to flanges as specified for flange insulation application.
 - d. Secure insulation to valves and specialties and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

I. Mineral-Fiber Insulation Installation

1. Insulation Installation on Straight Pipes and Tubes:
 - a. Secure each layer of preformed pipe insulation to pipe with wire or bands and tighten bands without deforming insulation materials.
 - b. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and applicable insulation joint sealant.
 - c. For insulation with factory-applied jackets on above ambient surfaces, secure laps with outward clinched staples at **6 inches (150 mm)** o.c.
 - d. For insulation with factory-applied jackets on below ambient surfaces, do not staple longitudinal tabs but secure tabs with additional adhesive as recommended by insulation material manufacturer and seal with vapor-barrier mastic and flashing sealant.
2. Insulation Installation on Pipe Flanges:
 - a. Install preformed pipe insulation to outer diameter of pipe flange.
 - b. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
 - c. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with mineral-fiber blanket insulation.
 - d. Install jacket material with manufacturer's recommended adhesive, overlap seams at least **1 inch (25 mm)**, and seal joints with flashing sealant.
3. Insulation Installation on Pipe Fittings and Elbows:
 - a. Install preformed sections of same material as straight segments of pipe insulation when available.
 - b. When preformed insulation elbows and fittings are not available, install mitered sections of pipe insulation, to a thickness equal to adjoining pipe insulation. Secure insulation materials with wire or bands.
4. Insulation Installation on Valves and Pipe Specialties:
 - a. Install preformed sections of same material as straight segments of pipe insulation when available.
 - b. When preformed sections are not available, install mitered sections of pipe insulation to valve body.
 - c. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
 - d. Install insulation to flanges as specified for flange insulation application.

J. Phenolic Insulation Installation

1. General Installation Requirements:
 - a. Secure single-layer insulation with stainless-steel bands at **12-inch (300-mm)** intervals and tighten bands without deforming insulation materials.
 - b. Install 2-layer insulation with joints tightly butted and staggered at least **3 inches (75 mm)**. Secure inner layer with **0.062-inch (1.6-mm)** wire spaced at **12-inch (300-mm)** intervals. Secure outer layer with stainless-steel bands at **12-inch (300-mm)** intervals.
2. Insulation Installation on Straight Pipes and Tubes:
 - a. Secure each layer of insulation to pipe with wire or bands and tighten bands without deforming insulation materials.

- b. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and applicable insulation joint sealant.
 - c. For insulation with factory-applied jackets on above ambient services, secure laps with outward clinched staples at **6 inches (150 mm)** o.c.
 - d. For insulation with factory-applied jackets with vapor retarders on below ambient services, do not staple longitudinal tabs but secure tabs with additional adhesive as recommended by insulation material manufacturer and seal with vapor-barrier mastic and flashing sealant.
 - 3. Insulation Installation on Pipe Flanges:
 - a. Install preformed pipe insulation to outer diameter of pipe flange.
 - b. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
 - c. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of block insulation of same material and thickness as pipe insulation.
 - 4. Insulation Installation on Pipe Fittings and Elbows:
 - a. Install preformed insulation sections of same material as straight segments of pipe insulation.
 - 5. Insulation Installation on Valves and Pipe Specialties:
 - a. Install preformed insulation sections of same material as straight segments of pipe insulation.
 - b. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
 - c. Install insulation to flanges as specified for flange insulation application.
- K. Polyisocyanurate Insulation Installation
 - 1. Insulation Installation on Straight Pipes and Tubes:
 - a. Secure each layer of insulation to pipe with tape or bands and tighten without deforming insulation materials. Orient longitudinal joints between half sections in 3 and 9 o'clock positions on the pipe.
 - b. For insulation with factory-applied jackets with vapor barriers, do not staple longitudinal tabs but secure tabs with additional adhesive or tape as recommended by insulation material manufacturer and seal with vapor-barrier mastic.
 - c. All insulation shall be tightly butted and free of voids and gaps at all joints. Vapor barrier must be continuous. Before installing jacket material, install vapor-barrier system.
 - 2. Insulation Installation on Pipe Flanges:
 - a. Install preformed pipe insulation to outer diameter of pipe flange.
 - b. Make width of insulation section same as overall width of flange and bolts, same thickness of adjacent pipe insulation, not to exceed **1-1/2-inch (38-mm)** thickness.
 - c. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of polyisocyanurate block insulation of same thickness as pipe insulation.
 - 3. Insulation Installation on Fittings and Elbows:
 - a. Install preformed sections of same material as straight segments of pipe insulation.
 - 4. Insulation Installation on Valves and Pipe Specialties:
 - a. Install preformed sections of polyisocyanurate insulation to valve body.
 - b. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
 - c. Install insulation to flanges as specified for flange insulation application.
- L. Polyolefin Insulation Installation
 - 1. Insulation Installation on Straight Pipes and Tubes:
 - a. Seal split-tube longitudinal seams and end joints with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.
 - 2. Insulation Installation on Pipe Flanges:
 - a. Install pipe insulation to outer diameter of pipe flange.

- b. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
 - c. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of polyolefin sheet insulation of same thickness as pipe insulation.
 - d. Secure insulation to flanges and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.
 3. Insulation Installation on Pipe Fittings and Elbows:
 - a. Install mitered sections of polyolefin pipe insulation.
 - b. Secure insulation materials and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.
 4. Insulation Installation on Valves and Pipe Specialties:
 - a. Install cut sections of polyolefin pipe and sheet insulation to valve body.
 - b. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
 - c. Install insulation to flanges as specified for flange insulation application.
 - d. Secure insulation to valves and specialties, and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

M. Polystyrene Insulation Installation

1. Insulation Installation on Straight Pipes and Tubes:
 - a. Secure each layer of insulation with tape or bands and tighten bands without deforming insulation materials. Orient longitudinal joints between half sections in 3 and 9 o'clock positions on the pipe.
 - b. For insulation with factory-applied jackets with vapor barriers, do not staple longitudinal tabs but secure tabs with additional adhesive or tape as recommended by insulation material manufacturer and seal with vapor-barrier mastic.
 - c. All insulation shall be tightly butted and free of voids and gaps at all joints. Vapor barrier must be continuous. Before installing jacket material, install vapor-barrier system.
2. Insulation Installation on Pipe Flanges:
 - a. Install preformed pipe insulation to outer diameter of pipe flange.
 - b. Make width of insulation section same as overall width of flange and bolts, same thickness of adjacent pipe insulation, not to exceed **1-1/2-inch (38-mm)** thickness.
 - c. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of polystyrene block insulation of same thickness as pipe insulation.
3. Insulation Installation on Pipe Fittings and Elbows:
 - a. Install preformed insulation sections of same material as straight segments of pipe insulation.
4. Insulation Installation on Valves and Pipe Specialties:
 - a. Install preformed section of polystyrene insulation to valve body.
 - b. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
 - c. Install insulation to flanges as specified for flange insulation application.

N. Field-Applied Jacket Installation

1. Where glass-cloth jackets are indicated, install directly over bare insulation or insulation with factory-applied jackets.
 - a. Draw jacket smooth and tight to surface with **2-inch (50-mm)** overlap at seams and joints.
 - b. Embed glass cloth between two **0.062-inch- (1.6-mm-)** thick coats of lagging adhesive.
 - c. Completely encapsulate insulation with coating, leaving no exposed insulation.
2. Where FSK jackets are indicated, install as follows:
 - a. Draw jacket material smooth and tight.
 - b. Install lap or joint strips with same material as jacket.

- c. Secure jacket to insulation with manufacturer's recommended adhesive.
- d. Install jacket with 1-1/2-inch (38-mm) laps at longitudinal seams and 3-inch- (75-mm-) wide joint strips at end joints.
- e. Seal openings, punctures, and breaks in vapor-retarder jackets and exposed insulation with vapor-barrier mastic.
3. Where PVC jackets are indicated, install with 1-inch (25-mm) overlap at longitudinal seams and end joints. Seal with manufacturer's recommended adhesive.
 - a. Apply two continuous beads of adhesive to seams and joints, one bead under lap and the finish bead along seam and joint edge.
4. Where metal jackets are indicated, install with 2-inch (50-mm) overlap at longitudinal seams and end joints. Overlap longitudinal seams arranged to shed water. Seal end joints with weatherproof sealant recommended by insulation manufacturer. Secure jacket with stainless-steel bands 12 inches (300 mm) o.c. and at end joints.
5. Where PVDC jackets are indicated, install as follows:
 - a. Apply three separate wraps of filament tape per insulation section to secure pipe insulation to pipe prior to installation of PVDC jacket.
 - b. Wrap factory-presizes jackets around individual pipe insulation sections with one end overlapping the previously installed sheet. Install presized jacket with an approximate overlap at butt joint of 2 inches (50 mm) over the previous section. Adhere lap seal using adhesive or SSL, and then apply 1-1/4 circumferences of appropriate PVDC tape around overlapped butt joint.
 - c. Continuous jacket can be spiral wrapped around a length of pipe insulation. Apply adhesive or PVDC tape at overlapped spiral edge. When electing to use adhesives, refer to manufacturer's written instructions for application of adhesives along this spiral edge to maintain a permanent bond.
 - d. Jacket can be wrapped in cigarette fashion along length of roll for insulation systems with an outer circumference of 33-1/2 inches (850 mm) or less. The 33-1/2-inch- (850-mm-) circumference limit allows for 2-inch- (50-mm-) overlap seal. Using the length of roll allows for longer sections of jacket to be installed at one time. Use adhesive on the lap seal. Visually inspect lap seal for "fishmouthing," and use PVDC tape along lap seal to secure joint.
 - e. Repair holes or tears in PVDC jacket by placing PVDC tape over the hole or tear and wrapping a minimum of 1-1/4 circumferences to avoid damage to tape edges.
- O. Finishes
 1. Equipment and Pipe Insulation with ASJ, Glass-Cloth, or Other Paintable Jacket Material: Paint jacket with paint system identified below and as specified in Division 07.
 - a. Flat Acrylic Finish: Two finish coats over a primer that is compatible with jacket material and finish coat paint. Add fungicidal agent to render fabric mildew proof.
 - 1) Finish Coat Material: Interior, flat, latex-emulsion size.
 2. Flexible Elastomeric Thermal Insulation: After adhesive has fully cured, apply two coats of insulation manufacturer's recommended protective coating.
 3. Color: Final color as selected by the Owner. Vary first and second coats to allow visual inspection of the completed Work.
 4. Do not field paint aluminum or stainless-steel jackets.
- P. Field Quality Control
 1. Perform tests and inspections.
 2. Tests and Inspections:
 - a. Inspect field-insulated equipment, randomly selected by the Owner, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to one location(s) for each type of equipment defined in the "Equipment Insulation Schedule" Article. For large equipment, remove only a portion adequate to determine compliance.
 - b. Inspect pipe, fittings, strainers, and valves, randomly selected by the Owner, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of

inspection shall be limited to three locations of straight pipe, three locations of threaded fittings, three locations of welded fittings, two locations of threaded strainers, two locations of welded strainers, three locations of threaded valves, and three locations of flanged valves for each pipe service defined in the "Piping Insulation Schedule, General" Article.

3. All insulation applications will be considered defective Work if sample inspection reveals noncompliance with requirements.

Q. Equipment Insulation Schedule

1. Insulation materials and thicknesses are identified below. If more than one material is listed for a type of equipment, selection from materials listed is Contractor's option.
2. Insulate indoor and outdoor equipment in paragraphs below that is not factory insulated.
3. Fire-suppression water storage tank insulation shall be one of the following:
 - a. Cellular Glass: **2 inches (50 mm)** thick.
 - b. Flexible Elastomeric: **1 inch (25 mm)** thick.
 - c. Mineral-Fiber Board: **1 inch (25 mm)** thick and **2-lb/cu. ft. (32-kg/cu. m)** OR **3-lb/cu. ft. (48-kg/cu. m)** OR **6-lb/cu. ft. (96-kg/cu. m)**, **as directed**, nominal density.
 - d. Mineral-Fiber Pipe and Tank: **1 inch (25 mm)** thick.
 - e. Phenolic: **1 inch (25 mm)** thick.
 - f. Polyisocyanurate: **1 inch (25 mm)** thick.
 - g. Polyolefin: **1 inch (25 mm)** thick.

R. Piping Insulation Schedule, General

1. Acceptable preformed pipe and tubular insulation materials and thicknesses are identified for each piping system and pipe size range. If more than one material is listed for a piping system, selection from materials listed is Contractor's option.
2. Items Not Insulated: Unless otherwise indicated, do not install insulation on the following:
 - a. Indoor fire-suppression piping.
 - b. Underground piping.

S. Indoor Piping Insulation Schedule

1. Indoor Engine Coolant Piping for Remote Radiator of Engine-Driven Fire Pump:
 - a. All Pipe Sizes: Insulation shall be one of the following:
 - 1) Calcium Silicate: **2 inches (50 mm)** thick.
 - 2) Cellular Glass: **2 inches (50 mm)** thick.
 - 3) Mineral-Fiber, Preformed Pipe, Type I or II: **2 inches (50 mm)** thick.
2. Indoor Engine Exhaust Piping and Silencer, All Pipe Sizes: Calcium silicate, **4 inches (100 mm)** thick.

T. Outdoor, Aboveground Piping Insulation Schedule

1. Outdoor Engine Coolant Piping for Remote Radiator of Engine-Driven Fire Pump:
 - a. All Pipe Sizes: Insulation shall be one of the following:
 - 1) Calcium Silicate: **2 inches (50 mm)** thick.
 - 2) Cellular Glass: **2 inches (50 mm)** thick.
 - 3) Mineral-Fiber, Preformed Pipe, Type I or II: **2 inches (50 mm)** thick.
2. Outdoor Engine Exhaust Piping and Silencer, All Pipe Sizes: Calcium silicate, **4 inches (100 mm)** thick.
3. Outdoor Fire-Suppression Piping Filled with Water:
 - a. All Pipe Sizes: Insulation shall be one of the following:
 - 1) Cellular Glass: **2 inches (50 mm)** thick.
 - 2) Flexible Elastomeric: **2 inches (50 mm)** thick.
 - 3) Mineral-Fiber, Preformed Pipe Insulation, Type I: **2 inches (50 mm)** thick.
 - 4) Phenolic: **2 inches (50 mm)** thick.
 - 5) Polyisocyanurate: **2 inches (50 mm)** thick.
 - 6) Polyolefin: **2 inches (50 mm)** thick.
 - 7) Polystyrene: **2 inches (50 mm)** thick.

U. Indoor, Field-Applied Jacket Schedule

1. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.
2. If more than one material is listed, selection from materials listed is Contractor's option.
3. Piping, Concealed:
 - a. None.
 - b. Aluminum, Smooth **OR** Corrugated **OR** Stucco Embossed, **as directed**: 0.016 inch (0.41 mm) **OR** 0.020 inch (0.51 mm) **OR** 0.024 inch (0.61 mm) **OR** 0.032 inch (0.81 mm) **OR** 0.040 inch (1.0 mm), **as directed**, thick.
 - c. Painted Aluminum, Smooth **OR** Corrugated **OR** Stucco Embossed, **as directed**: 0.016 inch (0.41 mm) **OR** 0.020 inch (0.51 mm) **OR** 0.024 inch (0.61 mm) **OR** 0.032 inch (0.81 mm), **as directed**, thick.
 - d. Stainless Steel, Type 304 **OR** Type 316, **as directed**, Smooth 2B Finish **OR** Corrugated **OR** Stucco Embossed, **as directed**: 0.010 inch (0.25 mm) **OR** 0.016 inch (0.41 mm) **OR** 0.020 inch (0.51 mm) **OR** 0.024 inch (0.61 mm), **as directed**, thick.
4. Piping, Exposed:
 - a. None.
 - b. PVC **OR** PVC, Color-Coded by System, **as directed**: 20 mils (0.5 mm) **OR** 30 mils (0.8 mm), **as directed**, thick.
 - c. Aluminum, Smooth **OR** Corrugated **OR** Stucco Embossed, **as directed**: 0.016 inch (0.41 mm) **OR** 0.020 inch (0.51 mm) **OR** 0.024 inch (0.61 mm) **OR** 0.032 inch (0.81 mm) **OR** 0.040 inch (1.0 mm), **as directed**, thick.
 - d. Painted Aluminum, Smooth **OR** Corrugated **OR** Stucco Embossed, **as directed**: 0.016 inch (0.41 mm) **OR** 0.020 inch (0.51 mm) **OR** 0.024 inch (0.61 mm) **OR** 0.032 inch (0.81 mm), **as directed**, thick.
 - e. Stainless Steel, Type 304 **OR** Type 316, **as directed**, Smooth 2B Finish **OR** Corrugated **OR** Stucco Embossed, **as directed**: 0.010 inch (0.25 mm) **OR** 0.016 inch (0.41 mm) **OR** 0.020 inch (0.51 mm) **OR** 0.024 inch (0.61 mm), **as directed**, thick.

V. Outdoor, Field-Applied Jacket Schedule

1. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.
2. If more than one material is listed, selection from materials listed is Contractor's option.
3. Equipment, Concealed:
 - a. None.
 - b. PVC **OR** PVC, Color-Coded by System, **as directed**: 20 mils (0.5 mm) **OR** 30 mils (0.8 mm), **as directed**, thick.
 - c. Aluminum, Smooth **OR** Corrugated **OR** Stucco Embossed, **as directed**: 0.016 inch (0.41 mm) **OR** 0.020 inch (0.51 mm) **OR** 0.024 inch (0.61 mm) **OR** 0.032 inch (0.81 mm) **OR** 0.040 inch (1.0 mm), **as directed**, thick.
 - d. Painted Aluminum, Smooth **OR** Corrugated **OR** Stucco Embossed, **as directed**: 0.016 inch (0.41 mm) **OR** 0.020 inch (0.51 mm) **OR** 0.024 inch (0.61 mm) **OR** 0.032 inch (0.81 mm), **as directed**, thick.
 - e. Stainless Steel, Type 304 **OR** Type 316, **as directed**, Smooth 2B Finish **OR** Corrugated **OR** Stucco Embossed, **as directed**: 0.010 inch (0.25 mm) **OR** 0.016 inch (0.41 mm) **OR** 0.020 inch (0.51 mm) **OR** 0.024 inch (0.61 mm), **as directed**, thick.
4. Equipment, Exposed, up to 48 Inches (1200 mm) in Diameter or with Flat Surfaces up to 72 Inches (1800 mm):
 - a. Aluminum **OR** Painted Aluminum, **as directed**, Smooth **OR** Corrugated **OR** Stucco Embossed, **as directed**, with Z-Shaped Locking Seam, **as directed**: 0.016 inch (0.41 mm) **OR** 0.020 inch (0.51 mm) **OR** 0.024 inch (0.61 mm) **OR** 0.032 inch (0.81 mm) **OR** 0.040 inch (1.0 mm), **as directed**, thick.
 - b. Stainless Steel, Type 304 **OR** Type 316, **as directed**, Smooth 2B Finish **OR** Corrugated **OR** Stucco Embossed, **as directed**, with Z-Shaped Locking Seam, **as directed**: 0.010 inch (0.25 mm) **OR** 0.016 inch (0.41 mm) **OR** 0.020 inch (0.51 mm) **OR** 0.024 inch (0.61 mm), **as directed**, thick.



5. Equipment, Exposed, Larger Than **48 Inches (1200 mm)** in Diameter or with Flat Surfaces Larger Than **72 Inches (1800 mm)**:
 - a. Aluminum **OR** Painted Aluminum, **as directed**, Smooth **OR** Stucco Embossed, **as directed**, with **1-1/4-Inch- (32-mm-)** Deep Corrugations **OR** **2-1/2-Inch- (65-mm-)** Deep Corrugations **OR** **4-by-1-Inch (100-by-25-mm)** Box Ribs, **as directed**: **0.032 inch (0.81 mm) OR 0.040 inch (1.0 mm)**, **as directed**, thick.
 - b. Stainless Steel, Type 304 **OR** Type 316, **as directed**, Smooth **OR** Stucco Embossed, **as directed**, with **1-1/4-Inch- (32-mm-)** Deep Corrugations **OR** **2-1/2-Inch- (65-mm-)** Deep Corrugations **OR** **4-by-1-Inch (100-by-25-mm)** Box Ribs, **as directed**: **0.020 inch (0.51 mm) OR 0.024 inch (0.61 mm)**, **as directed**, thick.
6. Outdoor Exposed Piping:
 - a. PVC: **20 mils (0.5 mm) OR 30 mils (0.8 mm) OR 40 mils (1.0 mm)**, **as directed**, thick.
 - b. Aluminum **OR** Painted Aluminum, **as directed**, Smooth **OR** Corrugated **OR** Stucco Embossed, **as directed**, with Z-Shaped Locking Seam, **as directed**: **0.016 inch (0.41 mm) OR 0.020 inch (0.51 mm) OR 0.024 inch (0.61 mm) OR 0.032 inch (0.81 mm) OR 0.040 inch (1.0 mm)**, **as directed**, thick.
 - c. Stainless Steel, Type 304 **OR** Type 316, **as directed**, Smooth 2B Finish **OR** Corrugated **OR** Stucco Embossed, **as directed** with Z-Shaped Locking Seam, **as directed**: **0.010 inch (0.25 mm) OR 0.016 inch (0.41 mm) OR 0.020 inch (0.51 mm) OR 0.024 inch (0.61 mm)**, **as directed**, thick.

END OF SECTION 21 07 00 00

SECTION 21 11 19 00 - FIRE-SUPPRESSION STANDPIPES

1.1 GENERAL

A. Description Of Work

1. This specification covers the furnishing and installation of materials for fire-suppression standpipes. Products shall be as follows or as directed by the Owner. Installation procedures shall be in accordance with the product manufacturer's recommendations. Demolition and removal of materials shall be as required to support the work.

B. Summary

1. Section Includes:
 - a. Pipes, fittings, and specialties.
 - b. Fire-protection valves.
 - c. Hose connections.
 - d. Hose stations.
 - e. Monitors.
 - f. Fire-department connections.
 - g. Alarm devices.
 - h. Manual control stations.
 - i. Control panels.
 - j. Pressure gages.

C. Definitions

1. High-Pressure Standpipe Piping: Fire-suppression standpipe piping designed to operate at working pressure higher than standard 175 psig (1200 kPa), but not higher than 250 psig (1725 kPa) OR 300 psig (2070 kPa), as directed.
2. Standard-Pressure Standpipe Piping: Fire-suppression standpipe piping designed to operate at working pressure 175 psig (1200 kPa) maximum.

D. System Descriptions

1. Automatic Wet-Type, Class I Standpipe System: Includes NPS 2-1/2 (DN 65) hose connections. Has open water-supply valve with pressure maintained and is capable of supplying water demand.
2. Automatic Wet-Type, Class II Standpipe System: Includes NPS 1-1/2 (DN 40) hose stations. Has open water-supply valve with pressure maintained and is capable of supplying water demand.
3. Automatic Wet-Type, Class III Standpipe System: Includes NPS 1-1/2 (DN 40) hose stations and NPS 2-1/2 (DN 65) hose connections. Has open water-supply valve with pressure maintained and is capable of supplying water demand.
4. Automatic Dry-Type, Class I Standpipe System: Includes NPS 2-1/2 (DN 65) hose connections. Has open water-supply valve and dry-pipe valve with standpipes containing compressed air. Opening fire-hose valve releases compressed air and permits water pressure to open dry-pipe valve. Water then flows into standpipes.
5. Automatic Dry-Type, Class II Standpipe System: Includes NPS 1-1/2 (DN 40) hose stations. Has open water-supply valve and dry-pipe valve with standpipes containing compressed air. Opening fire-hose valve releases compressed air and permits water pressure to open dry-pipe valve. Water then flows into standpipes.
6. Automatic Dry-Type, Class III Standpipe System: Includes NPS 1-1/2 (DN 40) hose stations and NPS 2-1/2 (DN 65) hose connections. Has open water-supply valve and dry-pipe valve with standpipes containing compressed air. Opening fire-hose valve releases compressed air and permits water pressure to open dry-pipe valve. Water then flows into standpipes.
7. Semiautomatic Dry-Type, Class I Standpipe System: Includes NPS 2-1/2 (DN 65) hose connections. Has open water-supply valve and deluge valve with standpipes containing air.

Actuation of detection device permits water pressure to open deluge valve. Water then flows into standpipes.

8. Semiautomatic Dry-Type, Class II Standpipe System: Includes **NPS 1-1/2 (DN 40)** hose stations. Has open water-supply valve and deluge valve with standpipes containing air. Actuation of detection device permits water pressure to open deluge valve. Water then flows into standpipes.
9. Semiautomatic Dry-Type, Class III Standpipe System: Includes **NPS 1-1/2 (DN 40)** hose stations and **NPS 2-1/2 (DN 65)** hose connections. Has open water-supply valve and deluge valve with standpipes containing air. Actuation of detection device permits water pressure to open deluge valve. Water then flows into standpipes.
10. Manual Wet-Type, Class I Standpipe System: Includes **NPS 2-1/2 (DN 65)** hose connections. Has small water supply to maintain water in standpipes. Piping is wet, but water must be pumped into standpipes to satisfy demand.
11. Manual Dry-Type, Class I Standpipe System: Includes **NPS 2-1/2 (DN 65)** hose connections. Does not have permanent water supply. Piping is dry. Water must be pumped into standpipes to satisfy demand.

E. Performance Requirements

1. Standard-Pressure, Fire-Suppression Standpipe System Component: Listed for **175-psig (1200-kPa)** minimum working pressure.
2. High-Pressure, Fire-Suppression Standpipe System Component: Listed for **250-psig (1725-kPa)** minimum **OR 300-psig (2070-kPa), as directed**, working pressure.
3. Delegated Design: Design fire-suppression standpipes, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.
4. Fire-suppression standpipe design shall be approved by authorities having jurisdiction.
 - a. Minimum residual pressure at each hose-connection outlet is as follows:
 - 1) **NPS 1-1/2 (DN 40)** Hose Connections: **65 psig (450 kPa)**.
 - 2) **NPS 2-1/2 (DN 65)** Hose Connections: **100 psig (690 kPa)**.
 - b. Maximum residual pressure at required flow at each hose-connection outlet is as follows unless otherwise indicated:
 - 1) **NPS 1-1/2 (DN 40)** Hose Connections: **100 psig (690 kPa)**.
 - 2) **NPS 2-1/2 (DN 65)** Hose Connections: **175 psig (1200 kPa)**.
5. Seismic Performance: Fire-suppression standpipes shall withstand the effects of earthquake motions determined according to NFPA 13 and ASCE/SEI 7.

F. Submittals

1. Product Data: For each type of product indicated.
2. Shop Drawings: For fire-suppression standpipes. Include plans, elevations, sections, details, and attachments to other work.
 - a. Wiring Diagrams: For power, signal, and control wiring.
3. Delegated-Design Submittal: For standpipe systems indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
4. Qualification Data: For qualified Installer and professional engineer.
5. Approved Standpipe Drawings: Working plans, prepared according to NFPA 14, that have been approved by authorities having jurisdiction, including hydraulic calculations if applicable.
6. Welding certificates.
7. Fire-hydrant flow test report.
8. Field Test Reports and Certificates: Indicate and interpret test results for compliance with performance requirements and as described in NFPA 14. Include "Contractor's Material and Test Certificate for Aboveground Piping" and "Contractor's Material and Test Certificate for Underground Piping."
9. Field quality-control reports.
10. Operation and Maintenance Data: For fire-suppression standpipes specialties to include in emergency, operation, and maintenance manuals.

G. Quality Assurance

1. Installer Qualifications:
 - a. Installer's responsibilities include designing, fabricating, and installing fire-suppression standpipes and providing professional engineering services needed to assume engineering responsibility. Base calculations on results of fire-hydrant flow test.
 - 1) Engineering Responsibility: Preparation of working plans, calculations, and field test reports by a qualified professional engineer.
2. Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.
3. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
4. NFPA Standards: Fire-suppression standpipe equipment, specialties, accessories, installation, and testing shall comply with NFPA 14, "Installation of Standpipe and Hose Systems."

H. Project Conditions

1. Interruption of Existing Fire-Suppression Standpipe Service: Do not interrupt fire-suppression standpipe service to facilities occupied by the Owner or others unless permitted under the following conditions and then only after arranging to provide temporary fire-suppression standpipe service according to requirements indicated:
 - a. Notify the Owner no fewer than two days in advance of proposed interruption of fire-suppression standpipe service.
 - b. Do not proceed with interruption of fire-suppression standpipe service without the Owner's written permission.

1.2 PRODUCTS

A. Piping Materials

1. Comply with requirements in "Piping Schedule" Article for applications of pipe, tube, and fitting materials, and for joining methods for specific services, service locations, and pipe sizes.

B. Steel Pipe And Fittings

1. Standard Weight, Galvanized- and Black-Steel Pipe: ASTM A 53/A 53M, Type E, Grade B. Pipe ends may be factory or field formed to match joining method.
2. Schedule 30, Galvanized- and Black-Steel Pipe: ASTM A 135; ASTM A 795/A 795M, Type E; or ASME B36.10M, wrought steel; with wall thickness not less than Schedule 30 and not more than Schedule 40. Pipe ends may be factory or field formed to match joining method.
3. Thinwall Galvanized- and Black-Steel Pipe: ASTM A 135 or ASTM A 795/A 795M, threadable, with wall thickness less than Schedule 30 and equal to or greater than Schedule 10. Pipe ends may be factory or field formed to match joining method.
4. Schedule 10, Black-Steel Pipe: ASTM A 135 or ASTM A 795/A 795M, Schedule 10 in **NPS 5 (DN 125)** and smaller; and NFPA 13-specified wall thickness in **NPS 6 to NPS 10 (DN 150 to DN 250)**, plain end.
5. Nonstandard OD, Thinwall Black-Steel Pipe: ASTM A 135 or ASTM A 795/A 795M, thinwall, with plain ends and wall thickness less than Schedule 10.
6. Hybrid Black-Steel Pipe: ASTM A 135 or ASTM A 795/A 795M, lightwall, with wall thickness less than Schedule 10 and greater than Schedule 5.
7. Standard-Weight, Galvanized- and Black-Steel Pipe Nipples: ASTM A 733, made of ASTM A 53/A 53M, seamless steel pipe with threaded ends.
8. Galvanized and Uncoated, Steel Couplings: ASTM A 865, threaded.
9. Galvanized and Uncoated, Gray-Iron Threaded Fittings: ASME B16.4, Class 125, standard pattern.
10. Malleable- or Ductile-Iron Unions: UL 860.
11. Cast-Iron Flanges: ASME B16.1, Class 125.
12. Steel Flanges and Flanged Fittings: ASME B16.5, Class 150.
13. Steel Welding Fittings: ASTM A 234/A 234M and ASME B16.9.

14. Grooved-Joint, Steel-Pipe Appurtenances:
 - a. Pressure Rating: **175 psig (1200 kPa) OR 250 psig (1725 kPa) OR 300 psig (2070 kPa), as directed**, minimum.
 - b. Galvanized and Uncoated, Grooved-End Fittings for Steel Piping: ASTM A 47/A 47M, malleable-iron casting or ASTM A 536, ductile-iron casting; with dimensions matching steel pipe.
 - c. Grooved-End-Pipe Couplings for Steel Piping: AWWA C606 and UL 213, rigid pattern, unless otherwise indicated, for steel-pipe dimensions. Include ferrous housing sections, EPDM-rubber gasket, and bolts and nuts.
- C. Copper Tube And Fittings
 1. Hard Copper Tube: **ASTM B 88, Type L (ASTM B 88M, Type B)** and **ASTM B 88, Type M (ASTM B 88M, Type C)** water tube, drawn temper.
 2. Cast-Copper, Solder-Joint Fittings: ASME B16.18, pressure fittings.
 3. Wrought-Copper, Solder-Joint Fittings: ASME B16.22, pressure fittings.
 4. Bronze Flanges: ASME B16.24, Class 150, with solder-joint ends.
 5. Copper Unions: MSS SP-123, cast-copper-alloy, hexagonal-stock body, with ball-and-socket, metal-to-metal seating surfaces, and solder-joint or threaded ends.
 6. Grooved-Joint, Copper-Tube Appurtenances:
 - a. Grooved-End, Copper Fittings: **ASTM B 75 (ASTM B 75M)**, copper tube or ASTM B 584, bronze castings.
 - b. Grooved-End-Tube Couplings: To fit copper tube dimensions, with design similar to AWWA C606. Include ferrous housing sections, EPDM-rubber gasket suitable for hot and cold water, and bolts and nuts.
- D. Piping Joining Materials
 1. Pipe-Flange Gasket Materials: AWWA C110, rubber, flat face, **1/8 inch (3.2 mm)** thick or ASME B16.21, nonmetallic and asbestos free.
 - a. Class 125, Cast-Iron Flanges and Class 150, Bronze Flat-Face Flanges: Full-face gaskets.
 - b. Class 250, Cast-Iron Flanges and Class 300, Steel Raised-Face Flanges: Ring-type gaskets.
 2. Metal, Pipe-Flange Bolts and Nuts: ASME B18.2.1, carbon steel unless otherwise indicated.
 3. Brazing Filler Metals: AWS A5.8/A5.8M, BCuP Series, copper-phosphorus alloys for general-duty brazing unless otherwise indicated.
 4. Welding Filler Metals: Comply with AWS D10.12M/D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.
- E. Listed Fire-Protection Valves
 1. General Requirements:
 - a. Valves shall be UL listed or FM approved.
 - b. Minimum Pressure Rating for Standard-Pressure Piping: **175 psig (1200 kPa)**.
 - c. Minimum Pressure Rating for High-Pressure Piping: **250 psig (1725 kPa) OR 300 psig (2070 kPa), as directed**.
 2. Ball Valves:
 - a. Standard: UL 1091 except with ball instead of disc.
 - b. Valves **NPS 1-1/2 (DN 40)** and Smaller: Bronze body with threaded ends.
 - c. Valves **NPS 2 and NPS 2-1/2 (DN 50 and DN 65)**: Bronze body with threaded ends or ductile-iron body with grooved ends.
 - d. Valves **NPS 3 (DN 80)**: Ductile-iron body with grooved ends.
 3. Bronze Butterfly Valves:
 - a. Standard: UL 1091.
 - b. Pressure Rating: **175 psig (1200 kPa)**.
 - c. Body Material: Bronze.
 - d. End Connections: Threaded.

4. Iron Butterfly Valves:
 - a. Standard: UL 1091.
 - b. Pressure Rating: 175 psig (1200 kPa).
 - c. Body Material: Cast or ductile iron.
 - d. Style: Lug or wafer.

OR
End Connections: Grooved.
5. Check Valves:
 - a. Standard: UL 312.
 - b. Pressure Rating: 250 psig (1725 kPa) minimum **OR** 300 psig (2070 kPa), as directed.
 - c. Type: Swing check.
 - d. Body Material: Cast iron.
 - e. End Connections: Flanged or grooved.
6. Bronze OS&Y Gate Valves:
 - a. Standard: UL 262.
 - b. Pressure Rating: 175 psig (1200 kPa).
 - c. Body Material: Bronze.
 - d. End Connections: Threaded.
7. Iron OS&Y Gate Valves:
 - a. Standard: UL 262.
 - b. Pressure Rating: 250 psig (1725 kPa) minimum **OR** 300 psig (2070 kPa), as directed.
 - c. Body Material: Cast or ductile iron.
 - d. End Connections: Flanged or grooved.
8. Indicating-Type Butterfly Valves:
 - a. Standard: UL 1091.
 - b. Pressure Rating: 175 psig (1200 kPa) minimum.
 - c. Valves **NPS 2 (DN 50)** and Smaller:
 - 1) Valve Type: Ball or butterfly.
 - 2) Body Material: Bronze.
 - 3) End Connections: Threaded.
 - d. Valves **NPS 2-1/2 (DN 65)** and Larger:
 - 1) Valve Type: Butterfly.
 - 2) Body Material: Cast or ductile iron.
 - 3) End Connections: Flanged, grooved, or wafer.
 - e. Valve Operation: Integral electrical, 115-V ac, prewired, single-circuit, supervisory switch **OR** electrical, 115-V ac, prewired, two-circuit, supervisory switch **OR** visual, as directed, indicating device.
9. NRS Gate Valves:
 - a. Standard: UL 262.
 - b. Pressure Rating: 250 psig (1725 kPa) minimum **OR** 300 psig (2070 kPa), as directed.
 - c. Body Material: Cast iron with indicator post flange.
 - d. Stem: Nonrising.
 - e. End Connections: Flanged or grooved.
10. Indicator Posts:
 - a. Standard: UL 789.
 - b. Type: Horizontal for wall mounting.
 - c. Body Material: Cast iron with extension rod and locking device.
 - d. Operation: Wrench **OR** Hand wheel, as directed.

F. Trim And Drain Valves

1. General Requirements:
 - a. Standard: UL's "Fire Protection Equipment Directory" listing or "Approval Guide," published by FM Global, listing.
 - b. Pressure Rating: 175 psig (1200 kPa) minimum.
2. Angle Valves.
3. Ball Valves.



4. Globe Valves.
5. Plug Valves.

G. Specialty Valves

1. General Requirements:
 - a. Standard: UL's "Fire Protection Equipment Directory" listing or "Approval Guide," published by FM Global, listing.
 - b. Pressure Rating:
 - 1) Standard-Pressure Piping Specialty Valves: 175 psig (1200 kPa) minimum.
 - 2) High-Pressure Piping Specialty Valves: 250 psig (1725 kPa) minimum OR 300 psig (2070 kPa), as directed.
 - c. Body Material: Cast or ductile iron.
 - d. Size: Same as connected piping.
 - e. End Connections: Flanged or grooved.
2. Alarm Valves:
 - a. Standard: UL 193.
 - b. Design: For horizontal or vertical installation.
 - c. Include trim sets for bypass, drain, electrical sprinkler alarm switch, pressure gages, retarding chamber, as directed, and fill-line attachment with strainer.
 - d. Drip Cup Assembly (if retarding chamber is required): Pipe drain without valves and separate from main drain piping.
 - e. Drip Cup Assembly (if retarding chamber is not required): Pipe drain with check valve to main drain piping.
3. Dry-Pipe Valves:
 - a. Standard: UL 260.
 - b. Design: Differential-pressure type.
 - c. Include UL 1486, quick-opening devices, trim sets for air supply, drain, priming level, alarm connections, ball drip valves, pressure gages, priming chamber attachment, and fill-line attachment.
 - d. Air-Pressure Maintenance Device:
 - 1) Standard: UL 260.
 - 2) Type: Automatic device to maintain minimum air pressure in piping.
 - 3) Include shutoff valves to permit servicing without shutting down sprinkler piping, bypass valve for quick filling, pressure regulator or switch to maintain pressure, strainer, pressure ratings with 14- to 60-psig (95- to 410-kPa) adjustable range, and 175-psig (1200-kPa) OR 300-psig (2070-kPa), as directed, outlet pressure.
 - e. Air Compressor:
 - 1) Standard: UL's "Fire Protection Equipment Directory" listing.
 - 2) Motor Horsepower: Fractional.
 - 3) Power: 120-V ac, 60 Hz, single phase.
4. Deluge Valves:
 - a. Standard: UL 260.
 - b. Design: Hydraulically operated, differential-pressure type.
 - c. Include trim sets for bypass, drain, electrical sprinkler alarm switch, pressure gages, drip cup assembly piped without valves and separate from main drain line, fill-line attachment with strainer, and push-rod chamber supply connection.
 - d. Wet, Pilot-Line Trim Set: Include gage to read push-rod chamber pressure, globe valve for manual operation of deluge valve, and connection for actuation device.
 - e. Dry, Pilot-Line Trim Set: Include dry, pilot-line actuator; air- and water-pressure gages; low-air-pressure warning switch; air relief valve; and actuation device. Dry, pilot-line actuator includes cast-iron, operated, diaphragm-type valve with resilient facing plate, resilient diaphragm, and replaceable bronze seat. Valve includes threaded water and air inlets and water outlet. Loss of air pressure on dry, pilot-line side allows pilot-line actuator to open and causes deluge valve to open immediately.
 - f. Air-Pressure Maintenance Device:

- 1) Standard: UL 260.
 - 2) Type: Automatic device to maintain minimum air pressure in piping.
 - 3) Include shutoff valves to permit servicing without shutting down sprinkler piping, bypass valve for quick filling, pressure regulator, or switch to maintain pressure, strainer, pressure ratings with 14- to 60-psig (95- to 410-kPa) adjustable range, and 175-psig (1200-kPa) OR 300-psig (2070-kPa), as directed, outlet pressure.
 - g. Air Compressor:
 - 1) Standard: UL's "Fire Protection Equipment Directory" listing.
 - 2) Motor Horsepower: Fractional.
 - 3) Power: 120-V ac, 60 Hz, single phase.
 5. Pressure-Reducing Valves:
 - a. UL 668 hose valve, with integral UL 1468 reducing device.
 - b. Pressure Rating: 300 psig (2070 kPa) minimum.
 - c. Material: Brass or bronze.
 - d. Inlet: Female pipe threads.
 - e. Outlet: Threaded with or without adapter having male hose threads.
 - f. Pattern: Angle or gate.
 - g. Finish: Polished chrome plated OR Rough brass or bronze OR Rough chrome plated, as directed.
 6. Automatic (Ball Drip) Drain Valves:
 - a. Standard: UL 1726.
 - b. Pressure Rating: 175 psig (1200 kPa) minimum.
 - c. Type: Automatic draining, ball check.
 - d. Size: NPS 3/4 (DN 20).
 - e. End Connections: Threaded.
- H. Hose Connections
1. Adjustable-Valve Hose Connections:
 - a. Standard: UL 668 hose valve, with integral UL 1468 reducing or restricting pressure-control device, for connecting fire hose.
 - b. Pressure Rating: 300 psig (2070 kPa) minimum.
 - c. Material: Brass or bronze.
 - d. Size: NPS 1-1/2 or NPS 2-1/2 (DN 40 or DN 65), as indicated.
 - e. Inlet: Female pipe threads.
 - f. Outlet: Male hose threads with lugged cap, gasket, and chain. Include hose valve threads according to NFPA 1963 and matching local fire-department threads.
 - g. Pattern: Angle or gate.
 - h. Pressure-Control Device Type: Pressure reducing OR restricting, as directed.
 - i. Design Outlet Pressure Setting: as directed by the Owner.
 - j. Finish: Polished chrome plated OR Rough brass or bronze OR Rough chrome plated, as directed.
 2. Nonadjustable-Valve Hose Connections:
 - a. Standard: UL 668 hose valve for connecting fire hose.
 - b. Pressure Rating: 300 psig (2070 kPa) minimum.
 - c. Material: Brass or bronze.
 - d. Size: NPS 1-1/2 or NPS 2-1/2 (DN 40 or DN 65), as indicated.
 - e. Inlet: Female pipe threads.
 - f. Outlet: Male hose threads with lugged cap, gasket, and chain. Include hose valve threads according to NFPA 1963 and matching local fire-department threads.
 - g. Pattern: Angle or gate.
 - h. Finish: Polished chrome plated OR Rough brass or bronze OR Rough chrome plated, as directed.
- I. NPS 1-1/2 (DN 40) Rack-Type Hose Stations
1. Hose Rack:
 - a. Standard: UL 47.



- b. Material: Brass or bronze with polished chrome-plated **OR** Steel with red-enamel, **as directed**, finish.
 - c. Type: Hose-rack assembly. Include hose valve, hose rack, water-retention device, hose pins, and hose.
 - d. Operation: Semiautomatic.
 - e. Sized to hold fire hose.
 - 2. Hose Valve:
 - a. Standard: UL 668 **NPS 1-1/2 (DN 40)**, for connecting fire hose.
 - b. Type: Adjustable **OR** Nonadjustable, **as directed**.
 - c. Pressure-Control Device: Not required **OR** Pressure reducing **OR** Pressure restricting, **as directed**.
 - d. Design Outlet Pressure Setting: Not applicable **OR as directed**.
 - e. Hose Valve and Trim Finish: Polished chrome plated **OR** Rough brass or bronze **OR** Rough chrome plated, **as directed**.
 - f. Pressure Rating: **300 psig (2070 kPa)** minimum.
 - g. Pattern: Angle.
 - h. Material: Brass or bronze.
 - i. Pressure-Control Device: UL 1468 integral or for field installation if indicated.
 - j. Size: **NPS 1-1/2 (DN 40)**.
 - k. Inlet: Female pipe threads.
 - l. Outlet: Male hose threads according to NFPA 1963 and matching local fire-department threads.
 - 3. Hose:
 - a. Standards: NFPA 1961 and UL 219 lined fire hose with swivel inlet, coupling, gaskets, and nozzle.
 - b. Size: **NPS 1-1/2 (DN 40)**.
 - c. Length: **50 feet (15 m) OR 75 feet (23 m) OR 100 feet (30 m)**, **as directed**.
 - d. Jacket: Combination of natural and synthetic threads **OR** Natural thread **OR** Synthetic thread, **as directed**.
 - e. Lining: Combination of rubber and plastic compounds **OR** Rubber compound **OR** Plastic compound, **as directed**.
 - f. Cover: Rubber, plastic, or combination of rubber and plastic compounds.
 - g. Nozzle: UL 401.
 - 1) Material: Brass **OR** Polished brass **OR** Rough chrome-plated brass **OR** Polished chrome-plated brass **OR** Polycarbonate plastic, **as directed**.
 - 2) Type: Plain, for nonadjustable water stream **OR** Spray, adjustable from shutoff to fog spray or straight stream **OR** Spray, adjustable from shutoff to full fog; for use on electrical fires, **as directed**.
- J. **NPS 1-1/2 BY NPS 2-1/2 (DN 40 BY DN 65)** Rack-Type Hose Stations
- 1. Hose Rack:
 - a. Standard: UL 47.
 - b. Material: Brass or bronze with polished chrome-plated **OR** Steel with red-enamel, **as directed**, finish.
 - c. Type: Hose-rack assembly. Include hose valve, reducer adapter, hose rack, water-retention device, hose pins, and hose.
 - d. Operation: Semiautomatic.
 - e. Sized to hold fire hose.
 - 2. Hose Valve:
 - a. Standard: UL 668, **NPS 2-1/2 (DN 65)**, for connecting fire hose.
 - b. Type: Adjustable **OR** Nonadjustable, **as directed**.
 - c. Pressure-Control Device: Not required **OR** Pressure reducing **OR** Pressure restricting, **as directed**.
 - d. Design Outlet Pressure Setting: Not applicable **OR as directed**.

- e. Hose Valve and Trim Finish: Polished chrome plated **OR** Rough brass or bronze **OR** Rough chrome plated, **as directed**.
 - f. Pressure Rating: **300 psig (2070 kPa)** minimum.
 - g. Pattern: Angle.
 - h. Material: Brass or bronze.
 - i. Pressure-Control Device: UL 1468, integral or for field installation if indicated.
 - j. Size: **NPS 2-1/2 (DN 65)**.
 - k. Inlet: Female pipe threads.
 - l. Outlet: Male hose threads according to NFPA 1963 and matching local fire-department threads.
 - m. Reducer Adapter: **NPS 2-1/2 by NPS 1-1/2 (DN 65 by DN 40)**.
3. Hose:
- a. Standards: NFPA 1961 and UL 219, lined fire hose with swivel inlet, coupling, gaskets, and nozzle.
 - b. Size: **NPS 1-1/2 (DN 40)**.
 - c. Length: **50 feet (15 m) OR 75 feet (23 m) OR 100 feet (30 m), as directed**.
 - d. Jacket: Combination of natural and synthetic threads **OR** Natural thread **OR** Synthetic thread, **as directed**.
 - e. Lining: Combination of rubber and plastic compounds **OR** Rubber compound **OR** Plastic compound, **as directed**.
 - f. Cover: Rubber, plastic, or combination of rubber and plastic compounds.
 - g. Nozzle: UL 401 spray nozzle unless plain nozzle is indicated.
 - 1) Material: Brass **OR** Polished brass **OR** Rough chrome-plated brass **OR** Polished chrome-plated brass **OR** Polycarbonate plastic, **as directed**.
 - 2) Type: Plain, for nonadjustable water stream **OR** Spray, adjustable from shutoff to fog spray or straight stream **OR** Spray, adjustable from shutoff to full fog; for use on electrical fires, **as directed**.
- K. **NPS 1-1/2 (DN 40)** Reel-Type Hose Stations
- 1. Hose Reel:
 - a. Standard: UL 47.
 - b. Hose Reel and Bracket Material: Steel.
 - c. Type: Hose-reel assembly. Include hose valve, wall bracket, hose reel, water-retention device, hose pins, and hose.
 - d. Operation: Semiautomatic.
 - e. Sized to hold fire hose.
 - f. Finish: Red enamel.
 - 2. Hose Valve:
 - a. Standard: UL 668, **NPS 1-1/2 (DN 40)**, for connecting fire hose.
 - b. Type: Adjustable **OR** Nonadjustable, **as directed**.
 - c. Pressure-Control Device: Not required **OR** Pressure reducing **OR** Pressure restricting, **as directed**.
 - d. Design Outlet Pressure Setting: Not applicable **OR as directed**.
 - e. Hose Valve and Trim Finish: Polished chrome plated **OR** Rough brass or bronze **OR** Rough chrome plated, **as directed**.
 - f. Pressure Rating: **300 psig (2070 kPa)** minimum.
 - g. Pattern: Angle.
 - h. Material: Brass or bronze.
 - i. Pressure-Control Device: UL 1468, integral or for field installation if indicated.
 - j. Size: **NPS 1-1/2 (DN 40)**.
 - k. Inlet: Female pipe threads.
 - l. Outlet: Male hose threads according to NFPA 1963 and matching local fire-department threads.
 - 3. Hose:
 - a. Standards: NFPA 1961 and UL 219 lined fire hose with swivel inlet, coupling, gaskets, and nozzle.

- b. Size: **NPS 1-1/2 (DN 40)**.
- c. Length: **50 feet (15 m) OR 75 feet (23 m) OR 100 feet (30 m), as directed.**
- d. Jacket: Combination of natural and synthetic threads **OR** Natural thread **OR** Synthetic thread, **as directed.**
- e. Lining: Combination of rubber and plastic compounds **OR** Rubber compound **OR** Plastic compound, **as directed.**
- f. Cover: Rubber, plastic, or combination of rubber and plastic compounds.
- g. Nozzle: UL 401.
 - 1) Material: Brass **OR** Polished brass **OR** Rough chrome-plated brass **OR** Polished chrome-plated brass **OR** Polycarbonate plastic, **as directed.**
 - 2) Type: Spray, adjustable from shutoff to fog spray or straight stream **OR** full fog; for use on electrical fires, **as directed.**

L. Monitors

- 1. Type: Stationary.
- 2. Nozzle: UL 401, **NPS 2-1/2 (DN 65)**, brass, adjustable from fog spray to straight stream to shutoff.
- 3. Horizontal Rotation: 360 degrees with locking device.
- 4. Vertical Rotation: 80-degree elevation and 60-degree depression with locking device.
- 5. Waterway: Double **OR** Single, **as directed**, brass or stainless-steel tube.
- 6. Waterway Size: **NPS 2-1/2 (DN 65)** minimum.
- 7. Water Stream Flow: **500 gpm (31.5 L/s) OR 750 gpm (47.3 L/s) OR 1000 gpm (63 L/s), as directed.**
- 8. Operation: Lever **OR** Wheel, **as directed.**
- 9. Base Inlet Size: **NPS 2-1/2 (DN 65) OR NPS 3 (DN 80) OR NPS 4 (DN 100), as directed.**
- 10. Finish: Red-painted body with brass trim.

M. Fire-Department Connections

- 1. Exposed-Type, Fire-Department Connection:
 - a. Standard: UL 405.
 - b. Type: Exposed, projecting, for wall mounting.
 - c. Pressure Rating: **175 psig (1200 kPa)** minimum.
 - d. Body Material: Corrosion-resistant metal.
 - e. Inlets: Brass with threads according to NFPA 1963 and matching local fire-department sizes and threads. Include extension pipe nipples, brass lugged swivel connections, and check devices or clappers.
 - f. Caps: Brass, lugged type, with gasket and chain.
 - g. Escutcheon Plate: Round, brass, wall type.
 - h. Outlet: Back, with pipe threads.
 - i. Number of Inlets: Two **OR** Three, **as directed.**
 - j. Escutcheon Plate Marking: Similar to "AUTO SPKR & STANDPIPE" **OR** "STANDPIPE", **as directed.**
 - k. Finish: Polished chrome plated **OR** Rough brass or bronze **OR** Rough chrome plated, **as directed.**
 - l. Outlet Size: **NPS 4 (DN 100) OR NPS 5 (DN 125) OR NPS 6 (DN 150), as directed.**
- 2. Flush-Type, Fire-Department Connection:
 - a. Standard: UL 405.
 - b. Type: Flush, for wall mounting.
 - c. Pressure Rating: **175 psig (1200 kPa)** minimum.
 - d. Body Material: Corrosion-resistant metal.
 - e. Inlets: Brass with threads according to NFPA 1963 and matching local fire-department sizes and threads. Include extension pipe nipples, brass lugged swivel connections, and check devices or clappers.
 - f. Caps: Brass, lugged type, with gasket and chain.
 - g. Escutcheon Plate: Rectangular, brass, wall type.

- h. Outlet: With pipe threads.
 - i. Body Style: Horizontal **OR** Square **OR** Vertical, **as directed**.
 - j. Number of Inlets: Two **OR** Three **OR** Four **OR** Six, **as directed**.
 - k. Outlet Location: Back **OR** Bottom **OR** Left side **OR** Right side **OR** Top, **as directed**.
 - l. Escutcheon Plate Marking: Similar to "AUTO SPKR & STANDPIPE" **OR** "STANDPIPE", **as directed**.
 - m. Finish: Polished chrome plated **OR** Rough brass or bronze **OR** Rough chrome plated, **as directed**.
 - n. Outlet Size: **NPS 4 (DN 100)** **OR** **NPS 5 (DN 125)** **OR** **NPS 6 (DN 150)** **OR** **NPS 8 (DN 200)**, **as directed**.
3. Yard-Type, Fire-Department Connection:
- a. Standard: UL 405.
 - b. Type: Exposed, freestanding.
 - c. Pressure Rating: **175 psig (1200 kPa)** minimum **OR** **300 psig (2070 kPa)**, **as directed**.
 - d. Body Material: Corrosion-resistant metal.
 - e. Inlets: Brass with threads according to NFPA 1963 and matching local fire-department sizes and threads. Include extension pipe nipples, brass lugged swivel connections, and check devices or clappers.
 - f. Caps: Brass, lugged type, with gasket and chain.
 - g. Escutcheon Plate: Round, brass, floor type.
 - h. Outlet: Bottom, with pipe threads.
 - i. Number of Inlets: Two **OR** Three **OR** Four, **as directed**.
 - j. Sleeve: Brass **OR** Not required, **as directed**.
 - k. Sleeve Height: **18 inches (460 mm)**.
 - l. Escutcheon Plate Marking: Similar to "AUTO SPKR & STANDPIPE" **OR** "STANDPIPE", **as directed**.
 - m. Finish, Including Sleeve: Polished chrome plated **OR** Rough brass or bronze **OR** Rough chrome plated, **as directed**.
 - n. Outlet Size: **NPS 4 (DN 100)** **OR** **NPS 5 (DN 125)** **OR** **NPS 6 (DN 150)**, **as directed**.
- N. Alarm Devices
- 1. Alarm-device types shall match piping and equipment connections.
 - 2. Water-Motor-Operated Alarm:
 - a. Standard: UL 753.
 - b. Type: Mechanically operated, with Pelton wheel.
 - c. Alarm Gong: Cast aluminum with red-enamel factory finish.
 - d. Size: **10-inch (250-mm)** diameter.
 - e. Components: Shaft length, bearings, and sleeve to suit wall construction.
 - f. Inlet: **NPS 3/4 (DN 20)**.
 - g. Outlet: **NPS 1 (DN 25)** drain connection.
 - 3. Electrically Operated Alarm Bell:
 - a. Standard: UL 464.
 - b. Type: Vibrating, metal alarm bell.
 - c. Size: **6-inch (150-mm)** minimum **OR** **8-inch (200-mm)** minimum **OR** **10-inch (250-mm)**, **as directed**, diameter.
 - d. Finish: Red-enamel factory finish, suitable for outdoor use.
 - 4. Water-Flow Indicators:
 - a. Standard: UL 346.
 - b. Water-Flow Detector: Electrically supervised.
 - c. Components: Two single-pole, double-throw circuit switches for isolated alarm and auxiliary contacts, 7 A, 125-V ac and 0.25 A, 24-V dc; complete with factory-set, field-adjustable retard element to prevent false signals and tamperproof cover that sends signal if removed.
 - d. Type: Paddle operated.
 - e. Pressure Rating: **250 psig (1725 kPa)**.
 - f. Design Installation: Horizontal or vertical.

5. Pressure Switches:
 - a. Standard: UL 346.
 - b. Type: Electrically supervised water-flow switch with retard feature.
 - c. Components: Single-pole, double-throw switch with normally closed contacts.
 - d. Design Operation: Rising pressure signals water flow.
 6. Valve Supervisory Switches:
 - a. Standard: UL 346.
 - b. Type: Electrically supervised.
 - c. Components: Single-pole, double-throw switch with normally closed contacts.
 - d. Design: Signals that controlled valve is in other than fully open position.
 7. Indicator-Post Supervisory Switches:
 - a. Standard: UL 346.
 - b. Type: Electrically supervised.
 - c. Components: Single-pole, double-throw switch with normally closed contacts.
 - d. Design: Signals that controlled indicator-post valve is in other than fully open position.
- O. Manual Control Stations
1. Description: UL listed or FM approved, hydraulic operation, with union, **NPS 1/2 (DN 15)** pipe nipple, and bronze ball valve. Include metal enclosure labeled "MANUAL CONTROL STATION" with operating instructions and cover held closed by breakable strut to prevent accidental opening.
- P. Control Panels
1. Description: Single-area, two-area, or single-area cross-zoned control panel as indicated, including NEMA ICS 6, Type 1 enclosure, detector, alarm, and solenoid-valve circuitry for operation of deluge valves. Panels contain power supply; battery charger; standby batteries; field-wiring terminal strip; electrically supervised solenoid valves and polarized fire-alarm bell; lamp test facility; single-pole, double-throw auxiliary alarm contacts; and rectifier.
 - a. Panels: UL listed and FM approved when used with thermal detectors and Class A detector circuit wiring. Electrical characteristics are 120-V ac, 60 Hz, with 24-V dc rechargeable batteries.
 - b. Manual Control Stations: Electric operation, metal enclosure, labeled "MANUAL CONTROL STATION" with operating instructions and cover held closed by breakable strut to prevent accidental opening.
OR
 Manual Control Stations: Hydraulic operation, with union, **NPS 1/2 (DN 15)** pipe nipple, and bronze ball valve. Include metal enclosure labeled "MANUAL CONTROL STATION" with operating instructions and cover held closed by breakable strut to prevent accidental opening.
- Q. Pressure Gages
1. Standard: UL 393.
 2. Dial Size: **3-1/2- to 4-1/2-inch (90- to 115-mm)** diameter.
 3. Pressure Gage Range: **0 to 250 psig (0 to 1725 kPa)** minimum **OR 0 to 300 psig (0 to 2070 kPa), as directed.**
 4. Water System Piping Gage: Include "WATER" or "AIR/WATER" label on dial face.
 5. Air System Piping Gage: Include retard feature, **as directed**, and "AIR" or "AIR/WATER" label on dial face.
- R. Escutcheons
1. General: Manufactured ceiling, floor, and wall escutcheons and floor plates.
 2. One-Piece, Cast-Brass Escutcheons: Polished chrome-plated or rough-brass finish with set-screws.
 3. One-Piece, Deep-Pattern Escutcheons: Deep-drawn, box-shaped brass with chrome-plated finish.

4. One-Piece, Stamped-Steel Escutcheons: Chrome-plated finish with set-screw or spring clips.
5. Split-Casting, Cast-Brass Escutcheons: Polished chrome-plated or rough-brass finish with concealed hinge and set-screw.
6. Split-Plate, Stamped-Steel Escutcheons: Chrome-plated finish with concealed **OR** exposed-rivet, **as directed**, hinge, set-screw or spring clips.
7. One-Piece Floor Plates: Cast-iron flange with holes for fasteners, **as directed**.
8. Split-Casting Floor Plates: Cast brass with concealed hinge.

S. Sleeves

1. Cast-Iron Wall-Pipe Sleeves: Cast or fabricated of cast iron and equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop unless otherwise indicated.
2. Galvanized-Steel-Sheet Sleeves: **0.0239-inch (0.6-mm)** minimum thickness; round tube closed with welded longitudinal joint.
3. Molded-PE Sleeves: Reusable, PE, tapered-cup shaped, and smooth outer surface with nailing flange for attaching to wooden forms.
4. Molded-PVC Sleeves: Permanent, with nailing flange for attaching to wooden forms.
5. PVC-Pipe Sleeves: ASTM D 1785, Schedule 40.
6. Galvanized-Steel-Pipe Sleeves: ASTM A 53/A 53M, Type E, standard weight, zinc coated, plain ends.
7. Stack Sleeve Fittings: Manufactured, cast-iron sleeve with integral clamping flange. Include clamping ring and bolts and nuts for membrane flashing.
 - a. Underdeck Clamp: Clamping ring with set-screws.

T. Sleeve Seals

1. Description: Modular sealing element unit, designed for field assembly, to fill annular space between pipe and sleeve.
 - a. Sealing Elements: EPDM-rubber or NBR interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
 - b. Pressure Plates: Carbon steel **OR** Plastic **OR** Stainless steel, **as directed**.
 - c. Connecting Bolts and Nuts: Carbon steel with corrosion-resistant coating **OR** Stainless steel, **as directed**, of length required to secure pressure plates to sealing elements.

U. Grout

1. Standard: ASTM C 1107, Grade B, posthardening and volume adjusting, dry, hydraulic-cement grout.
2. Characteristics: Nonshrink, and recommended for interior and exterior applications.
3. Design Mix: **5000-psi (34-MPa)**, 28-day compressive strength.
4. Packaging: Premixed and factory packaged.

1.3 EXECUTION

A. Preparation

1. Perform fire-hydrant flow test according to NFPA 14 and NFPA 291. Use results for system design calculations required in "Quality Assurance" Article.
2. Report test results promptly and in writing.

B. Service-Entrance Piping

1. Connect fire-suppression standpipe piping to water-service piping at service entrance into building. Comply with requirements for exterior piping in Division 21 Section "Facility Fire-suppression Water-service Piping".
2. Install shutoff valve, backflow preventer, **as directed**, pressure gage, drain, and other accessories at connection to fire-suppression water-service piping. Comply with requirements for backflow preventers in Division 21 Section "Facility Fire-suppression Water-service Piping", **as directed**.
3. Install shutoff valve, check valve, pressure gage, and drain at connection to water service.



C. Water-Supply Connections

1. Connect fire-suppression standpipe piping to building's interior water-distribution piping. Comply with requirements for interior piping in Division 22 Section "Domestic Water Piping".
2. Install shutoff valve, backflow preventer, **as directed**, pressure gage, drain, and other accessories at connection to water-distribution piping. Comply with requirements for backflow preventers in Division 22 Section "Domestic Water Piping Specialties", **as directed**.
OR
Install shutoff valve, check valve, pressure gage, and drain at connection to water supply.

D. Piping Installation

1. Locations and Arrangements: Drawing plans, schematics, and diagrams indicate general location and arrangement of piping. Install piping as indicated, as far as practical.
 - a. Deviations from approved working plans for piping require written approval from authorities having jurisdiction. File written approval with the Owner before deviating from approved working plans.
2. Piping Standard: Comply with requirements in NFPA 14 for installation of fire-suppression standpipe piping.
3. Install seismic restraints on piping. Comply with requirements in NFPA 13 for seismic-restraint device materials and installation.
4. Install listed fittings to make changes in direction, branch takeoffs from mains, and reductions in pipe sizes.
5. Install drain valves on standpipes. Extend drain piping to outside of building.
6. Install automatic (ball drip) drain valves to drain piping between fire-department connections and check valves. Drain to floor drain or outside building.
7. Install alarm devices in piping systems.
8. Install hangers and supports for standpipe system piping according to NFPA 14. Comply with requirements in NFPA 13 for hanger materials.
9. Install pressure gages on riser or feed main and at top of each standpipe. Include pressure gages with connection not less than **NPS 1/4 (DN 8)** and with soft-metal seated globe valve, arranged for draining pipe between gage and valve. Install gages to permit removal, and install where they will not be subject to freezing.
10. Drain dry-type standpipe system piping.
11. Pressurize and check dry-type standpipe system piping and air-pressure maintenance devices **OR** air compressors, **as directed**.
12. Fill wet-type standpipe system piping with water.
13. Install electric heating cables and pipe insulation on wet-type, fire-suppression standpipe piping in areas subject to freezing. Comply with requirements for heating cables in Division 21 Section "Heat Tracing For Fire-suppression Piping" and for piping insulation in Division 21 Section "Fire-suppression Systems Insulation".
14. Connect compressed-air supply to dry-pipe sprinkler piping.
OR
Connect air compressor to the following piping and wiring:
 - a. Pressure gages and controls.
 - b. Electrical power system.
 - c. Fire-alarm devices, including low-pressure alarm.

E. Joint Construction

1. Install couplings, flanges, flanged fittings, unions, nipples, and transition and special fittings that have finish and pressure ratings same as or higher than system's pressure rating for aboveground applications unless otherwise indicated.
2. Install unions adjacent to each valve in pipes **NPS 2 (DN 50)** and smaller.
3. Install flanges, flange adapters, or couplings for grooved-end piping on valves, apparatus, and equipment having **NPS 2-1/2 (DN 65)** and larger end connections.
4. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

5. Remove scale, slag, dirt, and debris from inside and outside of pipes, tubes, and fittings before assembly.
 6. Flanged Joints: Select appropriate gasket material in size, type, and thickness suitable for water service. Join flanges with gasket and bolts according to ASME B31.9.
 7. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
 - a. Apply appropriate tape or thread compound to external pipe threads.
 - b. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged.
 8. Steel-Piping, Cut-Grooved Joints: Cut square-edge groove in end of pipe according to AWWA C606. Assemble coupling with housing, gasket, lubricant, and bolts. Join steel pipe and grooved-end fittings according to AWWA C606 for steel-pipe joints.
 9. Steel-Piping, Roll-Grooved Joints: Roll rounded-edge groove in end of pipe according to AWWA C606. Assemble coupling with housing, gasket, lubricant, and bolts. Join steel pipe and grooved-end fittings according to AWWA C606 for steel-pipe grooved joints.
 10. Welded Joints: Construct joints according to AWS D10.12M/D10.12, using qualified processes and welding operators according to "Quality Assurance" Article.
 - a. Shop weld pipe joints where welded piping is indicated. Do not use welded joints for galvanized-steel pipe.
 11. Brazed Joints: Join copper tube and fittings according to CDA's "Copper Tube Handbook," "Brazed Joints" Chapter.
 12. Copper-Tubing Grooved Joints: Roll rounded-edge groove in end of tube according to AWWA C606. Assemble coupling with housing, gasket, lubricant, and bolts. Join copper tube and grooved-end fittings according to AWWA C606 for steel-pipe grooved joints.
 13. Dissimilar-Material Piping Joints: Make joints using adapters compatible with materials of both piping systems.
- F. Valve And Specialties Installation
1. Install listed fire-protection valves, trim and drain valves, specialty valves and trim, controls, and specialties according to NFPA 14 and authorities having jurisdiction.
 2. Install listed fire-protection shutoff valves supervised-open, located to control sources of water supply except from fire-department connections. Install permanent identification signs indicating portion of system controlled by each valve.
 3. Install check valve in each water-supply connection. Install backflow preventers instead of check valves in potable-water-supply sources.
 4. Specialty Valves:
 - a. General Requirements: Install in vertical position for proper direction of flow, in main supply to system.
 - b. Alarm Valves: Install bypass check valve and retarding chamber drain-line connection.
 - c. Dry-Pipe and Deluge Valves: Install trim sets for air supply, drain, priming level, alarm connections, ball drip valves, pressure gages, priming chamber attachment, and fill-line attachment.
 - 1) Install air compressor and compressed-air supply piping.
OR
Air-Pressure Maintenance Device: Install shutoff valves to permit servicing without shutting down sprinkler system; bypass valve for quick system filling; pressure regulator or switch to maintain system pressure; strainer; pressure ratings with **14- to 60-psig (95- to 410-kPa)** adjustable range; and **175-psig (1200-kPa)** maximum inlet pressure.
 - 2) Install compressed-air supply piping from building's compressed-air piping system.
- G. Hose-Connection Installation
1. Install hose connections adjacent to standpipes.
 2. Install freestanding hose connections for access and minimum passage restriction.
 3. Install **NPS 1-1/2 (DN 40)** hose-connection valves with flow-restricting device.



4. Install **NPS 2-1/2 (DN 65)** hose connections with quick-disconnect **NPS 2-1/2 by NPS 1-1/2 (DN 65 by DN 40)** reducer adapter and flow-restricting device.
 5. Install wall-mounted-type hose connections in cabinets. Include pipe escutcheons, with finish matching valves, inside cabinet where water-supply piping penetrates cabinet. Install valves at angle required for connection of fire hose. Comply with requirements for cabinets in Division 10 Section "Fire Extinguisher Cabinets".
- H. Hose-Station Installation
1. Install freestanding hose stations for access and minimum passage restriction.
 2. Install **NPS 1-1/2 (DN 40)** hose-station valves with flow-restricting device unless otherwise indicated.
 3. Install **NPS 2-1/2 (DN 65)** hose connections with quick-disconnect **NPS 2-1/2 by NPS 1-1/2 (DN 65 by DN 40)** reducer adapter and flow-restricting device unless otherwise indicated.
 4. Install freestanding hose stations with support or bracket attached to standpipe.
 5. Install wall-mounted, rack hose stations in cabinets. Include pipe escutcheons, with finish matching valves, inside cabinet where water-supply piping penetrates cabinet. Install valves at angle required for connection of fire hose. Comply with requirements for cabinets in Division 10 Section "Fire Extinguisher Cabinets".
 6. Install hose-reel hose stations on wall with bracket.
- I. Monitor Installation
1. Install monitors on standpipe piping.
- J. Fire-Department Connection Installation
1. Install wall-type, fire-department connections.
 2. Install yard-type, fire-department connections in concrete slab support. Comply with requirements for concrete in Division 03 Section "Cast-in-place Concrete".
 - a. Install two **OR** three, **as directed**, protective pipe bollards around **OR** on sides of, **as directed**, each fire-department connection. Comply with requirements for bollards in Division 05 Section "Metal Fabrications".
 3. Install automatic (ball drip) drain valve at each check valve for fire-department connection.
- K. Escutcheon Installation
1. Install escutcheons for penetrations of walls, ceilings, and floors.
 2. Escutcheons for New Piping:
 - a. Piping with Fitting or Sleeve Protruding from Wall: One piece, deep pattern.
 - b. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One piece, cast brass with polished chrome-plated finish **OR** stamped steel with set-screw **OR** stamped steel with set-screw or spring clips **OR** stamped steel with spring clips, **as directed**.
 - c. Bare Piping at Ceiling Penetrations in Finished Spaces: One piece, cast brass with polished chrome-plated finish **OR** One piece or split casting, cast brass with polished chrome-plated finish **OR** Split casting, cast brass with polished chrome-plated finish **OR** One piece, stamped steel with set-screw **OR** One piece or split plate, stamped steel with set-screw **OR** Split plate, stamped steel with set-screw, **as directed**.
 - d. Bare Piping in Unfinished Service Spaces: One piece, cast brass with polished chrome-plated finish **OR** cast brass with rough-brass finish **OR** stamped steel with set-screw **OR** stamped steel with spring clips **OR** stamped steel with set-screw or spring clips, **as directed**.
 - e. Bare Piping in Equipment Rooms: One piece, cast brass **OR** stamped steel with set-screw **OR** stamped steel with spring clips **OR** stamped steel with set-screw or spring clips, **as directed**.
 - f. Bare Piping at Floor Penetrations in Equipment Rooms: One-piece floor plate.
 3. Escutcheons for Existing Piping:
 - a. Chrome-Plated Piping: Split casting, cast brass with chrome-plated finish.

- b. Insulated Piping: Split plate, stamped steel with concealed or exposed-rivet hinge and spring clips.
- c. Bare Piping at Wall and Floor Penetrations in Finished Spaces: Split casting, cast brass with chrome-plated finish **OR** plate, stamped steel with concealed hinge and spring clips, **as directed**.
- d. Bare Piping at Ceiling Penetrations in Finished Spaces: Split casting, cast brass with chrome-plated finish **OR** plate, stamped steel with concealed hinge and set-screw, **as directed**.
- e. Bare Piping in Unfinished Service Spaces: Split casting, cast brass with polished chrome-plated finish **OR** casting, cast brass with rough-brass finish **OR** plate, stamped steel with concealed hinge and set-screw or spring clips **OR** plate, stamped steel with concealed or exposed-rivet hinge and set-screw or spring clips **OR** plate, stamped steel with exposed-rivet hinge and set-screw or spring clips, **as directed**.
- f. Bare Piping in Equipment Rooms: Split casting, cast brass **OR** plate, stamped steel with set-screw or spring clips, **as directed**.
- g. Bare Piping at Floor Penetrations in Equipment Rooms: Split-casting floor plate.

L. Sleeve Installation

- 1. General Requirements: Install sleeves for pipes and tubes passing through penetrations in floors, partitions, roofs, and walls.
- 2. Sleeves are not required for core-drilled holes.
- 3. Permanent sleeves are not required for holes formed by removable PE sleeves.
- 4. Cut sleeves to length for mounting flush with both surfaces unless otherwise indicated.
- 5. Install sleeves in new partitions, slabs, and walls as they are built.
- 6. For interior wall penetrations, seal annular space between sleeve and pipe or pipe insulation using joint sealants appropriate for size, depth, and location of joint. Comply with requirements for joint sealants in Division 07 Section "Joint Sealants".
- 7. For exterior wall penetrations above grade, seal annular space between sleeve and pipe using joint sealants appropriate for size, depth, and location of joint. Comply with requirements for joint sealants in Division 07 Section "Joint Sealants".
- 8. For exterior wall penetrations below grade, seal annular space between sleeve and pipe using sleeve seals.
- 9. Seal space outside of sleeves in concrete slabs and walls with grout.
- 10. Install sleeves that are large enough to provide **1/4-inch (6.4-mm)** annular clear space between sleeve and pipe or pipe insulation unless otherwise indicated.
- 11. Install sleeve materials according to the following applications:
 - a. Sleeves for Piping Passing through Concrete Floor Slabs: Molded PE **OR** Molded PVC **OR** Galvanized-steel pipe, **as directed**.
 - b. Sleeves for Piping Passing through Concrete Floor Slabs of Mechanical Equipment Areas or Other Wet Areas: Galvanized-steel pipe **OR** Stack sleeve fittings, **as directed**.
 - 1) Extend sleeves **2 inches (50 mm)** above finished floor level.
 - 2) For pipes penetrating floors with membrane waterproofing, extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified. Secure flashing between clamping flanges. Install section of cast-iron soil pipe to extend sleeve to **2 inches (50 mm)** above finished floor level. Comply with requirements for flashing in Division 07 Section "Sheet Metal Flashing And Trim".
 - c. Sleeves for Piping Passing through Gypsum-Board Partitions:
 - 1) PVC-pipe **OR** Galvanized-steel-pipe, **as directed**, sleeves for pipes smaller than **NPS 6 (DN 150)**.
 - 2) Galvanized-steel-sheet sleeves for pipes **NPS 6 (DN 150)** and larger.
 - 3) Exception: Sleeves are not required for water-supply tubes and waste pipes for individual plumbing fixtures if escutcheons will cover openings.
 - d. Sleeves for Piping Passing through Concrete Roof Slabs: Molded PE **OR** Molded PVC **OR** Galvanized-steel pipe, **as directed**.
 - e. Sleeves for Piping Passing through Exterior Concrete Walls:
 - 1) Galvanized-steel-pipe sleeves for pipes smaller than **NPS 6 (DN 150)**.

- 2) Cast-iron wall pipe sleeves for pipes **NPS 6 (DN 150)** and larger.
 - 3) Install sleeves that are large enough to provide **1-inch (25-mm)** annular clear space between sleeve and pipe or pipe insulation when sleeve seals are used.
 - f. Sleeves for Piping Passing through Interior Concrete Walls:
 - 1) PVC-pipe **OR** Galvanized-steel-pipe, **as directed**, sleeves for pipes smaller than **NPS 6 (DN 150)**.
 - 2) Galvanized-steel-sheet sleeves for pipes **NPS 6 (DN 150)** and larger.
 12. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Comply with requirements for firestop materials and installations in Division 07 Section "Penetration Firestopping".
- M. Sleeve Seal Installation
1. Install sleeve seals in sleeves in exterior concrete walls at water-service piping entries into building.
 2. Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble sleeve seal components and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.
- N. Identification
1. Install labeling and pipe markers on equipment and piping according to requirements in NFPA 14.
 2. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Division 26 Section "Identification For Electrical Systems".
- O. Field Quality Control
1. Perform tests and inspections.
 2. Tests and Inspections:
 - a. Leak Test: After installation, charge systems and test for leaks. Repair leaks and retest until no leaks exist.
 - b. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
 - c. Flush, test, and inspect standpipe systems according to NFPA 14, "System Acceptance" Chapter.
 - d. Energize circuits to electrical equipment and devices.
 - e. Start and run air compressors.
 - f. Coordinate with fire-alarm tests. Operate as required.
 - g. Coordinate with fire-pump tests. Operate as required.
 - h. Verify that equipment hose threads are same as local fire-department equipment.
 3. Fire-suppression standpipe system will be considered defective if it does not pass tests and inspections.
 4. Prepare test and inspection reports.
- P. Demonstration
1. Train the Owner's maintenance personnel to adjust, operate, and maintain specialty valves.
- Q. Piping Schedule
1. Piping between Fire-Department Connections and Check Valves: Galvanized, standard-weight steel pipe with threaded ends; cast-iron threaded fittings; and threaded **OR** grooved ends; grooved-end fittings; grooved-end-pipe couplings; and grooved, **as directed**, joints.
 2. Standard-pressure, wet-type, fire-suppression standpipe piping, **NPS 4 (DN 100)** and smaller, shall be one of the following:
 - a. Standard-weight or Schedule 30, black-steel pipe with threaded ends; uncoated, gray-iron threaded fittings; and threaded joints.
 - b. Standard-weight **OR** Schedule 30 or thinwall, **as directed**, galvanized-steel pipe with threaded ends; galvanized, gray-iron threaded fittings; and threaded joints.

- c. Standard-weight or Schedule 30, black-steel pipe with cut- or roll-grooved ends; uncoated, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.
- d. Standard-weight or Schedule 30, galvanized-steel pipe with cut-grooved ends; galvanized, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.
- e. Standard-weight or Schedule 30, black-steel pipe with plain ends; steel welding fittings; and welded joints.
- f. Thinwall **OR** Schedule 10, **as directed**, **OR** nonstandard OD, thinwall or hybrid, **as directed**, black-steel pipe with roll-grooved ends; uncoated, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.
- g. Thinwall **OR** Schedule 10, **as directed**, **OR** nonstandard OD, thinwall or hybrid, **as directed**, black-steel pipe with plain ends; welding fittings; and welded joints.
- h. **Type L (Type B) OR Type M (Type C), as directed**, hard copper tube with plain ends; cast- or wrought-copper solder-joint fittings; and brazed joints.
- i. **Type L (Type B) OR Type M (Type B), as directed**, hard copper tube with roll-grooved ends; copper, grooved-end fittings; grooved-end-tube couplings; and grooved joints.
3. Standard-pressure, wet-type, fire-suppression standpipe piping, **NPS 5 to NPS 8 (DN 125 to DN 200)**, shall be one of the following:
 - a. Standard-weight **OR** Schedule 30, **as directed**, or thinwall, black-steel pipe with threaded ends; uncoated, gray-iron threaded fittings; and threaded joints.
 - b. Standard-weight or Schedule 30, galvanized-steel pipe with threaded ends; galvanized, gray-iron threaded fittings; and threaded joints.
 - c. Standard-weight or Schedule 30, black-steel pipe with cut- or roll-grooved ends; uncoated, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.
 - d. Standard-weight or Schedule 30, galvanized-steel pipe with cut-grooved ends; galvanized, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.
 - e. Standard-weight or Schedule 30, black-steel pipe with plain ends; steel welding fittings; and welded joints.
 - f. Thinwall **OR** Schedule 10, **as directed**, or hybrid black-steel pipe with roll-grooved ends; uncoated, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.
 - g. Thinwall **OR** Schedule 10, **as directed**, or hybrid black-steel pipe with plain ends; welding fittings; and welded joints.
 - h. **Type L (Type B) OR Type M (Type C), as directed**, hard copper tube with plain ends; cast- or wrought-copper solder-joint fittings; and brazed joints.
 - i. **Type L (Type B) OR Type M (Type C), as directed**, hard copper tube with roll-grooved ends; copper, grooved-end fittings; grooved-end-tube couplings; and grooved joints.
4. Standard-pressure, wet-type, fire-suppression standpipe piping, **NPS 10 and NPS 12 (DN 250 and DN 300)**, shall be one of the following:
 - a. Standard-weight or Schedule 30, black-steel pipe with threaded ends; uncoated, gray-iron threaded fittings; and threaded joints.
 - b. Standard-weight or Schedule 30, galvanized-steel pipe with threaded ends; galvanized, gray-iron threaded fittings; and threaded joints.
 - c. Standard-weight or Schedule 30, black-steel pipe with cut- or roll-grooved ends; uncoated, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.
 - d. Standard-weight or Schedule 30, galvanized-steel pipe with cut-grooved ends; galvanized, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.
 - e. Standard-weight or Schedule 30, black-steel pipe with plain ends; steel welding fittings; and welded joints.
 - f. Thinwall **OR** Schedule 10, **as directed**, **OR** nonstandard OD, thinwall or hybrid, **as directed**, black-steel pipe with plain ends; welding fittings; and welded joints.

5. High-pressure, wet-type, fire-suppression standpipe piping, **NPS 4 (DN 100)** and smaller, shall be one of the following:
 - a. Standard-weight or Schedule 30, black-steel pipe with threaded ends; uncoated, gray-iron threaded fittings; and threaded joints.
 - b. Standard-weight or Schedule 30, galvanized-steel pipe with threaded ends; galvanized, gray-iron threaded fittings; and threaded joints.
 - c. Standard-weight or Schedule 30, black-steel pipe with cut-grooved **OR** roll-grooved, **as directed**, ends; uncoated, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.
 - d. Standard-weight or Schedule 30, galvanized-steel pipe with cut-grooved ends; galvanized, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.
 - e. Standard-weight or Schedule 30, black-steel pipe with plain ends; steel welding fittings; and welded joints.
 - f. Thinwall **OR** Schedule 10, **as directed**, **OR** nonstandard OD, thinwall or hybrid, **as directed**, black-steel pipe with plain ends; welding fittings; and welded joints.
6. High-pressure, wet-type, fire-suppression standpipe piping, **NPS 5 (DN 125)** and larger, shall be one of the following:
 - a. Standard-weight or Schedule 30, black-steel pipe with threaded ends; uncoated, gray-iron threaded fittings; and threaded joints.
 - b. Standard-weight or Schedule 30, galvanized-steel pipe with threaded ends; galvanized, gray-iron threaded fittings; and threaded joints.
 - c. Standard-weight or Schedule 30, black-steel pipe with cut- or roll-grooved ends; uncoated, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.
 - d. Standard-weight or Schedule 30, galvanized-steel pipe with cut-grooved ends; galvanized, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.
 - e. Standard-weight or Schedule 30, black-steel pipe with plain ends; steel welding fittings; and welded joints.
 - f. Thinwall **OR** Schedule 10, **as directed**, **OR** nonstandard OD, thinwall or hybrid, **as directed**, black-steel pipe with plain ends; welding fittings; and welded joints.
7. Standard-pressure, dry-type, fire-suppression standpipe piping, **NPS 4 (DN 100)** and smaller, shall be one of the following:
 - a. Standard-weight or Schedule 30, galvanized-steel pipe with threaded ends; galvanized, gray-iron threaded fittings; and threaded joints.
 - b. Standard-weight or Schedule 30, galvanized-steel pipe with cut-grooved ends; galvanized, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.
 - c. **Type L (Type B) OR Type M (Type C), as directed**, hard copper tube with plain ends; cast- or wrought-copper solder-joint fittings; and brazed joints.
 - d. **Type L (Type B) OR Type M (Type C), as directed**, hard copper tube with roll-grooved ends; copper, grooved-end fittings; grooved-end-tube couplings; and grooved joints.
8. Standard-pressure, dry-type, fire-suppression standpipe piping, **NPS 5 and NPS 6 (DN 125 and DN 150)**, shall be one of the following:
 - a. Standard-weight or Schedule 30, galvanized-steel pipe with threaded ends; galvanized, gray-iron threaded fittings; and threaded joints.
 - b. Standard-weight or Schedule 30, galvanized-steel pipe with cut-grooved ends; galvanized, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.
 - c. **Type L (Type B) OR Type M (Type C), as directed**, hard copper tube with plain ends; cast- or wrought-copper solder-joint fittings; and brazed joints.
 - d. **Type L (Type B) OR Type M (Type C), as directed**, hard copper tube with roll-grooved ends; copper, grooved-end fittings; grooved-end-tube couplings; and grooved joints.



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Task	Specification	Specification Description
21 12 13 00	21 11 19 00	Fire-Suppression Standpipes
21 12 23 00	21 11 19 00	Fire-Suppression Standpipes
21 12 29 00	01 22 16 00	No Specification Required
21 12 29 00	21 11 19 00	Fire-Suppression Standpipes

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SECTION 21 13 13 00 - WET-PIPE FIRE-SUPPRESSION SPRINKLERS

1.1 GENERAL

A. Description Of Work

1. This specification covers the furnishing and installation of materials for wet-pipe fire-suppression sprinklers. Products shall be as follows or as directed by the Owner. Installation procedures shall be in accordance with the product manufacturer's recommendations. Demolition and removal of materials shall be as required to support the work.

B. Summary

1. Section Includes:
 - a. Pipes, fittings, and specialties.
 - b. Fire-protection valves.
 - c. Fire-department connections.
 - d. Sprinklers.
 - e. Excess-pressure pumps.
 - f. Alarm devices.
 - g. Manual control stations.
 - h. Control panels.
 - i. Pressure gages.

C. Definitions

1. High-Pressure Sprinkler Piping: Wet-pipe sprinkler system piping designed to operate at working pressure higher than standard 175 psig (1200 kPa), but not higher than 250 psig (1725 kPa) OR 300 psig (2070 kPa), as directed.
2. Standard-Pressure Sprinkler Piping: Wet-pipe sprinkler system piping designed to operate at working pressure of 175 psig (1200 kPa) maximum.

D. System Descriptions

1. Wet-Pipe Sprinkler System: Automatic sprinklers are attached to piping containing water and that is connected to water supply through alarm valve. Water discharges immediately from sprinklers when they are opened. Sprinklers open when heat melts fusible link or destroys frangible device. Hose connections are included if indicated.
2. Deluge Sprinkler System: Open sprinklers are attached to piping connected to water supply through deluge valve. Fire-detection system, in same area as sprinklers, opens valve. Water flows into piping system and discharges from attached sprinklers when valve opens.

E. Performance Requirements

1. Standard-Pressure Piping System Component: Listed for 175-psig (1200-kPa) minimum working pressure.
2. High-Pressure Piping System Component: Listed for 250-psig (1725-kPa) minimum OR 300-psig (2070-kPa), as directed, working pressure.
3. Delegated Design: Design sprinkler system(s), including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.
4. Sprinkler system design shall be approved by authorities having jurisdiction.
 - a. Margin of Safety for Available Water Flow and Pressure: 10 OR 20, as directed, percent, including losses through water-service piping, valves, and backflow preventers.
 - b. Sprinkler Occupancy Hazard Classifications:
 - 1) Automobile Parking Areas: Ordinary Hazard, Group 1.
 - 2) Building Service Areas: Ordinary Hazard, Group 1.
 - 3) Churches: Light Hazard.
 - 4) Electrical Equipment Rooms: Ordinary Hazard, Group 1.
 - 5) Dry Cleaners: Ordinary Hazard, Group 2.

- 6) General Storage Areas: Ordinary Hazard, Group 1.
 - 7) Laundries: Ordinary Hazard, Group 1.
 - 8) Libraries except Stack Areas: Light Hazard.
 - 9) Library Stack Areas: Ordinary Hazard, Group 2.
 - 10) Machine Shops: Ordinary Hazard, Group 2.
 - 11) Mechanical Equipment Rooms: Ordinary Hazard, Group 1.
 - 12) Office and Public Areas: Light Hazard.
 - 13) Plastics Processing Areas: Extra Hazard, Group 2.
 - 14) Printing Plants: Extra Hazard, Group 1.
 - 15) Repair Garages: Ordinary Hazard, Group 2.
 - 16) Residential Living Areas: Light Hazard.
 - 17) Restaurant Service Areas: Ordinary Hazard, Group 1.
 - 18) Solvent Cleaning Areas: Extra Hazard, Group 2.
 - 19) Upholstering Plants: Extra Hazard, Group 1.
 - c. Minimum Density for Automatic-Sprinkler Piping Design:
 - 1) Residential (Dwelling) Occupancy: 0.05 gpm over 400-sq. ft. (2.04 mm/min. over 37.2-sq. m) area.
 - 2) Light-Hazard Occupancy: 0.10 gpm over 1500-sq. ft. (4.1 mm/min. over 139-sq. m) area.
 - 3) Ordinary-Hazard, Group 1 Occupancy: 0.15 gpm over 1500-sq. ft. (6.1 mm/min. over 139-sq. m) area.
 - 4) Ordinary-Hazard, Group 2 Occupancy: 0.20 gpm over 1500-sq. ft. (8.1 mm/min. over 139-sq. m) area.
 - 5) Extra-Hazard, Group 1 Occupancy: 0.30 gpm over 2500-sq. ft. (12.2 mm/min. over 232-sq. m) area.
 - 6) Extra-Hazard, Group 2 Occupancy: 0.40 gpm over 2500-sq. ft. (16.3 mm/min. over 232-sq. m) area.
 - 7) Special Occupancy Hazard: As determined by authorities having jurisdiction.
 - d. Minimum Density for Deluge-Sprinkler Piping Design:
 - 1) Ordinary-Hazard, Group 1 Occupancy: 0.15 gpm (6.1 mm/min.) over entire area.
 - 2) Ordinary-Hazard, Group 2 Occupancy: 0.20 gpm (8.1 mm/min.) over entire area.
 - 3) Extra-Hazard, Group 1 Occupancy: 0.30 gpm (12.2 mm/min.) over entire area.
 - 4) Extra-Hazard, Group 2 Occupancy: 0.40 gpm (16.3 mm/min.) over entire area.
 - 5) Special Occupancy Hazard: As determined by authorities having jurisdiction.
 - e. Maximum Protection Area per Sprinkler: Per UL listing.
OR
 Maximum Protection Area per Sprinkler:
 - 1) Residential Areas: 400 sq. ft. (37 sq. m).
 - 2) Office Spaces: 120 sq. ft. (11.1 sq. m) **OR** 225 sq. ft. (20.9 sq. m), as directed.
 - 3) Storage Areas: 130 sq. ft. (12.1 sq. m).
 - 4) Mechanical Equipment Rooms: 130 sq. ft. (12.1 sq. m).
 - 5) Electrical Equipment Rooms: 130 sq. ft. (12.1 sq. m).
 - 6) Other Areas: According to NFPA 13 recommendations unless otherwise indicated.
 - f. Total Combined Hose-Stream Demand Requirement: According to NFPA 13 unless otherwise indicated:
 - 1) Light-Hazard Occupancies: 100 gpm (6.3 L/s) for 30 minutes.
 - 2) Ordinary-Hazard Occupancies: 250 gpm (15.75 L/s) for 60 to 90 minutes.
 - 3) Extra-Hazard Occupancies: 500 gpm (31.5 L/s) for 90 to 120 minutes.
 5. Seismic Performance: Sprinkler piping shall withstand the effects of earthquake motions determined according to NFPA 13 and ASCE/SEI 7.
- F. Submittals
1. Product Data: For each type of product indicated.
 2. LEED Submittal:

- a. Product Data for Credit EQ 4.1: For solvent cements and adhesive primers, including printed statement of VOC content and chemical components.
 3. Shop Drawings: For wet-pipe sprinkler systems. Include plans, elevations, sections, details, and attachments to other work.
 - a. Wiring Diagrams: For power, signal, and control wiring.
 4. Delegated-Design Submittal: For sprinkler systems indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
 5. Qualification Data: For qualified Installer and professional engineer, **as directed**.
 6. Approved Sprinkler Piping Drawings: Working plans, prepared according to NFPA 13, that have been approved by authorities having jurisdiction, including hydraulic calculations if applicable.
 7. Welding certificates.
 8. Fire-hydrant flow test report.
 9. Field Test Reports and Certificates: Indicate and interpret test results for compliance with performance requirements and as described in NFPA 13. Include "Contractor's Material and Test Certificate for Aboveground Piping."
 10. Field quality-control reports.
 11. Operation and maintenance data.
- G. Quality Assurance
 1. Installer Qualifications:
 - a. Installer's responsibilities include designing, fabricating, and installing sprinkler systems and providing professional engineering services needed to assume engineering responsibility. Base calculations on results of fire-hydrant flow test.
 - 1) Engineering Responsibility: Preparation of working plans, calculations, and field test reports by a qualified professional engineer.
 2. Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.
 3. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
 4. NFPA Standards: Sprinkler system equipment, specialties, accessories, installation, and testing shall comply with the following:
 - a. NFPA 13, "Installation of Sprinkler Systems."
 - b. NFPA 13R, "Installation of Sprinkler Systems in Residential Occupancies up to and Including Four Stories in Height."
 - c. NFPA 24, "Installation of Private Fire Service Mains and Their Appurtenances."
- H. Project Conditions
 1. Interruption of Existing Sprinkler Service: Do not interrupt sprinkler service to facilities occupied by the Owner or others unless permitted under the following conditions and then only after arranging to provide temporary sprinkler service according to requirements indicated:
 - a. Notify the Owner no fewer than two days in advance of proposed interruption of sprinkler service.
 - b. Do not proceed with interruption of sprinkler service without the Owner's written permission.

1.2 PRODUCTS

- A. Piping Materials
 1. Comply with requirements in "Piping Schedule" Article for applications of pipe, tube, and fitting materials, and for joining methods for specific services, service locations, and pipe sizes.
- B. Steel Pipe And Fittings
 1. Standard Weight, Galvanized- and Black-Steel Pipe: ASTM A 53/A 53M, Type E, Grade B. Pipe ends may be factory or field formed to match joining method.

2. Schedule 30, Galvanized- and Black-Steel Pipe: ASTM A 135; ASTM A 795/A 795M, Type E; or ASME B36.10M, wrought steel; with wall thickness not less than Schedule 30 and not more than Schedule 40. Pipe ends may be factory or field formed to match joining method.
3. Thinwall Galvanized- and Black-Steel Pipe: ASTM A 135 or ASTM A 795/A 795M, threadable, with wall thickness less than Schedule 30 and equal to or greater than Schedule 10. Pipe ends may be factory or field formed to match joining method.
4. Schedule 10, Black-Steel Pipe: ASTM A 135 or ASTM A 795/A 795M, Schedule 10 in **NPS 5 (DN 125)** and smaller; and NFPA 13-specified wall thickness in **NPS 6 to NPS 10 (DN 150 to DN 250)**, plain end.
5. Nonstandard OD, Thinwall Black-Steel Pipe: ASTM A 135 or ASTM A 795/A 795M, thinwall, with plain ends and wall thickness less than Schedule 10.
6. Hybrid Black-Steel Pipe: ASTM A 135 or ASTM A 795/A 795M, lightwall, with wall thickness less than Schedule 10 and greater than Schedule 5.
7. Schedule 5 Steel Pipe: ASTM A 135 or ASTM A 795/A 795M, lightwall, with plain ends.
8. Galvanized- and Black-Steel Pipe Nipples: ASTM A 733, made of ASTM A 53/A 53M, standard-weight, seamless steel pipe with threaded ends.
9. Galvanized and Uncoated, Steel Couplings: ASTM A 865, threaded.
10. Galvanized and Uncoated, Gray-Iron Threaded Fittings: ASME B16.4, Class 125, standard pattern.
11. Malleable- or Ductile-Iron Unions: UL 860.
12. Cast-Iron Flanges: ASME 16.1, Class 125.
13. Steel Flanges and Flanged Fittings: ASME B16.5, Class 150.
14. Steel Welding Fittings: ASTM A 234/A 234M and ASME B16.9.
15. Grooved-Joint, Steel-Pipe Appurtenances:
 - a. Pressure Rating: **175 psig (1200 kPa) OR 250 psig (1725 kPa) OR 300 psig (2070 kPa)**, as directed, minimum.
 - b. Galvanized and Uncoated, Grooved-End Fittings for Steel Piping: ASTM A 47/A 47M, malleable-iron casting or ASTM A 536, ductile-iron casting; with dimensions matching steel pipe.
 - c. Grooved-End-Pipe Couplings for Steel Piping: AWWA C606 and UL 213, rigid pattern, unless otherwise indicated, for steel-pipe dimensions. Include ferrous housing sections, EPDM-rubber gasket, and bolts and nuts.
16. Steel Pressure-Seal Fittings: UL 213, FM-approved, **175-psig (1200-kPa)** pressure rating with steel housing, rubber O-rings, and pipe stop; for use with fitting manufacturers' pressure-seal tools.

C. Copper Tube And Fittings

1. Hard Copper Tube: **ASTM B 88, Type L (ASTM B 88M, Type B)** and **ASTM B 88, Type M (ASTM B 88M, Type C)** water tube, drawn temper.
2. Cast-Copper, Solder-Joint Fittings: ASME B16.18, pressure fittings.
3. Wrought-Copper, Solder-Joint Fittings: ASME B16.22, pressure fittings.
4. Bronze Flanges: ASME B16.24, Class 150, with solder-joint ends.
5. Copper Unions: MSS SP-123, cast-copper-alloy, hexagonal-stock body, with ball-and-socket, metal-to-metal seating surfaces, and solder-joint or threaded ends.
6. Copper Pressure-Seal Fittings:
 - a. Standard: UL 213.
 - b. **NPS 2 (DN 50)** and Smaller: Wrought-copper fitting with EPDM-rubber O-ring seal in each end.
 - c. **NPS 2-1/2 to NPS 4 (DN 65 to DN 100)**: Cast-bronze fitting with EPDM-rubber O-ring seal in each end.
7. Grooved-Joint, Copper-Tube Appurtenances:
 - a. Grooved-End, Copper Fittings: **ASTM B 75 (ASTM B 75M)**, copper tube or ASTM B 584, bronze castings.



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- a. Standard: UL 1091 except with ball instead of disc.
 - b. Valves **NPS 1-1/2 (DN 40)** and Smaller: Bronze body with threaded ends.
 - c. Valves **NPS 2 and NPS 2-1/2 (DN 50 and DN 65)**: Bronze body with threaded ends or ductile-iron body with grooved ends.
 - d. Valves **NPS 3 (DN 80)**: Ductile-iron body with grooved ends.
3. Bronze Butterfly Valves:
 - a. Standard: UL 1091.
 - b. Pressure Rating: **175 psig (1200 kPa)**.
 - c. Body Material: Bronze.
 - d. End Connections: Threaded.
4. Iron Butterfly Valves:
 - a. Standard: UL 1091.
 - b. Pressure Rating: **175 psig (1200 kPa)**.
 - c. Body Material: Cast or ductile iron.
 - d. Style: Lug or wafer.

OR

End Connections: Grooved.
5. Check Valves:
 - a. Standard: UL 312.
 - b. Pressure Rating: **250 psig (1725 kPa)** minimum **OR 300 psig (2070 kPa)**, as directed.
 - c. Type: Swing check.
 - d. Body Material: Cast iron.
 - e. End Connections: Flanged or grooved.
6. Bronze OS&Y Gate Valves:
 - a. Standard: UL 262.
 - b. Pressure Rating: **175 psig (1200 kPa)**.
 - c. Body Material: Bronze.
 - d. End Connections: Threaded.
7. Iron OS&Y Gate Valves:
 - a. Standard: UL 262.
 - b. Pressure Rating: **250 psig (1725 kPa)** minimum **OR 300 psig (2070 kPa)**, as directed.
 - c. Body Material: Cast or ductile iron.
 - d. End Connections: Flanged or grooved.
8. Indicating-Type Butterfly Valves:
 - a. Standard: UL 1091.
 - b. Pressure Rating: **175 psig (1200 kPa)** minimum.
 - c. Valves **NPS 2 (DN 50)** and Smaller:
 - 1) Valve Type: Ball or butterfly.
 - 2) Body Material: Bronze.
 - 3) End Connections: Threaded.
 - d. Valves **NPS 2-1/2 (DN 65)** and Larger:
 - 1) Valve Type: Butterfly.
 - 2) Body Material: Cast or ductile iron.
 - 3) End Connections: Flanged, grooved, or wafer.
 - e. Valve Operation: Integral electrical, 115-V ac, prewired, single-circuit, supervisory switch **OR** electrical, 115-V ac, prewired, two-circuit, supervisory switch **OR** visual, as directed, indicating device.
9. NRS Gate Valves:
 - a. Standard: UL 262.
 - b. Pressure Rating: **250 psig (1725 kPa)** minimum **OR 300 psig (2070 kPa)**, as directed.
 - c. Body Material: Cast iron with indicator post flange.
 - d. Stem: Nonrising.
 - e. End Connections: Flanged or grooved.
10. Indicator Posts:
 - a. Standard: UL 789.

- b. Type: Horizontal for wall mounting.
 - c. Body Material: Cast iron with extension rod and locking device.
 - d. Operation: Wrench **OR** Hand wheel, **as directed**.
- H. Trim And Drain Valves
 - 1. General Requirements:
 - a. Standard: UL's "Fire Protection Equipment Directory" listing or "Approval Guide," published by FM Global, listing.
 - b. Pressure Rating: **175 psig (1200 kPa)** minimum.
 - 2. Angle Valves.
 - 3. Ball Valves.
 - 4. Globe Valves.
 - 5. Plug Valves.
- I. Specialty Valves
 - 1. General Requirements:
 - a. Standard: UL's "Fire Protection Equipment Directory" listing or "Approval Guide," published by FM Global, listing.
 - b. Pressure Rating:
 - 1) Standard-Pressure Piping Specialty Valves: **175 psig (1200 kPa)** minimum.
 - 2) High-Pressure Piping Specialty Valves: **250 psig (1725 kPa)** minimum **OR 300 psig (2070 kPa), as directed**.
 - c. Body Material: Cast or ductile iron.
 - d. Size: Same as connected piping.
 - e. End Connections: Flanged or grooved.
 - 2. Alarm Valves:
 - a. Standard: UL 193.
 - b. Design: For horizontal or vertical installation.
 - c. Include trim sets for bypass, drain, electrical sprinkler alarm switch, pressure gages, retarding chamber, **as directed**, and fill-line attachment with strainer.
 - d. Drip Cup Assembly: Pipe drain without valves and separate from main drain piping.
OR
Drip Cup Assembly: Pipe drain with check valve to main drain piping.
 - 3. Deluge Valves:
 - a. Standard: UL 260.
 - b. Design: Hydraulically operated, differential-pressure type.
 - c. Include trim sets for bypass, drain, electrical sprinkler alarm switch, pressure gages, drip cup assembly piped without valves and separate from main drain line, fill-line attachment with strainer, and push-rod chamber supply connection.
 - d. Wet, Pilot-Line Trim Set: Include gage to read push-rod chamber pressure, globe valve for manual operation of deluge valve, and connection for actuation device.
 - 4. Automatic (Ball Drip) Drain Valves:
 - a. Standard: UL 1726.
 - b. Pressure Rating: **175 psig (1200 kPa)** minimum.
 - c. Type: Automatic draining, ball check.
 - d. Size: **NPS 3/4 (DN 20)**.
 - e. End Connections: Threaded.
- J. Fire-Department Connections
 - 1. Exposed-Type, Fire-Department Connection:
 - a. Standard: UL 405.
 - b. Type: Exposed, projecting, for wall mounting.
 - c. Pressure Rating: **175 psig (1200 kPa)** minimum.
 - d. Body Material: Corrosion-resistant metal.



- e. Inlets: Brass with threads according to NFPA 1963 and matching local fire-department sizes and threads. Include extension pipe nipples, brass lugged swivel connections, and check devices or clappers.
- f. Caps: Brass, lugged type, with gasket and chain.
- g. Escutcheon Plate: Round, brass, wall type.
- h. Outlet: Back, with pipe threads.
- i. Number of Inlets: Two **OR** Three, **as directed**.
- j. Escutcheon Plate Marking: Similar to "AUTO SPKR & STANDPIPE" **OR** "AUTO SPKR", **as directed**.
- k. Finish: Polished chrome plated **OR** Rough brass or bronze **OR** Rough chrome plated, **as directed**.
- l. Outlet Size: **NPS 4 (DN 100) OR NPS 5 (DN 125) OR NPS 6 (DN 150)**, **as directed**.
- 2. Flush-Type, Fire-Department Connection:
 - a. Standard: UL 405.
 - b. Type: Flush, for wall mounting.
 - c. Pressure Rating: **175 psig (1200 kPa)** minimum.
 - d. Body Material: Corrosion-resistant metal.
 - e. Inlets: Brass with threads according to NFPA 1963 and matching local fire-department sizes and threads. Include extension pipe nipples, brass lugged swivel connections, and check devices or clappers.
 - f. Caps: Brass, lugged type, with gasket and chain.
 - g. Escutcheon Plate: Rectangular, brass, wall type.
 - h. Outlet: With pipe threads.
 - i. Body Style: Horizontal **OR** Square **OR** Vertical, **as directed**.
 - j. Number of Inlets: Two **OR** Three **OR** Four **OR** Six, **as directed**.
 - k. Outlet Location: Back **OR** Bottom **OR** Left side **OR** Right side **OR** Top, **as directed**.
 - l. Escutcheon Plate Marking: Similar to "AUTO SPKR & STANDPIPE" **OR** "AUTO SPKR", **as directed**.
 - m. Finish: Polished chrome plated **OR** Rough brass or bronze **OR** Rough chrome plated, **as directed**.
 - n. Outlet Size: **NPS 4 (DN 100) OR NPS 5 (DN 125) OR NPS 6 (DN 150) OR NPS 8 (DN 200)**, **as directed**.
- 3. Yard-Type, Fire-Department Connection:
 - a. Standard: UL 405.
 - b. Type: Exposed, freestanding.
 - c. Pressure Rating: **175 psig (1200 kPa)** minimum **OR** **300 psig (2070 kPa)**, **as directed**.
 - d. Body Material: Corrosion-resistant metal.
 - e. Inlets: Brass with threads according to NFPA 1963 and matching local fire-department sizes and threads. Include extension pipe nipples, brass lugged swivel connections, and check devices or clappers.
 - f. Caps: Brass, lugged type, with gasket and chain.
 - g. Escutcheon Plate: Round, brass, floor type.
 - h. Outlet: Bottom, with pipe threads.
 - i. Number of Inlets: Two **OR** Three **OR** Four, **as directed**.
 - j. Sleeve: Brass **OR** Not required, **as directed**.
 - k. Sleeve Height: **18 inches (460 mm)**.
 - l. Escutcheon Plate Marking: Similar to "AUTO SPKR & STANDPIPE" **OR** "AUTO SPKR", **as directed**.
 - m. Finish, Including Sleeve: Polished chrome plated **OR** Rough brass or bronze **OR** Rough chrome plated, **as directed**.
 - n. Outlet Size: **NPS 4 (DN 100) OR NPS 5 (DN 125) OR NPS 6 (DN 150)**, **as directed**.

K. Sprinkler Specialty Pipe Fittings

- 1. Branch Outlet Fittings:
 - a. Standard: UL 213.

- b. Pressure Rating: **175 psig (1200 kPa)** minimum **OR 300 psig (2070 kPa)**, **as directed**.
 - c. Body Material: Ductile-iron housing with EPDM seals and bolts and nuts.
 - d. Type: Mechanical-T and -cross fittings.
 - e. Configurations: Snap-on and strapless, ductile-iron housing with branch outlets.
 - f. Size: Of dimension to fit onto sprinkler main and with outlet connections as required to match connected branch piping.
 - g. Branch Outlets: Grooved, plain-end pipe, or threaded.
 - 2. Flow Detection and Test Assemblies:
 - a. Standard: UL's "Fire Protection Equipment Directory" listing or "Approval Guide," published by FM Global, listing.
 - b. Pressure Rating: **175 psig (1200 kPa)** minimum **OR 300 psig (2070 kPa)**, **as directed**.
 - c. Body Material: Cast- or ductile-iron housing with orifice, sight glass, and integral test valve.
 - d. Size: Same as connected piping.
 - e. Inlet and Outlet: Threaded.
 - 3. Branch Line Testers:
 - a. Standard: UL 199.
 - b. Pressure Rating: **175 psig (1200 kPa)**.
 - c. Body Material: Brass.
 - d. Size: Same as connected piping.
 - e. Inlet: Threaded.
 - f. Drain Outlet: Threaded and capped.
 - g. Branch Outlet: Threaded, for sprinkler.
 - 4. Sprinkler Inspector's Test Fittings:
 - a. Standard: UL's "Fire Protection Equipment Directory" listing or "Approval Guide," published by FM Global, listing.
 - b. Pressure Rating: **175 psig (1200 kPa)** minimum **OR 300 psig (2070 kPa)**, **as directed**.
 - c. Body Material: Cast- or ductile-iron housing with sight glass.
 - d. Size: Same as connected piping.
 - e. Inlet and Outlet: Threaded.
 - 5. Adjustable Drop Nipples:
 - a. Standard: UL 1474.
 - b. Pressure Rating: **250 psig (1725 kPa)** minimum **OR 300 psig (2070 kPa)**, **as directed**.
 - c. Body Material: Steel pipe with EPDM-rubber O-ring seals.
 - d. Size: Same as connected piping.
 - e. Length: Adjustable.
 - f. Inlet and Outlet: Threaded.
 - 6. Flexible, Sprinkler Hose Fittings:
 - a. Standard: UL 1474.
 - b. Type: Flexible hose for connection to sprinkler, and with bracket for connection to ceiling grid.
 - c. Pressure Rating: **175 psig (1200 kPa)** minimum **OR 300 psig (2070 kPa)**, **as directed**.
 - d. Size: Same as connected piping, for sprinkler.
- L. Sprinklers
 - 1. General Requirements:
 - a. Standard: UL's "Fire Protection Equipment Directory" listing or "Approval Guide," published by FM Global, listing.
 - b. Pressure Rating for Residential Sprinklers: **175 psig (1200 kPa)** maximum.
 - c. Pressure Rating for Automatic Sprinklers: **175 psig (1200 kPa)** minimum.
 - d. Pressure Rating for High-Pressure Automatic Sprinklers: **250 psig (1725 kPa)** minimum **OR 300 psig (2070 kPa)**, **as directed**.
 - 2. Automatic Sprinklers with Heat-Responsive Element:
 - a. Early-Suppression, Fast-Response Applications: UL 1767.
 - b. Nonresidential Applications: UL 199.
 - c. Residential Applications: UL 1626.



- d. Characteristics: Nominal **1/2-inch (12.7-mm)** orifice with Discharge Coefficient K of 5.6, and for "Ordinary" temperature classification rating unless otherwise indicated or required by application.
 - 3. Open Sprinklers with Heat-Responsive Element Removed: UL 199.
 - a. Characteristics:
 - 1) Nominal **1/2-inch (12.7-mm)** Orifice: With Discharge Coefficient K between 5.3 and 5.8.
 - 2) Nominal **7/32-inch (13.5-mm)** Orifice: With Discharge Coefficient K between 7.4 and 8.2.
 - 4. Sprinkler Finishes:
 - a. Chrome plated.
 - b. Bronze.
 - c. Painted.
 - 5. Special Coatings:
 - a. Wax.
 - b. Lead.
 - c. Corrosion-resistant paint.
 - 6. Sprinkler Escutcheons: Materials, types, and finishes for the following sprinkler mounting applications. Escutcheons for concealed, flush, and recessed-type sprinklers are specified with sprinklers.
 - a. Ceiling Mounting: Chrome-plated steel, one piece, flat **OR** Chrome-plated steel, two piece, with **1-inch (25-mm)** vertical adjustment **OR** Plastic, white finish, one piece, flat, **as directed**.
 - b. Sidewall Mounting: Chrome-plated steel **OR** Plastic, white finish, **as directed**, one piece, flat.
 - 7. Sprinkler Guards:
 - a. Standard: UL 199.
 - b. Type: Wire cage with fastening device for attaching to sprinkler.
- M. Excess-Pressure Pumps
 - 1. Pump: Factory-fabricated, positive-displacement, gear type.
 - a. Pump and Motor: Directly connected.
 - b. Motor: Comply with requirements in Division 21 Section "Common Work Results For Fire Suppression".
 - 2. Miscellaneous Components: Wet-pipe kit of switches, fittings, valves, mounting brackets, and connections for power, hydraulic piping, and wiring from alarm devices.
 - 3. Motor Control: Differential-pressure switch.
 - 4. Lights: To indicate sprinkler system's operating condition.
 - a. White Light: Pressure is normal.
 - b. Red Light: Pressure is low.
 - 5. Capacity: **2.0 gpm at 75-psig (0.13 L/s at 520-kPa)** differential pressure and 1/3 hp **OR 1.85 gpm at 100-psig (0.12 L/s at 690-kPa)** differential pressure and 1/2 hp **OR 3.5 gpm at 100-psig (0.22 L/s at 690-kPa)** differential pressure and 1/2 hp, **as directed**.
- N. Alarm Devices
 - 1. Alarm-device types shall match piping and equipment connections.
 - 2. Water-Motor-Operated Alarm:
 - a. Standard: UL 753.
 - b. Type: Mechanically operated, with Pelton wheel.
 - c. Alarm Gong: Cast aluminum with red-enamel factory finish.
 - d. Size: **10-inch (250-mm)** diameter.
 - e. Components: Shaft length, bearings, and sleeve to suit wall construction.
 - f. Inlet: **NPS 3/4 (DN 20)**.
 - g. Outlet: **NPS 1 (DN 25)** drain connection.
 - 3. Electrically Operated Alarm Bell:

- a. Standard: UL 464.
 - b. Type: Vibrating, metal alarm bell.
 - c. Size: **6-inch (150-mm)** minimum-diameter **OR 8-inch (200-mm)** minimum-diameter **OR 10-inch (250-mm)** diameter, **as directed**.
 - d. Finish: Red-enamel factory finish, suitable for outdoor use.
- 4. Water-Flow Indicators:
 - a. Standard: UL 346.
 - b. Water-Flow Detector: Electrically supervised.
 - c. Components: Two single-pole, double-throw circuit switches for isolated alarm and auxiliary contacts, 7 A, 125-V ac and 0.25 A, 24-V dc; complete with factory-set, field-adjustable retard element to prevent false signals and tamperproof cover that sends signal if removed.
 - d. Type: Paddle operated.
 - e. Pressure Rating: **250 psig (1725 kPa)**.
 - f. Design Installation: Horizontal or vertical.
- 5. Pressure Switches:
 - a. Standard: UL 346.
 - b. Type: Electrically supervised water-flow switch with retard feature.
 - c. Components: Single-pole, double-throw switch with normally closed contacts.
 - d. Design Operation: Rising pressure signals water flow.
- 6. Valve Supervisory Switches:
 - a. Standard: UL 346.
 - b. Type: Electrically supervised.
 - c. Components: Single-pole, double-throw switch with normally closed contacts.
 - d. Design: Signals that controlled valve is in other than fully open position.
- 7. Indicator-Post Supervisory Switches:
 - a. Standard: UL 346.
 - b. Type: Electrically supervised.
 - c. Components: Single-pole, double-throw switch with normally closed contacts.
 - d. Design: Signals that controlled indicator-post valve is in other than fully open position.
- O. Manual Control Stations
 - 1. Description: UL listed or FM approved, hydraulic operation, with union, **NPS 1/2 (DN 15)** pipe nipple, and bronze ball valve. Include metal enclosure labeled "MANUAL CONTROL STATION" with operating instructions and cover held closed by breakable strut to prevent accidental opening.
- P. Control Panels
 - 1. Description: Single-area, two-area, or single-area cross-zoned control panel as indicated, including NEMA ICS 6, Type 1 enclosure, detector, alarm, and solenoid-valve circuitry for operation of deluge valves. Panels contain power supply; battery charger; standby batteries; field-wiring terminal strip; electrically supervised solenoid valves and polarized fire-alarm bell; lamp test facility; single-pole, double-throw auxiliary alarm contacts; and rectifier.
 - a. Panels: UL listed and FM approved when used with thermal detectors and Class A detector circuit wiring. Electrical characteristics are 120-V ac, 60 Hz, with 24-V dc rechargeable batteries.
 - b. Manual Control Stations: Electric operation, metal enclosure, labeled "MANUAL CONTROL STATION" with operating instructions and cover held closed by breakable strut to prevent accidental opening.
OR
Manual Control Stations: Hydraulic operation, with union, **NPS 1/2 (DN 15)** pipe nipple, and bronze ball valve. Include metal enclosure labeled "MANUAL CONTROL STATION" with operating instructions and cover held closed by breakable strut to prevent accidental opening.

Q. Pressure Gages

1. Standard: UL 393.
2. Dial Size: 3-1/2- to 4-1/2-inch (90- to 115-mm) diameter.
3. Pressure Gage Range: 0 to 250 psig (0 to 1725 kPa) minimum **OR** 0 to 300 psig (0 to 2070 kPa), **as directed**.
4. Water System Piping Gage: Include "WATER" or "AIR/WATER" label on dial face.
5. Air System Piping Gage: Include retard feature, **directed**, and "AIR" or "AIR/WATER" label on dial face.

R. Escutcheons

1. General: Manufactured ceiling, floor, and wall escutcheons and floor plates.
2. One-Piece, Cast-Brass Escutcheons: Polished chrome-plated **OR** rough-brass, **as directed**, finish with set-screws.
3. One-Piece, Deep-Pattern Escutcheons: Deep-drawn, box-shaped brass with chrome-plated finish.
4. One-Piece, Stamped-Steel Escutcheons: Chrome-plated finish with set-screw **OR** spring clips, **as directed**.
5. Split-Casting, Cast-Brass Escutcheons: Polished chrome-plated **OR** rough-brass, **as directed**, finish with concealed hinge and set-screw.
6. Split-Plate, Stamped-Steel Escutcheons: Chrome-plated finish with concealed **OR** exposed-rivet, **as directed**, hinge, set-screw **OR** spring clips, **as directed**.
7. One-Piece Floor Plates: Cast-iron flange with holes for fasteners, **as directed**.
8. Split-Casting Floor Plates: Cast brass with concealed hinge.

S. Sleeves

1. Cast-Iron Wall Pipe Sleeves: Cast or fabricated of cast iron and equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop unless otherwise indicated.
2. Galvanized-Steel-Sheet Sleeves: 0.0239-inch (0.6-mm) minimum thickness; round tube closed with welded longitudinal joint.
3. Molded-PE Sleeves: Reusable, PE, tapered-cup shaped, and smooth outer surface with nailing flange for attaching to wooden forms.
4. Molded-PVC Sleeves: Permanent, with nailing flange for attaching to wooden forms.
5. PVC-Pipe Sleeves: ASTM D 1785, Schedule 40.
6. Galvanized-Steel-Pipe Sleeves: ASTM A 53/A 53M, Type E, standard weight, zinc coated, plain ends.
7. Stack Sleeve Fittings: Manufactured, cast-iron sleeve with integral clamping flange. Include clamping ring and bolts and nuts for membrane flashing.
 - a. Underdeck Clamp: Clamping ring with set-screws.

T. Sleeve Seals

1. Description: Modular sealing element unit, designed for field assembly, to fill annular space between pipe and sleeve.
 - a. Sealing Elements: EPDM-rubber or NBR interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
 - b. Pressure Plates: Carbon steel **OR** Plastic **OR** Stainless steel, **as directed**.
 - c. Connecting Bolts and Nuts: Carbon steel with corrosion-resistant coating **OR** Stainless steel, **as directed**, of length required to secure pressure plates to sealing elements.

U. Grout

1. Standard: ASTM C 1107, Grade B, posthardening and volume adjusting, dry, hydraulic-cement grout.
2. Characteristics: Nonshrink, and recommended for interior and exterior applications.
3. Design Mix: 5000-psi (34-MPa), 28-day compressive strength.
4. Packaging: Premixed and factory packaged.

1.3 EXECUTION

A. Preparation

1. Perform fire-hydrant flow test according to NFPA 13 and NFPA 291. Use results for system design calculations required in "Quality Assurance" Article.
2. Report test results promptly and in writing.

B. Service-Entrance Piping

1. Connect sprinkler piping to water-service piping for service entrance to building. Comply with requirements for exterior piping in Division 21 Section "Facility Fire-suppression Water-service Piping".
2. Install shutoff valve, backflow preventer, **as directed**, pressure gage, drain, and other accessories indicated at connection to water-service piping. Comply with requirements for backflow preventers in Division 21 Section "Facility Fire-suppression Water-service Piping", **as directed**.
OR
Install shutoff valve, check valve, pressure gage, and drain at connection to water service.

C. Water-Supply Connections

1. Connect sprinkler piping to building's interior water-distribution piping. Comply with requirements for interior piping in Division 22 Section "Domestic Water Piping".
2. Install shutoff valve, backflow preventer, **as directed**, pressure gage, drain, and other accessories indicated at connection to water-distribution piping. Comply with requirements for backflow preventers in Division 22 Section "Domestic Water Piping Specialties", **as directed**.
OR
Install shutoff valve, check valve, pressure gage, and drain at connection to water supply.

D. Piping Installation

1. Locations and Arrangements: Drawing plans, schematics, and diagrams indicate general location and arrangement of piping. Install piping as indicated, as far as practical.
 - a. Deviations from approved working plans for piping require written approval from authorities having jurisdiction. File written approval with the Owner before deviating from approved working plans.
2. Piping Standard: Comply with requirements for installation of sprinkler piping in NFPA 13.
3. Install seismic restraints on piping. Comply with requirements for seismic-restraint device materials and installation in NFPA 13.
4. Use listed fittings to make changes in direction, branch takeoffs from mains, and reductions in pipe sizes.
5. Install unions adjacent to each valve in pipes **NPS 2 (DN 50)** and smaller.
6. Install flanges, flange adapters, or couplings for grooved-end piping on valves, apparatus, and equipment having **NPS 2-1/2 (DN 65)** and larger end connections.
7. Install "Inspector's Test Connections" in sprinkler system piping, complete with shutoff valve, and sized and located according to NFPA 13.
8. Install sprinkler piping with drains for complete system drainage.
9. Install sprinkler control valves, test assemblies, and drain risers adjacent to standpipes when sprinkler piping is connected to standpipes.
10. Install automatic (ball drip) drain valve at each check valve for fire-department connection, to drain piping between fire-department connection and check valve. Install drain piping to and spill over floor drain or to outside building.
11. Install alarm devices in piping systems.
12. Install hangers and supports for sprinkler system piping according to NFPA 13. Comply with requirements for hanger materials in NFPA 13.
13. Install pressure gages on riser or feed main, at each sprinkler test connection, and at top of each standpipe. Include pressure gages with connection not less than **NPS 1/4 (DN 8)** and with soft metal seated globe valve, arranged for draining pipe between gage and valve. Install gages to permit removal, and install where they will not be subject to freezing.



14. Pressurize and check preaction sprinkler system piping and air-pressure maintenance devices **OR** air compressors, **as directed**.
15. Fill sprinkler system piping with water.
16. Install electric heating cables and pipe insulation on sprinkler piping in areas subject to freezing. Comply with requirements for heating cables in Division 21 Section "Heat Tracing For Fire-suppression Piping" and for piping insulation in Division 21 Section "Fire-suppression Systems Insulation".

E. Joint Construction

1. Install couplings, flanges, flanged fittings, unions, nipples, and transition and special fittings that have finish and pressure ratings same as or higher than system's pressure rating for aboveground applications unless otherwise indicated.
2. Install unions adjacent to each valve in pipes **NPS 2 (DN 50)** and smaller.
3. Install flanges, flange adapters, or couplings for grooved-end piping on valves, apparatus, and equipment having **NPS 2-1/2 (DN 65)** and larger end connections.
4. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
5. Remove scale, slag, dirt, and debris from inside and outside of pipes, tubes, and fittings before assembly.
6. Flanged Joints: Select appropriate gasket material in size, type, and thickness suitable for water service. Join flanges with gasket and bolts according to ASME B31.9.
7. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
 - a. Apply appropriate tape or thread compound to external pipe threads.
 - b. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged.
8. Twist-Locked Joints: Insert plain end of steel pipe into plain-end-pipe fitting. Rotate retainer lugs one-quarter turn or tighten retainer pin.
9. Steel-Piping, Pressure-Sealed Joints: Join lightwall steel pipe and steel pressure-seal fittings with tools recommended by fitting manufacturer.
10. Welded Joints: Construct joints according to AWS D10.12M/D10.12, using qualified processes and welding operators according to "Quality Assurance" Article.
 - a. Shop weld pipe joints where welded piping is indicated. Do not use welded joints for galvanized-steel pipe.
11. Steel-Piping, Cut-Grooved Joints: Cut square-edge groove in end of pipe according to AWWA C606. Assemble coupling with housing, gasket, lubricant, and bolts. Join steel pipe and grooved-end fittings according to AWWA C606 for steel-pipe joints.
12. Steel-Piping, Roll-Grooved Joints: Roll rounded-edge groove in end of pipe according to AWWA C606. Assemble coupling with housing, gasket, lubricant, and bolts. Join steel pipe and grooved-end fittings according to AWWA C606 for steel-pipe grooved joints.
13. Steel-Piping, Pressure-Sealed Joints: Join Schedule 5 steel pipe and steel pressure-seal fittings with tools recommended by fitting manufacturer.
14. Brazed Joints: Join copper tube and fittings according to CDA's "Copper Tube Handbook," "Brazed Joints" Chapter.
15. Copper-Tubing Grooved Joints: Roll rounded-edge groove in end of tube according to AWWA C606. Assemble coupling with housing, gasket, lubricant, and bolts. Join copper tube and grooved-end fittings according to AWWA C606 for steel-pipe grooved joints.
16. Copper-Tubing, Pressure-Sealed Joints: Join copper tube and copper pressure-seal fittings with tools recommended by fitting manufacturer.
17. Extruded-Tee Connections: Form tee in copper tube according to ASTM F 2014. Use tool designed for copper tube; drill pilot hole, form collar for outlet, dimple tube to form seating stop, and braze branch tube into collar.
18. Dissimilar-Material Piping Joints: Make joints using adapters compatible with materials of both piping systems.

19. Plastic-Piping, Solvent-Cement Joints: Clean and dry joining surfaces. Join pipe and fittings according to the following:
 - a. Comply with ASTM F 402 for safe-handling practice of cleaners, primers, and solvent cements. Apply primer.
 - b. CPVC Piping: Join according to ASTM D 2846/D 2846M Appendix.
- F. Installation Of Cover System For Sprinkler Piping
 1. Install cover system, brackets, and cover components for sprinkler piping according to manufacturer's "Installation Manual" and with NFPA 13 or NFPA 13R for supports.
- G. Valve And Specialties Installation
 1. Install listed fire-protection valves, trim and drain valves, specialty valves and trim, controls, and specialties according to NFPA 13 and authorities having jurisdiction.
 2. Install listed fire-protection shutoff valves supervised open, located to control sources of water supply except from fire-department connections. Install permanent identification signs indicating portion of system controlled by each valve.
 3. Install check valve in each water-supply connection. Install backflow preventers instead of check valves in potable-water-supply sources.
 4. Specialty Valves:
 - a. General Requirements: Install in vertical position for proper direction of flow, in main supply to system.
 - b. Alarm Valves: Include bypass check valve and retarding chamber drain-line connection.
 - c. Deluge Valves: Install in vertical position, in proper direction of flow, and in main supply to deluge system. Install trim sets for drain, priming level, alarm connections, ball drip valves, pressure gages, priming chamber attachment, and fill-line attachment.
- H. Excess-Pressure Pump Installation
 1. Assemble components and mount on wood backing. Comply with requirements in Division 06 Section "Rough Carpentry" for wood backing material and installation.
 2. Install excess-pressure pumps, controls, devices, and supports for sprinkler piping application.
 - a. Mounting: Install on wall, where indicated **OR** attached to water-supply pipe, **as directed**.
- I. Sprinkler Installation
 1. Install sprinklers in suspended ceilings in center of narrow dimension of, **as directed**, acoustical ceiling panels.
 2. Install dry-type sprinklers with water supply from heated space. Do not install pendent or sidewall, wet-type sprinklers in areas subject to freezing.
 3. Install sprinklers into flexible, sprinkler hose fittings and install hose into bracket on ceiling grid.
- J. Fire-Department Connection Installation
 1. Install wall-type, fire-department connections.
 2. Install yard-type, fire-department connections in concrete slab support. Comply with requirements for concrete in Division 03 Section "Cast-in-place Concrete".
 - a. Install two **OR** three, **as directed**, protective pipe bollards around **OR** on sides of, **as directed**, each fire-department connection. Comply with requirements for bollards in Division 05 Section "Metal Fabrications".
 3. Install automatic (ball drip) drain valve at each check valve for fire-department connection.
- K. Escutcheon Installation
 1. Install escutcheons for penetrations of walls, ceilings, and floors.
 2. Escutcheons for New Piping:
 - a. Piping with Fitting or Sleeve Protruding from Wall: One piece, deep pattern.
 - b. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One piece, cast brass with polished chrome-plated finish **OR** stamped steel with set-screw **OR** stamped steel with set-screw or spring clips **OR** stamped steel with spring clips, **as directed**.



- c. Bare Piping at Ceiling Penetrations in Finished Spaces: One piece, cast brass with polished chrome-plated finish **OR** One piece or split casting, cast brass with polished chrome-plated finish **OR** Split casting, cast brass with polished chrome-plated finish **OR** One piece, stamped steel with set-screw **OR** One piece or split plate, stamped steel with set-screw **OR** Split plate, stamped steel with set-screw, **as directed**.
 - d. Bare Piping in Unfinished Service Spaces: One piece, cast brass with polished chrome-plated finish **OR** cast brass with rough-brass finish **OR** stamped steel with set-screw **OR** stamped steel with spring clips **OR** stamped steel with set-screw or spring clips, **as directed**.
 - e. Bare Piping in Equipment Rooms: One piece, cast brass **OR** stamped steel with set-screw **OR** stamped steel with spring clips **OR** stamped steel with set-screw or spring clips, **as directed**.
 - f. Bare Piping at Floor Penetrations in Equipment Rooms: One-piece floor plate.
3. Escutcheons for Existing Piping:
- a. Chrome-Plated Piping: Split casting, cast brass with chrome-plated finish.
 - b. Insulated Piping: Split plate, stamped steel with concealed or exposed-rivet hinge and spring clips.
 - c. Bare Piping at Wall and Floor Penetrations in Finished Spaces: Split casting, cast brass with chrome-plated finish **OR** plate, stamped steel with concealed hinge and spring clips, **as directed**.
 - d. Bare Piping at Ceiling Penetrations in Finished Spaces: Split casting, cast brass with chrome-plated finish **OR** plate, stamped steel with concealed hinge and set-screw, **as directed**.
 - e. Bare Piping in Unfinished Service Spaces: Split casting, cast brass with polished chrome-plated finish **OR** casting, cast brass with rough-brass finish **OR** plate, stamped steel with concealed hinge and set-screw or spring clips **OR** plate, stamped steel with concealed or exposed-rivet hinge and set-screw or spring clips **OR** plate, stamped steel with exposed-rivet hinge and set-screw or spring clips, **as directed**.
 - f. Bare Piping in Equipment Rooms: Split casting, cast brass **OR** plate, stamped steel with set-screw or spring clips, **as directed**.
 - g. Bare Piping at Floor Penetrations in Equipment Rooms: Split-casting floor plate.

L. Sleeve Installation

- 1. General Requirements: Install sleeves for pipes and tubes passing through penetrations in floors, partitions, roofs, and walls.
- 2. Sleeves are not required for core-drilled holes.
- 3. Permanent sleeves are not required for holes formed by removable PE sleeves.
- 4. Cut sleeves to length for mounting flush with both surfaces unless otherwise indicated.
- 5. Install sleeves in new partitions, slabs, and walls as they are built.
- 6. For interior wall penetrations, seal annular space between sleeve and pipe or pipe insulation using joint sealants appropriate for size, depth, and location of joint. Comply with requirements for joint sealants in Division 07 Section "Joint Sealants".
- 7. For exterior wall penetrations above grade, seal annular space between sleeve and pipe using joint sealants appropriate for size, depth, and location of joint. Comply with requirements for joint sealants in Division 07 Section "Joint Sealants".
- 8. For exterior wall penetrations below grade, seal annular space between sleeve and pipe using sleeve seals.
- 9. Seal space outside of sleeves in concrete slabs and walls with grout.
- 10. Install sleeves that are large enough to provide **1/4-inch (6.4-mm)** annular clear space between sleeve and pipe or pipe insulation unless otherwise indicated.
- 11. Install sleeve materials according to the following applications:
 - a. Sleeves for Piping Passing through Concrete Floor Slabs: Molded PE **OR** Molded PVC **OR** Galvanized-steel pipe, **as directed**.
 - b. Sleeves for Piping Passing through Concrete Floor Slabs of Mechanical Equipment Areas or Other Wet Areas: Galvanized-steel pipe **OR** Stack sleeve fittings, **as directed**.

- 1) Extend sleeves **2 inches (50 mm)** above finished floor level.
- 2) For pipes penetrating floors with membrane waterproofing, extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified. Secure flashing between clamping flanges. Install section of cast-iron soil pipe to extend sleeve to **2 inches (50 mm)** above finished floor level. Comply with requirements for flashing in Division 07 Section "Sheet Metal Flashing And Trim".
- c. Sleeves for Piping Passing through Gypsum-Board Partitions:
 - 1) PVC-pipe **OR** Galvanized-steel-pipe, **as directed**, sleeves for pipes smaller than **NPS 6 (DN 150)**.
 - 2) Galvanized-steel-sheet sleeves for pipes **NPS 6 (DN 150)** and larger.
 - 3) Exception: Sleeves are not required for water-supply tubes and waste pipes for individual plumbing fixtures if escutcheons will cover openings.
- d. Sleeves for Piping Passing through Concrete Roof Slabs: Molded PE **OR** Molded PVC **OR** Galvanized-steel pipe, **as directed**.
- e. Sleeves for Piping Passing through Exterior Concrete Walls:
 - 1) Galvanized-steel-pipe sleeves for pipes smaller than **NPS 6 (DN 150)**.
 - 2) Cast-iron wall-pipe sleeves for pipes **NPS 6 (DN 150)** and larger.
 - 3) Install sleeves that are large enough to provide **1-inch (25-mm)** annular clear space between sleeve and pipe or pipe insulation when sleeve seals are used.
- f. Sleeves for Piping Passing through Interior Concrete Walls:
 - 1) PVC-pipe **OR** Galvanized-steel-pipe, **as directed**, sleeves for pipes smaller than **NPS 6 (DN 150)**.
 - 2) Galvanized-steel-sheet sleeves for pipes **NPS 6 (DN 150)** and larger.
12. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Comply with requirements for firestop materials and installations in Division 07 Section "Penetration Firestopping".
- M. Sleeve Seal Installation
 1. Install sleeve seals in sleeves in exterior concrete walls at water-service piping entries into building.
 2. Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble sleeve seal components and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.
- N. Identification
 1. Install labeling and pipe markers on equipment and piping according to requirements in NFPA 13.
 2. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Division 26 Section "Identification For Electrical Systems".
- O. Field Quality Control
 1. Perform tests and inspections.
 2. Tests and Inspections:
 - a. Leak Test: After installation, charge systems and test for leaks. Repair leaks and retest until no leaks exist.
 - b. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
 - c. Flush, test, and inspect sprinkler systems according to NFPA 13, "Systems Acceptance" Chapter.
 - d. Energize circuits to electrical equipment and devices.
 - e. Start and run excess-pressure pumps.
 - f. Coordinate with fire-alarm tests. Operate as required.
 - g. Coordinate with fire-pump tests. Operate as required.
 - h. Verify that equipment hose threads are same as local fire-department equipment.
 3. Sprinkler piping system will be considered defective if it does not pass tests and inspections.
 4. Prepare test and inspection reports.



P. Cleaning

1. Clean dirt and debris from sprinklers.
2. Remove and replace sprinklers with paint other than factory finish.

Q. Piping Schedule

1. Piping between Fire-Department Connections and Check Valves: Galvanized, standard-weight steel pipe with threaded ends; cast-iron threaded fittings; and threaded **OR** grooved ends; grooved-end fittings; grooved-end-pipe couplings; and grooved, **as directed**, joints.
2. Sprinkler specialty fittings may be used, downstream of control valves, instead of specified fittings.
3. Copper-tube, extruded-tee connections may be used for tee branches in copper tubing instead of specified copper fittings. Branch-connection joints must be brazed.
4. CPVC pipe; Schedule 40 **OR** Schedule 80, **as directed**, CPVC fittings; and solvent-cemented joints may be used for light-hazard and residential occupancies.
5. Standard-pressure, wet-pipe sprinkler system, **NPS 2 (DN 50)** and smaller, shall be one of the following:
 - a. Standard-weight or Schedule 30, black-steel pipe with threaded ends; uncoated, gray-iron threaded fittings; and threaded joints.
 - b. Standard-weight or Schedule 30, galvanized-steel pipe with threaded ends; galvanized, gray-iron threaded fittings; and threaded joints.
 - c. Standard-weight or Schedule 30, black-steel pipe with plain ends; uncoated, plain-end-pipe fittings; and twist-locked joints.
 - d. Standard-weight or Schedule 30, galvanized-steel pipe with plain ends; galvanized, plain-end-pipe fittings; and twist-locked joints.
 - e. Standard-weight or Schedule 30, black-steel pipe with cut- or roll-grooved ends; uncoated, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.
 - f. Standard-weight or Schedule 30, galvanized-steel pipe with cut-grooved ends; galvanized, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.
 - g. Standard-weight or Schedule 30, black-steel pipe with plain ends; steel welding fittings; and welded joints.
 - h. Thinwall **OR** Schedule 10, **as directed**, nonstandard OD, thinwall or hybrid black-steel pipe with roll-grooved ends; uncoated, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.
 - i. Thinwall **OR** Schedule 10, **as directed**, or hybrid black-steel pipe with plain ends; uncoated, plain-end-pipe fittings; and twist-locked joints.
 - j. Thinwall **OR** Schedule 10, **as directed**, nonstandard OD, thinwall or hybrid black-steel pipe with plain ends; welding fittings; and welded joints.
 - k. Schedule 5 steel pipe; steel pressure-seal fittings; and pressure-sealed joints.
 - l. **Type L (Type B) OR Type M (Type C), as directed**, hard copper tube with plain ends; cast- or wrought-copper solder-joint fittings; and brazed joints.
 - m. **Type L (Type B) OR Type M (Type C), as directed**, hard copper tube with plain ends; copper pressure-seal fittings; and pressure-sealed joints.
 - n. **NPS 2 (DN 50), Type L (Type B) OR Type M (Type C), as directed**, hard copper tube with roll-grooved ends; copper, grooved-end fittings; grooved-end-tube couplings; and grooved joints.
6. Standard-pressure, wet-pipe sprinkler system, **NPS 2-1/2 to NPS 4 (DN 65 to DN 100)**, shall be one of the following:
 - a. Standard-weight or Schedule 30, black-steel pipe with threaded ends; uncoated, gray-iron threaded fittings; and threaded joints.
 - b. Standard-weight or Schedule 30, galvanized-steel pipe with threaded ends; galvanized, gray-iron threaded fittings; and threaded joints.
 - c. Standard-weight or Schedule 30, black-steel pipe with cut- or roll-grooved ends; uncoated, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.

- d. Standard-weight or Schedule 30, galvanized-steel pipe with cut-grooved ends; galvanized, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.
- e. Standard-weight or Schedule 30, black-steel pipe with plain ends; steel welding fittings; and welded joints.
- f. Thinwall **OR** Schedule 10, **as directed**, nonstandard OD, thinwall or hybrid black-steel pipe with roll-grooved ends; uncoated, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.
- g. Thinwall **OR** Schedule 10, **as directed**, nonstandard OD, thinwall or hybrid black-steel pipe with plain ends; welding fittings; and welded joints.
- h. **Type L (Type B) OR Type M (Type C), as directed**, hard copper tube with plain ends; cast- or wrought-copper solder-joint fittings; and brazed joints.
- i. **Type L (Type B) OR Type M (Type C), as directed**, hard copper tube with plain ends; copper pressure-seal fittings; and pressure-sealed joints.
- j. **Type L (Type B) OR Type M (Type C), as directed**, hard copper tube with roll-grooved ends; copper, grooved-end fittings; grooved-end-tube couplings; and grooved joints.
7. Standard-pressure, wet-pipe sprinkler system, **NPS 5 (DN 125)** and larger, shall be one of the following:
 - a. Standard-weight or Schedule 30, black-steel pipe with threaded ends; uncoated, gray-iron threaded fittings; and threaded joints.
 - b. Standard-weight or Schedule 30, galvanized-steel pipe with threaded ends; galvanized, gray-iron threaded fittings; and threaded joints.
 - c. Standard-weight or Schedule 30, black-steel pipe with cut- or roll-grooved ends; uncoated, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.
 - d. Standard-weight or Schedule 30, galvanized-steel pipe with cut-grooved ends; galvanized, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.
 - e. Standard-weight or Schedule 30, black-steel pipe with plain ends; steel welding fittings; and welded joints.
 - f. Thinwall **OR** Schedule 10, **as directed**, or hybrid black-steel pipe with roll-grooved ends; uncoated, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.
 - g. Thinwall **OR** Schedule 10, **as directed**, or hybrid black-steel pipe with plain ends; welding fittings; and welded joints.
 - h. **Type L (Type B) OR Type M (Type C), as directed**, hard copper tube with plain ends; cast- or wrought-copper solder-joint fittings; and brazed joints.
 - i. **Type L (Type B) OR Type M (Type C), as directed**, hard copper tube with roll-grooved ends; copper, grooved-end fittings; grooved-end-tube couplings; and grooved joints.
8. High-pressure, wet-pipe sprinkler system, **NPS 4 (DN 100)** and smaller, shall be one of the following:
 - a. Standard-weight or Schedule 30, galvanized-steel pipe with threaded ends; galvanized, gray-iron threaded fittings; and threaded joints.
 - b. Standard-weight or Schedule 30, galvanized-steel pipe with cut-grooved ends; galvanized, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.
 - c. Standard-weight or Schedule 30, black-steel pipe with plain ends; steel welding fittings; and welded joints.
 - d. Thinwall **OR** Schedule 10, **as directed**, or hybrid black-steel pipe with plain ends; welding fittings; and welded joints.
9. High-pressure, wet-pipe sprinkler system, **NPS 5 (DN 125)** and larger, shall be one of the following:
 - a. Standard-weight or Schedule 30, galvanized-steel pipe with threaded ends; galvanized, gray-iron threaded fittings; and threaded joints.

- b. Standard-weight or Schedule 30, galvanized-steel pipe with cut-grooved ends; galvanized, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.
- c. Standard-weight or Schedule 30, black-steel pipe with plain ends; steel welding fittings; and welded joints.
- d. Thinwall **OR** Schedule 10, **as directed**, or hybrid black-steel pipe with plain ends; welding fittings; and welded joints.

R. Sprinkler Schedule

- 1. Use sprinkler types in subparagraphs below for the following applications:
 - a. Rooms without Ceilings: Upright sprinklers.
 - b. Rooms with Suspended Ceilings: Pendent sprinklers **OR** Recessed sprinklers **OR** Flush sprinklers **OR** Concealed sprinklers, **as directed**.
 - c. Wall Mounting: Sidewall sprinklers.
 - d. Spaces Subject to Freezing: Upright sprinklers **OR** Pendent, dry sprinklers **OR** Sidewall, dry sprinklers, **as directed**.
 - e. Deluge-Sprinkler Systems: Upright and pendent, open sprinklers.
 - f. Special Applications: Extended-coverage, flow-control, and quick-response sprinklers where indicated.
- 2. Provide sprinkler types in subparagraphs below with finishes indicated.
 - a. Concealed Sprinklers: Rough brass, with factory-painted white cover plate.
 - b. Flush Sprinklers: Bright chrome, with painted white escutcheon.
 - c. Recessed Sprinklers: Bright chrome, with bright chrome escutcheon.
 - d. Residential Sprinklers: Dull chrome.
 - e. Upright, Pendent, and Sidewall Sprinklers: Chrome plated in finished spaces exposed to view; rough bronze in unfinished spaces not exposed to view; wax coated where exposed to acids, chemicals, or other corrosive fumes.

END OF SECTION 21 13 13 00

SECTION 21 13 16 00 - DRY-PIPE FIRE-SUPPRESSION SPRINKLERS

1.1 GENERAL

A. Description Of Work

1. This specification covers the furnishing and installation of materials for dry-pipe fire-suppression sprinklers. Products shall be as follows or as directed by the Owner. Installation procedures shall be in accordance with the product manufacturer's recommendations. Demolition and removal of materials shall be as required to support the work.

B. Summary

1. Section Includes:
 - a. Pipes, fittings, and specialties.
 - b. Fire-protection valves.
 - c. Fire-department connections.
 - d. Sprinkler specialty pipe fittings.
 - e. Sprinklers.
 - f. Alarm devices.
 - g. Manual control stations.
 - h. Control panels.
 - i. Pressure gages.

C. Definitions

1. Standard-Pressure Sprinkler Piping: Dry-pipe sprinkler system piping designed to operate at working pressure **175 psig (1200 kPa)** maximum.

D. System Descriptions

1. Dry-Pipe Sprinkler System: Automatic sprinklers are attached to piping containing compressed air. Opening of sprinklers releases compressed air and permits water pressure to open dry-pipe valve. Water then flows into piping and discharges from sprinklers that are open.
2. Combined Dry-Pipe and Preaction Sprinkler System: Automatic sprinklers are attached to piping containing compressed air. Fire-detection system in same area as sprinklers actuates tripping devices that open dry-pipe valve without loss of air pressure and actuates fire alarm. Water discharges from sprinklers that have opened.
3. Single-Interlock Preaction Sprinkler System: Automatic sprinklers are attached to piping containing low-pressure air. Actuation of fire-detection system in same area as sprinklers opens deluge valve, permitting water to flow into piping and to discharge from sprinklers that have opened.
4. Double-Interlock Preaction Sprinkler System: Automatic sprinklers are attached to piping containing low-pressure air. Actuation of a fire-detection system in the same area as sprinklers opens the deluge valve permitting water to flow into the sprinkler piping; a closed solenoid valve in the sprinkler piping is opened by another fire-detection device; then water will discharge from sprinklers that have opened.

E. Performance Requirements

1. Standard-Pressure Piping System Component: Listed for **175-psig (1200-kPa)** minimum working pressure.
2. Delegated Design: Design sprinkler system(s), including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.
3. Sprinkler system design shall be approved by authorities having jurisdiction.
 - a. Margin of Safety for Available Water Flow and Pressure: **10 OR 20, as directed**, percent, including losses through water-service piping, valves, and backflow preventers.
 - b. Sprinkler Occupancy Hazard Classifications:
 - 1) Automobile Parking Areas: Ordinary Hazard, Group 1.

- 2) Building Service Areas: Ordinary Hazard, Group 1.
- 3) Churches: Light Hazard.
- 4) Electrical Equipment Rooms: Ordinary Hazard, Group 1.
- 5) Dry Cleaners: Ordinary Hazard, Group 2.
- 6) General Storage Areas: Ordinary Hazard, Group 1.
- 7) Laundries: Ordinary Hazard, Group 1.
- 8) Libraries Except Stack Areas: Light Hazard.
- 9) Library Stack Areas: Ordinary Hazard, Group 2.
- 10) Machine Shops: Ordinary Hazard, Group 2.
- 11) Mechanical Equipment Rooms: Ordinary Hazard, Group 1.
- 12) Office and Public Areas: Light Hazard.
- 13) Plastics Processing Areas: Extra Hazard, Group 2.
- 14) Printing Plants: Extra Hazard, Group 1.
- 15) Repair Garages: Ordinary Hazard, Group 2.
- 16) Restaurant Service Areas: Ordinary Hazard, Group 1.
- 17) Solvent Cleaning Areas: Extra Hazard, Group 2.
- 18) Upholstering Plants: Extra Hazard, Group 1.
- c. Minimum Density for Automatic-Sprinkler Piping Design:
 - 1) Light-Hazard Occupancy: **0.10 gpm over 1500-sq. ft. (4.1 mm/min. over 139-sq. m)** area.
 - 2) Ordinary-Hazard, Group 1 Occupancy: **0.15 gpm over 1500-sq. ft. (6.1 mm/min. over 139-sq. m)** area.
 - 3) Ordinary-Hazard, Group 2 Occupancy: **0.20 gpm over 1500-sq. ft. (8.1 mm/min. over 139-sq. m)** area.
 - 4) Extra-Hazard, Group 1 Occupancy: **0.30 gpm over 2500-sq. ft. (12.2 mm/min. over 232-sq. m)** area.
 - 5) Extra-Hazard, Group 2 Occupancy: **0.40 gpm over 2500-sq. ft. (16.3 mm/min. over 232-sq. m)** area.
 - 6) Special Occupancy Hazard: As determined by authorities having jurisdiction.
- d. Maximum Protection Area per Sprinkler: Per UL listing.
OR
Maximum Protection Area per Sprinkler:
 - 1) Office Spaces: **120 sq. ft. (11.1 sq. m) OR 225 sq. ft. (20.9 sq. m), as directed.**
 - 2) Storage Areas: **130 sq. ft. (12.1 sq. m).**
 - 3) Mechanical Equipment Rooms: **130 sq. ft. (12.1 sq. m).**
 - 4) Electrical Equipment Rooms: **130 sq. ft. (12.1 sq. m).**
 - 5) Other Areas: According to NFPA 13 recommendations unless otherwise indicated.
- e. Total Combined Hose-Stream Demand Requirement: According to NFPA 13 unless otherwise indicated:
 - 1) Light-Hazard Occupancies: **100 gpm (6.3 L/s)** for 30 minutes.
 - 2) Ordinary-Hazard Occupancies: **250 gpm (15.75 L/s)** for 60 to 90 minutes.
 - 3) Extra-Hazard Occupancies: **500 gpm (31.5 L/s)** for 90 to 120 minutes.
4. Seismic Performance: Sprinkler piping shall withstand the effects of earthquake motions determined according to NFPA 13 and ASCE/SEI 7.

F. Submittals

1. Product Data: For each type of product indicated.
2. Shop Drawings: For dry-pipe sprinkler systems. Include plans, elevations, sections, details, and attachments to other work.
 - a. Wiring Diagrams: For power, signal, and control wiring.
3. Delegated-Design Submittal: For sprinkler systems indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
4. Qualification Data: For qualified Installer and professional engineer, **as directed.**

5. Approved Sprinkler Piping Drawings: Working plans, prepared according to NFPA 13, that have been approved by authorities having jurisdiction, including hydraulic calculations if applicable.
6. Fire-hydrant flow test report.
7. Field Test Reports and Certificates: Indicate and interpret test results for compliance with performance requirements and as described in NFPA 13. Include "Contractor's Material and Test Certificate for Aboveground Piping."
8. Field quality-control reports.
9. Operation and maintenance data.

G. Quality Assurance

1. Installer Qualifications:
 - a. Installer's responsibilities include designing, fabricating, and installing sprinkler systems and providing professional engineering services needed to assume engineering responsibility. Base calculations on results of fire-hydrant flow test.
 - 1) Engineering Responsibility: Preparation of working plans, calculations, and field test reports by a qualified professional engineer.
2. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
3. NFPA Standards: Sprinkler system equipment, specialties, accessories, installation, and testing shall comply with the following:
 - a. NFPA 13, "Installation of Sprinkler Systems."
 - b. NFPA 13R, "Installation of Sprinkler Systems in Residential Occupancies up to and Including Four Stories in Height."
 - c. NFPA 24, "Installation of Private Fire Service Mains and Their Appurtenances."

H. Project Conditions

1. Interruption of Existing Sprinkler Service: Do not interrupt sprinkler service to facilities occupied by the Owner or others unless permitted under the following conditions and then only after arranging to provide temporary sprinkler service according to requirements indicated:
 - a. Notify the Owner no fewer than two days in advance of proposed interruption of sprinkler service.
 - b. Do not proceed with interruption of sprinkler service without the Owner's written permission.

1.2 PRODUCTS

A. Piping Materials

1. Comply with requirements in "Piping Schedule" Article for applications of pipe, tube, and fitting materials, and joining methods for specific services, service locations, and pipe sizes.

B. Steel Pipe And Fittings

1. Standard Weight, Galvanized-Steel Pipe: ASTM A 53/A 53M, Type E, Grade B. Pipe ends may be factory or field formed to match joining method.
2. Schedule 30, Galvanized-Steel Pipe: ASTM A 135; ASTM A 795/A 795M, Type E; or ASME B36.10M, wrought steel; with wall thickness not less than Schedule 30 and not more than Schedule 40. Pipe ends may be factory or field formed to match joining method.
3. Thinwall Galvanized-Steel Pipe: ASTM A 135 or ASTM A 795/A 795M, threadable, with wall thickness less than Schedule 30 and equal to or greater than Schedule 10. Pipe ends may be factory or field formed to match joining method.
4. Galvanized-Steel Pipe Nipples: ASTM A 733, made of ASTM A 53/A 53M, standard-weight, seamless steel pipe with threaded ends.
5. Galvanized, Steel Couplings: ASTM A 865, threaded.
6. Galvanized, Gray-Iron Threaded Fittings: ASME B16.4, Class 125, standard pattern.
7. Malleable- or Ductile-Iron Unions: UL 860.
8. Cast-Iron Flanges: ASME B16.1, Class 125.



9. Plain-End-Pipe Fittings: UL 213, ductile-iron body with retainer lugs that require one-quarter turn or screwed retainer pin to secure pipe in fitting.
 10. Grooved-Joint, Steel-Pipe Appurtenances:
 - a. Pressure Rating: **175 psig (1200 kPa) OR 250 psig (1725 kPa) OR 300 psig (2070 kPa), as directed**, minimum.
 - b. Galvanized, Grooved-End Fittings for Steel Piping: ASTM A 47/A 47M, malleable-iron casting or ASTM A 536, ductile-iron casting; with dimensions matching steel pipe.
 - c. Grooved-End-Pipe Couplings for Steel Piping: AWWA C606 and UL 213, rigid pattern, unless otherwise indicated, for steel-pipe dimensions. Include ferrous housing sections, EPDM-rubber gasket, and bolts and nuts.
- C. Copper Tube And Fittings
1. Hard Copper Tube: **ASTM B 88, Type L (ASTM B 88M, Type B)** and **ASTM B 88, Type M (ASTM B 88M, Type C)** water tube, drawn temper.
 2. Cast-Copper, Solder-Joint Fittings: ASME B16.18, pressure fittings.
 3. Wrought-Copper, Solder-Joint Fittings: ASME B16.22, pressure fittings.
 4. Bronze Flanges: ASME B16.24, Class 150, with solder-joint ends.
 5. Copper Unions: MSS SP-123, cast-copper-alloy, hexagonal-stock body, with ball-and-socket, metal-to-metal seating surfaces, and solder-joint or threaded ends.
 6. Copper Pressure-Seal Fittings:
 - a. Standard: UL 213.
 - b. **NPS 2 (DN 50)** and Smaller: Wrought-copper fitting with EPDM-rubber O-ring seal in each end.
 - c. **NPS 2-1/2 to NPS 4 (DN 65 to DN 100)**: Cast-bronze fitting with EPDM-rubber O-ring seal in each end.
 7. Grooved-Joint, Copper-Tube Appurtenances:
 - a. Grooved-End, Copper Fittings: **ASTM B 75 (ASTM B 75M)**, copper tube or ASTM B 584, bronze castings.
 - b. Grooved-End-Tube Couplings: To fit copper tube, with dimensions and design similar to AWWA C606. Include ferrous housing sections, EPDM-rubber gasket suitable for hot and cold water, and bolts and nuts.
 8. Copper-Tube, Extruded-Tee Connections:
 - a. Description: Tee formed in copper tube according to ASTM F 2014.
- D. Piping Joining Materials
1. Pipe-Flange Gasket Materials: AWWA C110, rubber, flat face, **1/8 inch (3.2 mm)** thick or ASME B16.21, nonmetallic and asbestos free.
 - a. Class 125, Cast-Iron and Class 150, Bronze Flat-Face Flanges: Full-face gaskets.
 - b. Class 250, Cast-Iron and Class 300, Raised-Face Flanges: Ring-type gaskets.
 2. Metal, Pipe-Flange Bolts and Nuts: ASME B18.2.1, carbon steel unless otherwise indicated.
 3. Brazing Filler Metals: AWS A5.8/A5.8M, BCuP Series, copper-phosphorus alloys for general-duty brazing unless otherwise indicated.
- E. Listed Fire-Protection Valves
1. General Requirements:
 - a. Valves shall be UL listed or FM approved.
 - b. Minimum Pressure Rating for Standard-Pressure Piping: **175 psig (1200 kPa)**.
 2. Ball Valves:
 - a. Standard: UL 1091 except with ball instead of disc.
 - b. Valves **NPS 1-1/2 (DN 40)** and Smaller: Bronze body with threaded ends.
 - c. Valves **NPS 2 and NPS 2-1/2 (DN 50 and DN 65)**: Bronze body with threaded ends or ductile-iron body with grooved ends.
 - d. Valves **NPS 3 (DN 80)**: Ductile-iron body with grooved ends.
- F. Bronze Butterfly Valves:

- a. Standard: UL 1091.
 - b. Pressure Rating: **175 psig (1200 kPa)**.
 - c. Body Material: Bronze.
 - d. End Connections: Threaded.
- G. Iron Butterfly Valves:
- a. Standard: UL 1091.
 - b. Pressure Rating: **175 psig (1200 kPa)**.
 - c. Body Material: Cast or ductile iron.
 - d. Style: Lug or wafer.
- OR**
- End Connections: Grooved.
- H. Check Valves:
- a. Standard: UL 312
 - b. Pressure Rating: **250 psig (1725 kPa)** minimum **OR 300 psig (2070 kPa), as directed.**
 - c. Type: Swing check.
 - d. Body Material: Cast iron.
 - e. End Connections: Flanged or grooved.
2. Bronze OS&Y Gate Valves:
- a. Standard: UL 262.
 - b. Pressure Rating: **175 psig (1200 kPa)**.
 - c. Body Material: Bronze.
 - d. End Connections: Threaded.
3. Iron OS&Y Gate Valves:
- a. Standard: UL 262.
 - b. Pressure Rating: **250 psig (1725 kPa)** minimum **OR 300 psig (2070 kPa), as directed.**
 - c. Body Material: Cast or ductile iron.
 - d. End Connections: Flanged or grooved.
4. Indicating-Type Butterfly Valves:
- a. Standard: UL 1091.
 - b. Pressure Rating: **175 psig (1200 kPa)** minimum.
 - c. Valves **NPS 2 (DN 50)** and Smaller:
 - 1) Valve Type: Ball or butterfly.
 - 2) Body Material: Bronze.
 - 3) End Connections: Threaded.
 - d. Valves **NPS 2-1/2 (DN 65)** and Larger:
 - 1) Valve Type: Butterfly.
 - 2) Body Material: Cast or ductile iron.
 - 3) End Connections: Flanged, grooved, or wafer.
 - e. Valve Operation: Integral electrical, 115-V ac, prewired, single-circuit, supervisory switch **OR** electrical, 115-V ac, prewired, two-circuit, supervisory switch **OR** visual, **as directed**, indicating device.
5. NRS Gate Valves:
- a. Standard: UL 262.
 - b. Pressure Rating: **250 psig (1725 kPa)** minimum **OR 300 psig (2070 kPa), as directed.**
 - c. Body Material: Cast iron with indicator post flange.
 - d. Stem: Nonrising.
 - e. End Connections: Flanged or grooved.
6. Indicator Posts:
- a. Standard: UL 789.
 - b. Type: Horizontal for wall mounting.
 - c. Body Material: Cast iron with extension rod and locking device.
 - d. Operation: Wrench **OR** Hand wheel, **as directed.**
- I. Trim And Drain Valves



1. General Requirements:
 - a. Standard: UL's "Fire Protection Equipment Directory" listing or "Approval Guide," published by FM Global, listing.
 - b. Pressure Rating: **175 psig (1200 kPa)** minimum.
2. Angle Valves.
3. Ball Valves.
4. Globe Valves.
5. Plug Valves.

J. Specialty Valves

1. General Requirements:
 - a. Standard: UL's "Fire Protection Equipment Directory" listing or "Approval Guide," published by FM Global, listing.
 - b. Pressure Rating:
 - 1) Standard-Pressure Piping Specialty Valves: **175 psig (1200 kPa)** minimum.
 - 2) High-Pressure Piping Specialty Valves: **250 psig (1725 kPa)** minimum **OR 300 psig (2070 kPa), as directed.**
 - c. Body Material: Cast or ductile iron.
 - d. Size: Same as connected piping.
 - e. End Connections: Flanged or grooved.
2. Dry-Pipe Valves:
 - a. Standard: UL 260
 - b. Design: Differential-pressure type.
 - c. Include UL 1486, quick-opening devices, trim sets for air supply, drain, priming level, alarm connections, ball drip valves, pressure gages, priming chamber attachment, and fill-line attachment.
 - d. Air-Pressure Maintenance Device:
 - 1) Standard: UL 260.
 - 2) Type: Automatic device to maintain minimum air pressure in piping.
 - 3) Include shutoff valves to permit servicing without shutting down sprinkler piping, bypass valve for quick filling, pressure regulator or switch to maintain pressure, strainer, pressure ratings with **14- to 60-psig (95- to 410-kPa)** adjustable range, and **175-psig (1200-kPa) OR 300-psig (2070-kPa), as directed**, outlet pressure.
 - e. Air Compressor:
 - 1) Standard: UL's "Fire Protection Equipment Directory" listing or "Approval Guide," published by FM Global, listing.
 - 2) Motor Horsepower: Fractional.
 - 3) Power: 120-V ac, 60 Hz, single phase.
3. Deluge Valves:
 - a. Standard: UL 260.
 - b. Design: Hydraulically operated, differential-pressure type.
 - c. Include trim sets for bypass, drain, electrical sprinkler alarm switch, pressure gages, drip cup assembly piped without valves and separate from main drain line, fill-line attachment with strainer, and push-rod chamber supply connection.
 - d. Dry, Pilot-Line Trim Set: Include dry, pilot-line actuator; air- and water-pressure gages; low-air-pressure warning switch; air relief valve; and actuation device. Dry, pilot-line actuator includes cast-iron, operated, diaphragm-type valve with resilient facing plate, resilient diaphragm, and replaceable bronze seat. Valve includes threaded water and air inlets and water outlet. Loss of air pressure on dry, pilot-line side allows pilot-line actuator to open and causes deluge valve to open immediately.
 - e. Air-Pressure Maintenance Device:
 - 1) Standard: UL 260.
 - 2) Type: Automatic device to maintain minimum air pressure in piping.
 - 3) Include shutoff valves to permit servicing without shutting down sprinkler piping, bypass valve for quick filling, pressure regulator or switch to maintain pressure,

- strainer, pressure ratings with 14- to 60-psig (95- to 410-kPa) adjustable range, and 175-psig (1200-kPa) OR 300-psig (2070-kPa), as directed, outlet pressure.
- f. Air Compressor:
 - 1) Standard: UL's "Fire Protection Equipment Directory" listing or "Approval Guide," published by FM Global, listing.
 - 2) Motor Horsepower: Fractional.
 - 3) Power: 120-V ac, 60 Hz, single phase.
 4. Automatic (Ball Drip) Drain Valves:
 - a. Standard: UL 1726.
 - b. Pressure Rating: 175 psig (1200 kPa) minimum.
 - c. Type: Automatic draining, ball check.
 - d. Size: NPS 3/4 (DN 20).
 - e. End Connections: Threaded.
- K. Fire-Department Connections
1. Exposed-Type, Fire-Department Connection:
 - a. Standard: UL 405.
 - b. Type: Exposed, projecting, for wall mounting.
 - c. Pressure Rating: 175 psig (1200 kPa) minimum.
 - d. Body Material: Corrosion-resistant metal.
 - e. Inlets: Brass with threads according to NFPA 1963 and matching local fire-department sizes and threads. Include extension pipe nipples, brass lugged swivel connections, and check devices or clappers.
 - f. Caps: Brass, lugged type, with gasket and chain.
 - g. Escutcheon Plate: Round, brass, wall type.
 - h. Outlet: Back, with pipe threads.
 - i. Number of Inlets: Two OR Three, as directed.
 - j. Escutcheon Plate Marking: Similar to "AUTO SPKR & STANDPIPE" OR "AUTO SPKR", as directed.
 - k. Finish: Polished chrome plated OR Rough brass or bronze OR Rough chrome plated, as directed.
 - l. Outlet Size: NPS 4 (DN 100) OR NPS 5 (DN 125) OR NPS 6 (DN 150), as directed.
 2. Flush-Type, Fire-Department Connection:
 - a. Standard: UL 405.
 - b. Type: Flush, for wall mounting.
 - c. Pressure Rating: 175 psig (1200 kPa) minimum.
 - d. Body Material: Corrosion-resistant metal.
 - e. Inlets: Brass with threads according to NFPA 1963 and matching local fire-department sizes and threads. Include extension pipe nipples, brass lugged swivel connections, and check devices or clappers.
 - f. Caps: Brass, lugged type, with gasket and chain.
 - g. Escutcheon Plate: Rectangular, brass, wall type.
 - h. Outlet: With pipe threads.
 - i. Body Style: Horizontal OR Square OR Vertical, as directed.
 - j. Number of Inlets: Two OR Three OR Four OR Six, as directed.
 - k. Outlet Location: Back OR Bottom OR Left side OR Right side OR Top, as directed.
 - l. Escutcheon Plate Marking: Similar to "AUTO SPKR & STANDPIPE" OR "AUTO SPKR", as directed.
 - m. Finish: Polished chrome plated OR Rough brass or bronze OR Rough chrome plated, as directed.
 - n. Outlet Size: NPS 4 (DN 100) OR NPS 5 (DN 125) OR NPS 6 (DN 150) OR NPS 8 (DN 200), as directed.
 3. Yard-Type, Fire-Department Connection:
 - a. Standard: UL 405.
 - b. Type: Exposed, freestanding.
 - c. Pressure Rating: 175 psig (1200 kPa) minimum OR 300 psig (2070 kPa), as directed.



- d. Body Material: Corrosion-resistant metal.
 - e. Inlets: Brass with threads according to NFPA 1963 and matching local fire-department sizes and threads. Include extension pipe nipples, brass lugged swivel connections, and check devices or clappers.
 - f. Caps: Brass, lugged type, with gasket and chain.
 - g. Escutcheon Plate: Round, brass, floor type.
 - h. Outlet: Bottom, with pipe threads.
 - i. Number of Inlets: Two **OR** Three **OR** Four, **as directed**.
 - j. Sleeve: Brass **OR** Not required, **as directed**.
 - k. Sleeve Height: **18 inches (460 mm)**.
 - l. Escutcheon Plate Marking: Similar to "AUTO SPKR & STANDPIPE" **OR** "AUTO SPKR", **as directed**.
 - m. Finish, Including Sleeve: Polished chrome plated **OR** Rough brass or bronze **OR** Rough chrome plated, **as directed**.
 - n. Outlet Size: **NPS 4 (DN 100) OR NPS 5 (DN 125) OR NPS 6 (DN 150)**, **as directed**.
- L. Sprinkler Specialty Pipe Fittings
- 1. General Requirements for Dry-Pipe-System Fittings: UL listed for dry-pipe service.
 - 2. Branch Outlet Fittings:
 - a. Standard: UL 213.
 - b. Pressure Rating: **175 psig (1200 kPa)** minimum **OR 300 psig (2070 kPa)**, **as directed**.
 - c. Body Material: Ductile-iron housing with EPDM seals and bolts and nuts.
 - d. Type: Mechanical-T and -cross fittings.
 - e. Configurations: Snap-on and strapless, ductile-iron housing with branch outlets.
 - f. Size: Of dimension to fit onto sprinkler main and with outlet connections as required to match connected branch piping.
 - g. Branch Outlets: Grooved, plain-end pipe, or threaded.
 - 3. Flow Detection and Test Assemblies:
 - a. Standard: UL's "Fire Protection Equipment Directory" listing or "Approval Guide," published by FM Global, listing.
 - b. Pressure Rating: **175 psig (1200 kPa)** minimum **OR 300 psig (2070 kPa)**, **as directed**.
 - c. Body Material: Cast- or ductile-iron housing with orifice, sight glass, and integral test valve.
 - d. Size: Same as connected piping.
 - e. Inlet and Outlet: Threaded.
 - 4. Branch Line Testers:
 - a. Standard: UL 199.
 - b. Pressure Rating: **175 psig (1200 kPa)** minimum.
 - c. Body Material: Brass.
 - d. Size: Same as connected piping.
 - e. Inlet: Threaded.
 - f. Drain Outlet: Threaded and capped.
 - g. Branch Outlet: Threaded, for sprinkler.
 - 5. Sprinkler Inspector's Test Fittings:
 - a. Standard: UL's "Fire Protection Equipment Directory" listing or "Approval Guide," published by FM Global, listing.
 - b. Pressure Rating: **175 psig (1200 kPa)** minimum **OR 300 psig (2070 kPa)**, **as directed**.
 - c. Body Material: Cast- or ductile-iron housing with sight glass.
 - d. Size: Same as connected piping.
 - e. Inlet and Outlet: Threaded.
 - 6. Adjustable Drop Nipples:
 - a. Standard: UL 1474.
 - b. Pressure Rating: **250 psig (1725 kPa)** minimum **OR 300 psig (2070 kPa)**, **as directed**.
 - c. Body Material: Steel pipe with EPDM O-ring seals.
 - d. Size: Same as connected piping.
 - e. Length: Adjustable.

- f. Inlet and Outlet: Threaded.
- 7. Flexible, Sprinkler Hose Fittings:
 - a. Standard: UL 1474.
 - b. Type: Flexible hose for connection to sprinkler, and with bracket for connection to ceiling grid.
 - c. Pressure Rating: **175 psig (1200 kPa)** minimum **OR 300 psig (2070 kPa)**, **as directed**.
 - d. Size: Same as connected piping, for sprinkler.

M. Sprinklers

- 1. General Requirements:
 - a. Standard: UL's "Fire Protection Equipment Directory" listing or "Approval Guide," published by FM Global, listing.
 - b. Pressure Rating for Residential Sprinklers: **175 psig (1200 kPa)** maximum.
 - c. Pressure Rating for Automatic Sprinklers: **175 psig (1200 kPa)** minimum.
 - d. Pressure Rating for High-Pressure Automatic Sprinklers: **250 psig (1725 kPa)** minimum **OR 300 psig (2070 kPa)**, **as directed**.
- 2. Automatic Sprinklers with Heat-Responsive Element:
 - a. Nonresidential Applications: UL 199.
 - b. Residential Applications: UL 1626.
 - c. Characteristics: Nominal **1/2-inch (12.7-mm)** orifice with discharge coefficient K of 5.6, and for "Ordinary" temperature classification rating unless otherwise indicated or required by application.
- 3. Sprinkler Finishes:
 - a. Chrome plated.
 - b. Bronze.
 - c. Painted.
- 4. Special Coatings:
 - a. Wax.
 - b. Lead.
 - c. Corrosion-resistant paint.
- 5. Sprinkler Escutcheons: Materials, types, and finishes for the following sprinkler mounting applications. Escutcheons for concealed, flush, and recessed-type sprinklers are specified with sprinklers.
 - a. Ceiling Mounting: Chrome-plated steel, one piece, flat **OR** Chrome-plated steel, two piece, with **1-inch (25-mm)** vertical adjustment **OR** Plastic, white finish, one piece, flat, **as directed**.
 - b. Sidewall Mounting: Chrome-plated steel **OR** Plastic, white finish, **as directed**, one piece, flat.
- 6. Sprinkler Guards:
 - a. Standard: UL 199.
 - b. Type: Wire cage with fastening device for attaching to sprinkler.

N. Alarm Devices

- 1. Alarm-device types shall match piping and equipment connections.
- 2. Water-Motor-Operated Alarm:
 - a. Standard: UL 753.
 - b. Type: Mechanically operated, with Pelton wheel.
 - c. Alarm Gong: Cast aluminum with red-enamel factory finish.
 - d. Size: **10-inch (250-mm)** diameter.
 - e. Components: Shaft length, bearings, and sleeve to suit wall construction.
 - f. Inlet: **NPS 3/4 (DN 20)**.
 - g. Outlet: **NPS 1 (DN 25)** drain connection.
- 3. Electrically Operated Alarm Bell:
 - a. Standard: UL 464.
 - b. Type: Vibrating, metal alarm bell.

- c. Size: **6-inch (150-mm)** minimum **OR 8-inch (200-mm)** minimum **OR 10-inch (250-mm)**, as **directed**, diameter.
 - d. Finish: Red-enamel factory finish, suitable for outdoor use.
- 4. Pressure Switches:
 - a. Standard: UL 346.
 - b. Type: Electrically supervised water-flow switch with retard feature.
 - c. Components: Single-pole, double-throw switch with normally closed contacts.
 - d. Design Operation: Rising pressure signals water flow.
- 5. Valve Supervisory Switches:
 - a. Standard: UL 346.
 - b. Type: Electrically supervised.
 - c. Components: Single-pole, double-throw switch with normally closed contacts.
 - d. Design: Signals that controlled valve is in other than fully open position.
- 6. Indicator-Post Supervisory Switches:
 - a. Standard: UL 346.
 - b. Type: Electrically supervised.
 - c. Components: Single-pole, double-throw switch with normally closed contacts.
 - d. Design: Signals that controlled indicator-post valve is in other than fully open position.
- O. Manual Control Stations
 - 1. Description: UL listed or FM Global approved, hydraulic operation, with union, **NPS 1/2 (DN 15)** pipe nipple, and bronze ball valve. Include metal enclosure labeled "MANUAL CONTROL STATION" with operating instructions and cover held closed by breakable strut to prevent accidental opening.
- P. Control Panels
 - 1. Description: Single-area, two-area, or single-area cross-zoned type control panel as indicated, including NEMA ICS 6, Type 1 enclosure, detector, alarm, and solenoid-valve circuitry for operation of deluge valves. Panels contain power supply; battery charger; standby batteries; field-wiring terminal strip; electrically supervised solenoid valves and polarized fire-alarm bell; lamp test facility; single-pole, double-throw auxiliary alarm contacts; and rectifier.
 - 2. Panels: UL listed and FM Global approved when used with thermal detectors and Class A detector circuit wiring. Electrical characteristics are 120-V ac, 60 Hz, with 24-V dc rechargeable batteries.
 - a. Manual Control Stations: Electric operation, metal enclosure, labeled "MANUAL CONTROL STATION" with operating instructions and cover held closed by breakable strut to prevent accidental opening.
 - OR**
 - Manual Control Stations: Hydraulic operation, with union, **NPS 1/2 (DN 15)** pipe nipple, and bronze ball valve. Include metal enclosure labeled "MANUAL CONTROL STATION" with operating instructions and cover held closed by breakable strut to prevent accidental opening.
- Q. Pressure Gages
 - 1. Standard: UL 393.
 - 2. Dial Size: **3-1/2- to 4-1/2-inch (90- to 115-mm)** diameter.
 - 3. Pressure Gage Range: **0 to 250 psig (0 to 1725 kPa)** minimum **OR 0 to 300 psig (0 to 2070 kPa)**, as **directed**.
 - 4. Water System Piping Gage: Include "WATER" or "AIR/WATER" label on dial face.
 - 5. Air System Piping Gage: Include retard feature, as **directed**, and "AIR" or "AIR/WATER" label on dial face.
- R. Escutcheons
 - 1. General: Manufactured ceiling, floor, and wall escutcheons and floor plates.

2. One-Piece, Cast-Brass Escutcheons: Polished chrome-plated or rough-brass finish with set-screws.
3. One-Piece, Deep-Pattern Escutcheons: Deep-drawn, box-shaped brass with chrome-plated finish.
4. One-Piece, Stamped-Steel Escutcheons: Chrome-plated finish with set-screw or spring clips.
5. Split-Casting, Cast-Brass Escutcheons: Polished chrome-plated or rough-brass finish with concealed hinge and set-screw.
6. Split-Plate, Stamped-Steel Escutcheons: Chrome-plated finish with concealed **OR** exposed-rivet, **as directed**, hinge, set-screw or spring clips.
7. One-Piece Floor Plates: Cast-iron flange with holes for fasteners, **as directed**.
8. Split-Casting Floor Plates: Cast brass with concealed hinge.

S. Sleeves

1. Cast-Iron Wall Pipe Sleeves: Cast or fabricated of cast iron and equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop unless otherwise indicated.
2. Galvanized-Steel-Sheet Sleeves: **0.0239-inch (0.6-mm)** minimum thickness; round tube closed with welded longitudinal joint.
3. Molded-PE Sleeves: Reusable, PE, tapered-cup shaped, and smooth outer surface with nailing flange for attaching to wooden forms.
4. Molded-PVC Sleeves: Permanent, with nailing flange for attaching to wooden forms.
5. PVC-Pipe Sleeves: ASTM D 1785, Schedule 40.
6. Galvanized-Steel-Pipe Sleeves: ASTM A 53/A 53M, Type E, standard weight, zinc coated, plain ends.
7. Stack Sleeve Fittings: Manufactured, cast-iron sleeve with integral clamping flange. Include clamping ring and bolts and nuts for membrane flashing.
 - a. Underdeck Clamp: Clamping ring with set-screws.

T. Sleeve Seals

1. Description: Modular sealing element unit, designed for field assembly, to fill annular space between pipe and sleeve.
 - a. Sealing Elements: EPDM-rubber or NBR interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
 - b. Pressure Plates: Carbon steel **OR** Plastic **OR** Stainless steel, **as directed**.
 - c. Connecting Bolts and Nuts: Carbon steel with corrosion-resistant coating **OR** Stainless steel, **as directed**, of length required to secure pressure plates to sealing elements.

U. Grout

1. Standard: ASTM C 1107, Grade B, posthardening and volume adjusting, dry, hydraulic-cement grout.
2. Characteristics: Nonshrink, and recommended for interior and exterior applications.
3. Design Mix: **5000-psi (34-MPa)**, 28-day compressive strength.
4. Packaging: Premixed and factory packaged.

1.3 EXECUTION

A. Preparation

1. Perform fire-hydrant flow test according to NFPA 13 and NFPA 291. Use results for system design calculations required in "Quality Assurance" Article.
2. Report test results promptly and in writing.

B. Service-Entrance Piping

1. Connect sprinkler piping to water-service piping for service entrance to building. Comply with requirements in Division 21 Section "Facility Fire-suppression Water-service Piping" for exterior piping.



2. Install shutoff valve, backflow preventer, **as directed**, pressure gage, drain, and other accessories indicated at connection to water-service piping. Comply with requirements in Division 21 Section "Facility Fire-suppression Water-service Piping" for backflow preventers, **as directed**.
3. Install shutoff valve, check valve, pressure gage, and drain at connection to water service.

C. Water-Supply Connections

1. Connect sprinkler piping to building's interior water-distribution piping. Comply with requirements in Division 22 Section "Domestic Water Piping" for interior piping.
2. Install shutoff valve, backflow preventer, **as directed**, pressure gage, drain, and other accessories indicated at connection to water-distribution piping. Comply with requirements in Division 22 Section "Domestic Water Piping Specialties" for backflow preventers, **as directed**.
3. Install shutoff valve, check valve, pressure gage, and drain at connection to water supply.

D. Piping Installation

1. Locations and Arrangements: Drawing plans, schematics, and diagrams indicate general location and arrangement of piping. Install piping as indicated, as far as practical.
 - a. Deviations from approved working plans for piping require written approval from authorities having jurisdiction. File written approval with the Owner before deviating from approved working plans.
2. Piping Standard: Comply with requirements in NFPA 13 for installation of sprinkler piping.
3. Install seismic restraints on piping. Comply with requirements in NFPA 13 for seismic-restraint device materials and installation.
4. Use listed fittings to make changes in direction, branch takeoffs from mains, and reductions in pipe sizes.
5. Install unions adjacent to each valve in pipes **NPS 2 (DN 50)** and smaller.
6. Install flanges, flange adapters, or couplings for grooved-end piping on valves, apparatus, and equipment having **NPS 2-1/2 (DN 65)** and larger end connections.
7. Install "Inspector's Test Connections" in sprinkler system piping, complete with shutoff valve, and sized and located according to NFPA 13.
8. Install sprinkler piping with drains for complete system drainage.
9. Install sprinkler control valves, test assemblies, and drain risers adjacent to standpipes when sprinkler piping is connected to standpipes.
10. Install automatic (ball drip) drain valves to drain piping between fire-department connections and check valves. Drain to floor drain or to outside building.
11. Connect compressed-air supply to dry-pipe sprinkler piping.

OR

Connect air compressor to the following piping and wiring:

 - a. Pressure gages and controls.
 - b. Electrical power system.
 - c. Fire-alarm devices, including low-pressure alarm.
12. Install alarm devices in piping systems.
13. Install hangers and supports for sprinkler system piping according to NFPA 13. Comply with requirements in NFPA 13 for hanger materials.
14. Install pressure gages on riser or feed main, at each sprinkler test connection, and at top of each standpipe. Include pressure gages with connection not less than **NPS 1/4 (DN 8)** and with soft metal seated globe valve, arranged for draining pipe between gage and valve. Install gages to permit removal, and install where they will not be subject to freezing.
15. Drain dry-pipe sprinkler piping.
16. Pressurize and check dry-pipe sprinkler system piping and air-pressure maintenance devices **OR** air compressors, **as directed**.

E. Joint Construction

1. Install couplings, flanges, flanged fittings, unions, nipples, and transition and special fittings that have finish and pressure ratings same as or higher than system's pressure rating for aboveground applications unless otherwise indicated.
 2. Install unions adjacent to each valve in pipes **NPS 2 (DN 50)** and smaller.
 3. Install flanges, flange adapters, or couplings for grooved-end piping on valves, apparatus, and equipment having **NPS 2-1/2 (DN 65)** and larger end connections.
 4. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
 5. Remove scale, slag, dirt, and debris from inside and outside of pipes, tubes, and fittings before assembly.
 6. Flanged Joints: Select appropriate gasket material in size, type, and thickness suitable for water service. Join flanges with gasket and bolts according to ASME B31.9.
 7. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
 - a. Apply appropriate tape or thread compound to external pipe threads.
 - b. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged.
 8. Twist-Locked Joints: Insert plain end of steel pipe into plain-end-pipe fitting. Rotate retainer lugs one-quarter turn or tighten retainer pin.
 9. Steel-Piping, Cut-Grooved Joints: Cut square-edge groove in end of pipe according to AWWA C606. Assemble coupling with housing, gasket, lubricant, and bolts. Join steel pipe and grooved-end fittings according to AWWA C606 for steel-pipe joints.
 10. Brazed Joints: Join copper tube and fittings according to CDA's "Copper Tube Handbook," "Brazed Joints" Chapter.
 11. Copper-Tubing Grooved Joints: Roll rounded-edge groove in end of tube according to AWWA C606. Assemble coupling with housing, gasket, lubricant, and bolts. Join copper tube and grooved-end fittings according to AWWA C606 for steel-pipe grooved joints.
 12. Copper-Tubing, Pressure-Sealed Joints: Join copper tube and copper pressure-seal fittings with tools recommended by fitting manufacturer.
 13. Extruded-Tee Connections: Form tee in copper tube according to ASTM F 2014. Use tool designed for copper tube; drill pilot hole, form collar for outlet, dimple tube to form seating stop, and braze branch tube into collar.
 14. Dissimilar-Material Piping Joints: Make joints using adapters compatible with materials of both piping systems.
- F. Valve And Specialties Installation
1. Install listed fire-protection valves, trim and drain valves, specialty valves and trim, controls, and specialties according to NFPA 13 and authorities having jurisdiction.
 2. Install listed fire-protection shutoff valves supervised open, located to control sources of water supply except from fire-department connections. Install permanent identification signs indicating portion of system controlled by each valve.
 3. Install check valve in each water-supply connection. Install backflow preventers instead of check valves in potable-water-supply sources.
 4. Specialty Valves:
 - a. General Requirements: Install in vertical position for proper direction of flow, in main supply to system.
 - b. Dry-Pipe and Deluge Valves: Install trim sets for air supply, drain, priming level, alarm connections, ball drip valves, pressure gages, priming chamber attachment, and fill-line attachment.
 - 1) Install air compressor and compressed-air supply piping.
 - 2) Air-Pressure Maintenance Device: Install shutoff valves to permit servicing without shutting down sprinkler system; bypass valve for quick system filling; pressure regulator or switch to maintain system pressure; strainer; pressure ratings with **14- to 60-psig (95- to 410-kPa)** adjustable range; and **175-psig (1200-kPa)** maximum inlet pressure.
 - 3) Install compressed-air supply piping from building's compressed-air piping system.



- G. Sprinkler Installation
1. Install sprinklers in suspended ceilings in center of narrow dimension of, **as directed**, acoustical ceiling panels.
 2. Install dry-type sprinklers with water supply from heated space. Do not install pendent or sidewall, wet-type sprinklers in areas subject to freezing.
 3. Install sprinklers into flexible, sprinkler hose fittings and install hose into bracket on ceiling grid.
- H. Fire-Department Connection Installation
1. Install wall-type, fire-department connections.
 2. Install yard-type, fire-department connections in concrete slab support. Comply with requirements for concrete in Division 03 Section "Cast-in-place Concrete".
 - a. Install two **OR** three, **as directed**, protective pipe bollards around **OR** on sides of, **as directed**, each fire-department connection. Comply with requirements for bollards in Division 05 Section "Metal Fabrications".
 3. Install automatic (ball drip) drain valve at each check valve for fire-department connection.
- I. Escutcheon Installation
1. Install escutcheons for penetrations of walls, ceilings, and floors.
 2. Escutcheons for New Piping:
 - a. Piping with Fitting or Sleeve Protruding from Wall: One piece, deep pattern.
 - b. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One piece, cast brass with polished chrome-plated finish **OR** stamped steel with set-screw **OR** stamped steel with set-screw or spring clips **OR** stamped steel with spring clips, **as directed**.
 - c. Bare Piping at Ceiling Penetrations in Finished Spaces: One piece, cast brass with polished chrome-plated finish **OR** One piece or split casting, cast brass with polished chrome-plated finish **OR** Split casting, cast brass with polished chrome-plated finish **OR** One piece, stamped steel with set-screw **OR** One piece or split plate, stamped steel with set-screw **OR** Split plate, stamped steel with set-screw, **as directed**.
 - d. Bare Piping in Unfinished Service Spaces: One piece, cast brass with polished chrome-plated finish **OR** cast brass with rough-brass finish **OR** stamped steel with set-screw **OR** stamped steel with spring clips **OR** stamped steel with set-screw or spring clips, **as directed**.
 - e. Bare Piping in Equipment Rooms: One piece, cast brass **OR** stamped steel with set-screw **OR** stamped steel with spring clips **OR** stamped steel with set-screw or spring clips, **as directed**.
 - f. Bare Piping at Floor Penetrations in Equipment Rooms: One-piece floor plate.
 3. Escutcheons for Existing Piping:
 - a. Chrome-Plated Piping: Split casting, cast brass with chrome-plated finish.
 - b. Insulated Piping: Split plate, stamped steel with concealed or exposed-rivet hinge and spring clips.
 - c. Bare Piping at Wall and Floor Penetrations in Finished Spaces: Split casting, cast brass with chrome-plated finish **OR** plate, stamped steel with concealed hinge and spring clips, **as directed**.
 - d. Bare Piping at Ceiling Penetrations in Finished Spaces: Split casting, cast brass with chrome-plated finish **OR** plate, stamped steel with concealed hinge and set-screw, **as directed**.
 - e. Bare Piping in Unfinished Service Spaces: Split casting, cast brass with polished chrome-plated finish **OR** casting, cast brass with rough-brass finish **OR** plate, stamped steel with concealed hinge and set-screw or spring clips **OR** plate, stamped steel with concealed or exposed-rivet hinge and set-screw or spring clips **OR** plate, stamped steel with exposed-rivet hinge and set-screw or spring clips, **as directed**.
 - f. Bare Piping in Equipment Rooms: Split casting, cast brass **OR** plate, stamped steel with set-screw or spring clips, **as directed**.
 - g. Bare Piping at Floor Penetrations in Equipment Rooms: Split-casting floor plate.

J. Sleeve Installation

1. General Requirements: Install sleeves for pipes and tubes passing through penetrations in floors, partitions, roofs, and walls.
2. Sleeves are not required for core-drilled holes.
3. Permanent sleeves are not required for holes formed by removable PE sleeves.
4. Cut sleeves to length for mounting flush with both surfaces unless otherwise indicated.
5. Install sleeves in new partitions, slabs, and walls as they are built.
6. For interior wall penetrations, seal annular space between sleeve and pipe using joint sealants appropriate for size, depth, and location of joint. Comply with requirements for joint sealants in Division 07 Section "Joint Sealants".
7. For exterior wall penetrations above grade, seal annular space between sleeve and pipe using joint sealants appropriate for size, depth, and location of joint. Comply with requirements for joint sealants in Division 07 Section "Joint Sealants".
8. For exterior wall penetrations below grade, seal annular space between sleeve and pipe using sleeve seals.
9. Seal space outside of sleeves in concrete slabs and walls with grout.
10. Install sleeves that are large enough to provide **1/4-inch (6.4-mm)** annular clear space between sleeve and pipe unless otherwise indicated.
11. Install sleeve materials according to the following applications:
 - a. Sleeves for Piping Passing through Concrete Floor Slabs: Molded PE **OR** Molded PVC **OR** Galvanized-steel pipe, **as directed**.
 - b. Sleeves for Piping Passing through Concrete Floor Slabs of Mechanical Equipment Areas or Other Wet Areas: Galvanized-steel pipe **OR** Stack sleeve fittings, **as directed**.
 - 1) Extend sleeves **2 inches (50 mm)** above finished floor level.
 - 2) For pipes penetrating floors with membrane waterproofing, extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified. Secure flashing between clamping flanges. Install section of cast-iron soil pipe to extend sleeve to **2 inches (50 mm)** above finished floor level. Comply with requirements for flashing in Division 07 Section "Sheet Metal Flashing And Trim".
 - c. Sleeves for Piping Passing through Gypsum-Board Partitions:
 - 1) PVC-pipe **OR** Galvanized-steel-pipe, **as directed**, sleeves for pipes smaller than **NPS 6 (DN 150)**.
 - 2) Galvanized-steel-sheet sleeves for pipes **NPS 6 (DN 150)** and larger.
 - 3) Exception: Sleeves are not required for water-supply tubes and waste pipes for individual plumbing fixtures if escutcheons will cover openings.
 - d. Sleeves for Piping Passing through Concrete Roof Slabs: Molded PE **OR** Molded PVC **OR** Galvanized-steel pipe, **as directed**.
 - e. Sleeves for Piping Passing through Exterior Concrete Walls:
 - 1) Galvanized-steel-pipe sleeves for pipes smaller than **NPS 6 (DN 150)**.
 - 2) Cast-iron wall pipe sleeves for pipes **NPS 6 (DN 150)** and larger.
 - 3) Install sleeves that are large enough to provide **1-inch (25-mm)** annular clear space between sleeve and pipe when sleeve seals are used.
 - f. Sleeves for Piping Passing through Interior Concrete Walls:
 - 1) PVC-pipe **OR** Galvanized-steel pipe, **as directed**, sleeves for pipes smaller than **NPS 6 (DN 150)**.
 - 2) Galvanized-steel-sheet sleeves for pipes **NPS 6 (DN 150)** and larger.
12. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Comply with requirements in Division 07 Section "Penetration Firestopping" for firestop materials and installations.

K. Sleeve Seal Installation

1. Install sleeve seals in sleeves in exterior concrete walls at water-service piping entries into building.
2. Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble sleeve seal components and install in annular space between pipe

and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

- L. Identification
 - 1. Install labeling and pipe markers on equipment and piping according to requirements in NFPA 13.
 - 2. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Division 26 Section "Identification For Electrical Systems".
- M. Field Quality Control
 - 1. Perform tests and inspections.
 - 2. Tests and Inspections:
 - a. Leak Test: After installation, charge systems and test for leaks. Repair leaks and retest until no leaks exist.
 - b. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
 - c. Flush, test, and inspect sprinkler systems according to NFPA 13, "Systems Acceptance" Chapter.
 - d. Energize circuits to electrical equipment and devices.
 - e. Start and run air compressors.
 - f. Coordinate with fire-alarm tests. Operate as required.
 - g. Coordinate with fire-pump tests. Operate as required.
 - h. Verify that equipment hose threads are same as local fire-department equipment.
 - 3. Sprinkler piping system will be considered defective if it does not pass tests and inspections.
 - 4. Prepare test and inspection reports.
- N. Cleaning
 - 1. Clean dirt and debris from sprinklers.
 - 2. Remove and replace sprinklers with paint other than factory finish.
- O. Demonstration
 - 1. Train the Owner's maintenance personnel to adjust, operate, and maintain specialty valves.
- P. Piping Schedule
 - 1. Piping between Fire-Department Connections and Check Valves: Galvanized, standard-weight steel pipe with threaded ends; cast-iron threaded fittings; and threaded **OR** grooved ends; grooved-end fittings; grooved-end-pipe couplings; and grooved, **as directed**, joints.
 - 2. Sprinkler specialty fittings may be used, downstream of control valves, instead of specified fittings.
 - 3. Copper-tube, extruded-tee connections may be used for tee branches in copper tubing instead of specified copper fittings. Branch-connection joints must be brazed.
 - 4. Standard-pressure, dry-pipe sprinkler system, **NPS 2 (DN 50)** and smaller, shall be one of the following:
 - a. Standard-weight or Schedule 30, galvanized-steel pipe with threaded ends; galvanized, gray-iron threaded fittings; and threaded joints.
 - b. Standard-weight **OR** Schedule 30 **OR** thinwall, **as directed**, galvanized-steel pipe with plain ends; plain-end-pipe fittings; and twist-locked joints.
 - c. Standard-weight or Schedule 30, galvanized-steel pipe with cut-grooved ends; galvanized, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.
 - d. **Type L (Type B) OR Type M (Type C), as directed**, hard copper tube with plain ends; cast-or wrought-copper solder-joint fittings; and brazed joints.
 - e. **Type L (Type B) OR Type M (Type C), as directed**, hard copper tube with plain ends; copper pressure-seal fittings; and pressure-sealed joints.
 - f. **NPS 2 (DN 50), Type L (Type B) OR Type M (Type C), as directed**, hard copper tube with roll-grooved ends; copper, grooved-end fittings; grooved-end-tube couplings; and grooved joints.

5. Standard-pressure, dry-pipe sprinkler system, **NPS 2-1/2 to NPS 4 (DN 65 to DN 100)**, shall be one of the following:
 - a. Standard-weight or Schedule 30, galvanized-steel pipe with threaded ends; galvanized, gray-iron threaded fittings; and threaded joints.
 - b. Standard-weight or Schedule 30, galvanized-steel pipe with cut-grooved ends; galvanized, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.
 - c. **Type L (Type B) OR Type M (Type C), as directed**, hard copper tube with plain ends; cast-or wrought-copper solder-joint fittings; and brazed joints.
 - d. **Type L (Type B) OR Type M (Type C), as directed**, hard copper tube with plain ends; copper pressure-seal fittings; and pressure-sealed joints.
 - e. **Type L (Type B) OR Type M (Type C), as directed**, hard copper tube with roll-grooved ends; copper, grooved-end fittings; grooved-end-tube couplings; and grooved joints.
6. Standard-pressure, dry-pipe sprinkler system, **NPS 5 and NPS 6 (DN 125 and DN 150)**, shall be one of the following:
 - a. Standard-weight or Schedule 30, galvanized-steel pipe with threaded ends; galvanized, gray-iron threaded fittings; and threaded joints.
 - b. Standard-weight or Schedule 30, galvanized-steel pipe with cut-grooved ends; galvanized, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.
 - c. **Type L (Type B) OR Type M (Type C), as directed**, hard copper tube with plain ends; cast-or wrought-copper solder-joint fittings; and brazed joints.
 - d. **Type L (Type B) OR Type M (Type C), as directed**, hard copper tube with roll-grooved ends; copper, grooved-end fittings; grooved-end-tube couplings; and grooved joints.

Q. Sprinkler Schedule

1. Use sprinkler types in subparagraphs below for the following applications:
 - a. Rooms without Ceilings: Upright sprinklers.
 - b. Rooms with Suspended Ceilings: Dry pendent sprinklers **OR** Dry recessed sprinklers **OR** Dry flush sprinklers **OR** Dry concealed sprinklers, **as directed**.
 - c. Wall Mounting: Dry sidewall sprinklers.
 - d. Spaces Subject to Freezing: Upright sprinklers **OR** Dry pendent sprinklers **OR** Dry sidewall sprinklers, **as directed**.
 - e. Special Applications: Extended-coverage and quick-response sprinklers where indicated.
2. Provide sprinkler types in subparagraphs below with finishes indicated.
 - a. Concealed Sprinklers: Rough brass, with factory-painted white cover plate.
 - b. Flush Sprinklers: Bright chrome, with painted white escutcheon.
 - c. Recessed Sprinklers: Bright chrome, with bright chrome escutcheon.
 - d. Upright, Pendent, and Sidewall Sprinklers: Chrome plated in finished spaces exposed to view; rough bronze in unfinished spaces not exposed to view; wax coated where exposed to acids, chemicals, or other corrosive fumes.

END OF SECTION 21 13 16 00

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SECTION 21 13 39 00 - FOAM FIRE EXTINGUISHING

1.1 GENERAL

A. Description Of Work

1. This specification covers the furnishing and installation of materials for foam fire extinguishing. Products shall be as follows or as directed by the Owner. Installation procedures shall be in accordance with the product manufacturer's recommendations. Demolition and removal of materials shall be as required to support the work.

B. Summary

1. This Section includes fixed, low-expansion, AFFF fire-extinguishing systems and the following:
 - a. Concentrate piping and piping specialties.
 - b. Proportioning tanks and proportioning devices.
 - c. Foam concentrate.
 - d. Discharge devices.
 - e. Monitoring and alarm devices.

C. Definitions

1. AFFF: Aqueous film-forming foam.
2. AR-AFFF: Alcohol-resistant aqueous film-forming foam.
3. ATS: Acceptance Testing Specifications.

D. System Description

1. Description: Engineered, fixed, wet-pipe **OR** dry-pipe, **OR** preaction, **OR** deluge, **as directed**, automatically actuated, low-expansion, AFFF **OR** AR-AFFF, **as directed**, fire-extinguishing system for flammable-liquid fires. System includes diaphragm proportioning tanks and devices as described in NFPA 16.

E. Performance Requirements

1. Standard Piping System Component Working Pressure: Listed for at least **175 psig (1200 kPa)**.
2. Minimum design parameters to be used with the approval of authorities having jurisdiction are as follows:
 - a. Solution: 3 percent foam-water solution.
 - b. Sprinkler Spacing: Maximum of **100 sq. ft. (9.5 sq. m)** per sprinkler, and maximum **12-foot (3.7-m)** spacing.
 - c. Design Density: Minimum **0.16 gpm/sq. ft. (0.108 L/s per sq. m)**.
 - d. Foam Supply: Minimum 10-minute discharge time.
 - e. Water Supply: Minimum 60 minutes.
 - f. Remote Area: Minimum **5000-sq. ft. (476-sq. m)** design area for closed-sprinkler systems. Open-sprinkler systems shall discharge over the entire system area.
 - g. Sprinkler Temperature Rating: Maximum **250 to 300 deg F (121 to 149 deg C)** at a roof or ceiling, and **135 to 170 deg F (57 to 77 deg C)** for intermediate sprinklers.
3. Seismic Performance: Fire-suppression piping shall be capable of withstanding the effects of earthquake motions determined according to NFPA 13.

F. Submittals

1. Product Data: For the following:
 - a. Piping and equipment seismic restraints.
 - b. Valves.
 - c. Proportioning tanks and proportioning devices.
 - d. Foam concentrate.
 - e. Discharge devices. Include flow characteristics.
 - f. Monitoring and alarm devices. Include electrical data.



2. Shop Drawings: Signed and sealed by a qualified professional engineer. Include the following for each hazard area, drawn to scale:
 - a. Include plans, elevations, sections, details, and attachments to other work. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
 - b. Wiring Diagrams: Power, signal, and control wiring.
 - c. Design Calculations: For amount of foam concentrate required for each hazard area.
 - d. Plans: Show the following:
 - 1) Foam-solution proportioning tanks and devices, piping, discharge devices, monitoring and alarm devices, and accessories.
 - 2) Method of attaching hangers to building structure.
 - 3) Fire alarm panel.
 - 4) Equipment and furnishings.
3. Permit-Approved Drawings: Working plans, prepared according to NFPA 16, that have been approved by authorities having jurisdiction. Include design calculations.
4. Welding certificates.
5. Field quality-control test reports.
6. Operation and Maintenance Data: For foam fire extinguishing to include in emergency, operation, and maintenance manuals.

G. Quality Assurance

1. Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX.
2. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
3. FMG Compliance: Provide components that are FMG approved and that are listed in FMG's "Fire Protection Approval Guide."
4. UL Compliance: Provide equipment listed in UL's "Fire Protection Equipment Directory."

1.2 PRODUCTS

A. Pipe And Fittings

1. Steel Pipe: ASTM A 53/A 53M, ASTM A 135, ASTM A 106, or ASTM A 795, Type E or S, Grade A or B, Schedule 40, with factory- or field-formed threaded ends.
 - a. Cast-Iron Threaded Flanges: ASME B16.1.
 - b. Malleable-Iron Threaded Fittings: ASME B16.3.
 - c. Gray-Iron Threaded Fittings: ASME B16.4.
 - d. Butt-Weld Fittings: ASTM A 234/A 234M, Grade WPB, Schedule 40, carbon-steel butt-weld fittings.
 - e. Steel Threaded Pipe Nipples: ASTM A 733, made of ASTM A 53/A 53M or ASTM A 106, Schedule 40, seamless steel pipe. Include ends matching joining method.
 - f. Steel Threaded Couplings: ASTM A 865.
2. Stainless Steel: ASTM A 312/A 312M, Schedule 40, with factory-formed threaded or beveled ends; ASTM A 376/A 376M for seamless pipe; or ASTM A 213/A 213M, ASTM A 249/A 249M, and ASTM A 269 for seamless and welded tubing.
 - a. Class 150 Threaded Fittings: ASME B16.3 and MSS SP 114.
 - b. Butt-Weld Fittings: ASTM A 403/A 403M.
 - c. Flanges, Forged Fittings and Flanges, and Socket-Weld Fittings: ASTM A 182/A 182M.
 - d. Bar Stock and Compression Fittings: ASTM A 276 and ASTM A 479/A 479M.
3. Red Brass Pipe: ASTM B 43, Schedule 40, with factory- or field-formed threaded ends.
 - a. Threaded Flanges and Fittings: ASTM B 584.
4. Refer to Division 21 Section "Common Work Results For Fire Suppression" for basic joining materials.

B. Valves

1. Ball Valves: Bronze body with threaded or flanged ends. Comply with UL 1091, except with stainless-steel ball instead of disc.

C. Specialties

1. Concentrate Storage Tank: Buna-N, bladder-type proportioning tank complying with UL 162 and ASME Boiler and Pressure Vessel Code: Section VIII. Include bladder, internal piping, fill and drain, pipe assembly, glass sight gage, piping, and valves. Concentrate to be contained in the bladder.
 - a. Orientation: Horizontal design with saddle **OR** Vertical design with skirt, **as directed**, support.
2. Proportioning Controller: Venturi type complying with UL 162 and of capacity to match design at minimum and maximum flow.
3. Concentrate Control Valve: Water-operated ball or deluge valve designed to open with flow through the proportioning controller.
4. Concentrate Strainers: Bronze body and stainless-steel mesh strainer with minimum **0.125-inch (3.2-mm)** perforations to remove solids that would block system components.
5. Provide devices that comply with NFPA 16, are compatible with the foam concentrate, and are designed to be drained and cleaned.

D. Foam Concentrate

1. Description: AFFF **OR** AR-AFFF, **as directed**, liquid concentrate, complying with NFPA 11 and UL 162, for making foam-water fire-extinguishing foam solution.

E. Pressure Gages

1. Description: Comply with UL 393, with **3-1/2-inch- (90-mm-)** minimum diameter dial, **0- to 300-psig (0- to 2070-kPa)** dial range, and caption "WATER" or "CONCENTRATE" on dial face.

F. Discharge Devices

1. General: Discharge devices shall be listed and approved by UL and FMG.
2. Sprinklers: Closed **OR** Open, **as directed**, air-aspirating **OR** non-air-aspirating, **as directed**, type complying with UL 162 and suitable for discharging foam.
3. Spray Nozzles: Foam-water spray nozzles including foam generator and distributing deflector complying with UL 162 and designed to distribute foam or water in the absence of foam solution in a special pattern peculiar to a particular head.

G. Monitoring Devices

1. Valve Supervisory Switches: UL 753, electrical, single pole, double throw, with normally closed contacts. Include design that signals controlled valve is in other than fully open position.

H. Alarm Devices

1. Description: UL listed or FMG approved, low voltage, and surface mounting. Alarm and monitoring devices are specified in Division 28 Section(s) "Digital, Addressable Fire-alarm System" OR "Zoned (dc Loop) Fire-alarm System".

1.3 EXECUTION

A. Concentrate Storage Tank Installation

1. Install proportioning tanks on concrete bases. Concrete bases are specified in Division 21 Section "Common Work Results For Fire Suppression".
2. Install tanks level and plumb, according to layout drawings, original design, and referenced standards. Maintain manufacturer's recommended clearances. Arrange units so controls and devices needing service are accessible.
3. Install seismic restraints for tanks. Anchor tanks to substrate.



- B. Piping Applications
1. Flanged pipe and fittings and flanged joints may be used to connect to specialties and accessories and where required for maintenance.
 2. AFFF-Concentrate Piping: Steel pipe, malleable- or cast-iron threaded fittings, and threaded joints.
 3. AFFF-Concentrate Piping: Steel pipe with welded fittings and joints.
 4. AR-AFFF-Concentrate Piping: Brass **OR** Stainless-steel, **as directed**, pipe, threaded fittings, and joints.
 5. AR-AFFF-Concentrate Piping: Stainless-steel pipe with welded fittings and joints.
 6. Foam-solution piping is specified in Division 21 Section "Wet-pipe Sprinkler Systems".
- C. Piping Installation
1. Install piping and other components level and plumb.
 2. Refer to Division 21 Section "Common Work Results For Fire Suppression" for basic pipe installation and joint construction.
 3. Install proportioning tanks anchored to substrate.
 4. Install pipe and fittings, valves, and discharge devices according to requirements listed in NFPA 16, "Installation of Deluge Foam-Water Sprinkler and Foam-Water Spray Systems."
 - a. Support piping using supports and methods according to NFPA 13.
 - b. Install seismic restraints for proportioning tanks and piping systems.
 - c. Install monitoring and alarm devices according to NFPA 16 and NFPA 72.
- D. Connections
1. Piping installation requirements are specified in Division 21 Section "Wet-pipe Sprinkler Systems". Drawings indicate general arrangement of piping, fittings, and specialties.
 2. Provide concentrate control, maintenance service, and drain valves with piping to permit maintenance of the foam concentrate with continuous sprinkler system service.
 3. Install proportioning controller in fire-suppression piping to provide coverage to area indicated on Drawings.
 4. Install piping adjacent to equipment to allow service and maintenance.
 5. Connect electrical devices to building's fire alarm system. Electrical power, wiring, and devices are specified in Division 28 Section(s) "Digital, Addressable Fire-alarm System" OR "Zoned (dc Loop) Fire-alarm System".
- E. Labeling
1. Install labeling on piping, equipment, and panels according to Division 22 Section "Identification For Plumbing Piping And Equipment".
- F. Charging System
1. Fill proportioning tanks with foam concentrate after field quality-control testing is complete and satisfactory results have been achieved.
- G. Field Quality Control
1. Inspection: Engage the services of a qualified professional engineer to inspect installed fire-extinguishing systems, prepare installation report, and certify that installation complies with the Contract Documents, calculations, and requirements of authorities having jurisdiction.
 2. Comply with operating instructions and procedures in NFPA 16, "Acceptance Tests" Chapter. Include the following tests and inspections to demonstrate compliance with requirements:
 - a. Check mechanical items.
 - b. Inspect equipment and fire-extinguishing foam concentrate, and check mountings for adequate anchoring to substrate.
 - c. Check electrical systems.
 - d. Flush piping.
 - e. Perform acceptance test.
 - f. Perform pressure test.

- g. Perform operating test.
 - h. Perform discharge test.
 - i. Correct malfunctioning equipment, then retest to demonstrate compliance. Replace equipment that cannot be satisfactorily corrected or does not perform as specified and indicated, then retest to demonstrate compliance. Repeat procedure until satisfactory results are obtained.
 - 1) Report test results promptly and in writing and authorities having jurisdiction.
- 3. Perform the following field tests and inspections and prepare test reports:
 - a. After installing foam fire-extinguishing piping system and after electrical circuitry has been energized, test for compliance with requirements.
 - b. Perform each electrical test and visual and mechanical inspection stated in NETA ATS, "Inspection and Test Procedures" and "System Function Tests." Certify compliance with test parameters.
 - c. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
 - d. Operational Test: After electrical circuitry has been energized, start systems to confirm proper unit operation.
 - e. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- 4. Remove and replace malfunctioning units and retest as specified above.

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SECTION 21 22 16 00 - CLEAN-AGENT EXTINGUISHING SYSTEMS

1.1 GENERAL

A. Description Of Work

1. This specification covers the furnishing and installation of materials for clean-agent extinguishing systems. Products shall be as follows or as directed by the Owner. Installation procedures shall be in accordance with the product manufacturer's recommendations. Demolition and removal of materials shall be as required to support the work.

B. Summary

1. This Section includes clean-agent extinguishing systems and the following:
 - a. Piping and piping specialties.
 - b. Extinguishing-agent containers.
 - c. Extinguishing agent.
 - d. Detection and alarm devices.
 - e. Control and alarm panels.
 - f. Accessories.
 - g. Connection devices for and wiring between system components.
 - h. Connection devices for power and integration into building's fire alarm system.

C. Definitions

1. ATS: Acceptance Testing Specifications.
2. EPO: Emergency Power Off.

D. System Description

1. Clean-agent fire-extinguishing system shall be an engineered system for total flooding of the hazard area including the room cavity below the ceiling and below the raised floor. Provide separate zones above and below the raised floor. If smoke is detected below the raised floor, agent shall be discharged in the underfloor zone only. If smoke is detected above the raised floor, agent shall be discharged in zones above and below the floor.

E. Performance Requirements

1. Design clean-agent extinguishing system and obtain approval from authorities having jurisdiction. Design system for Class A, B, or C fires as appropriate for areas being protected and include safety factor. Use clean agent indicated and in concentration suitable for normally occupied areas.
2. Performance Requirements: Discharge HFC 227ea within 10 seconds and maintain 7.1 percent concentration by volume at 70 deg F (21 deg C) for 10-minute holding time in hazard areas.
 - a. HFC 227ea concentration in hazard areas greater than 9.0 percent immediately after discharge or less than 5.8 percent throughout holding time will not be accepted without written authorization from the Owner and authorities having jurisdiction.
 - b. System Capabilities: Minimum 620-psig (4278-kPa) calculated working pressure and 360-psig (2484-kPa) initial charging pressure.
3. Performance Requirements: Discharge IG-541 within 60 seconds and maintain 38 percent concentration by volume at 70 deg F (21 deg C) for 10-minute holding time in hazard areas.
 - a. IG-541 concentration in hazard areas greater than 40 percent immediately after discharge or less than 32 percent throughout holding time will not be accepted without written authorization from the Owner and authorities having jurisdiction.
 - b. System Capabilities: Minimum 2175-psig (15-MPa) calculated working pressure upstream from orifice union, minimum 1000-psig (6895-kPa) calculated working pressure downstream from orifice union, and 2175-psig (15-MPa) initial charging pressure.



4. Cross-Zoned Detection: Devices located in two separate zones. Sound alarm on activating single-detection device, and discharge extinguishing agent on actuating single-detection device in other zone.
OR
Verified Detection: Devices located in single zone. Sound alarm on activating single-detection device, and discharge extinguishing agent on actuating second-detection device.
5. System Operating Sequence: As follows:
 - a. Actuating First Detector: Visual indication on annunciator panel, energize audible alarm and visual alarms (slow pulse), shut down air-conditioning and ventilating systems serving protected area, close doors in protected area, and send signal to fire alarm system.
 - b. Actuating Second Detector: Visual indication on annunciator panel, energize audible and visual alarms (fast pulse), shut down power to protected equipment, start time delay for extinguishing-agent discharge for 30 seconds, and discharge extinguishing agent. On agent discharge, release preaction valve to allow water to fill sprinkler system.
 - c. Extinguishing-agent discharge will operate audible alarms and strobe lights inside and outside the protected area.
6. System Operating Sequence: System shall be cross-zoned, air-sampling detectors and photoelectric detectors reporting to a fully programmable microprocessor-based control panel programmed to operate as follows:
 - a. If one photoelectric detector and air-sampling detector reaches the third detection level (Fire 1), agent discharge will be initiated as described for the third detection level (Fire 1) below.
 - b. Air-Sampling System:
 - 1) First Detection Level (Alert): Mild audible and visual indication on annunciator panel. Strobe lights flash slowly in the protected area.
 - 2) Second Detection Level (Action): Strong audible and visual indication on annunciator panel. Strobe lights flash rapidly in the protected area.
 - 3) Third Detection Level (Fire 1): Strong audible and visual indication on annunciator panel. Energize horn(s), bell(s), and strobe light(s) in the protected area and outside entry doors. Shut down air-conditioning and ventilating systems serving the protected area, and close doors in the protected area. Send signal to fire alarm system, initiate 30-second time delay for extinguishing-agent discharge, and discharge extinguishing agent. At agent discharge, terminate power to equipment in the protected area, and release preaction valve to allow water flow to sprinkler system.
 - 4) Fourth Detection Level (Fire 2): Same as Fire 1.
7. Manual stations shall immediately discharge extinguishing agent when activated.
8. Operating abort switches will delay extinguishing-agent discharge while being activated, and switches must be reset to prevent agent discharge. Release of hand pressure on the switch will cause agent discharge if the time delay has expired.
9. EPO: Will terminate power to protected equipment immediately on actuation.
10. Low-Agent Pressure Switch: Initiate trouble alarm if sensing less than set pressure.
11. Power Transfer Switch: Transfer from normal to stand-by power source.
12. Seismic Performance: Fire-suppression piping and containers shall be capable of withstanding the effects of earthquake motions determined according to ASCE 7, "Minimum Design Loads for Buildings and Other Structures": Section 9, "Earthquake Loads."

F. Submittals

1. Product Data: For each product indicated.
2. LEED Submittal:
 - a. Product Data for Credit EA 4: Documentation required by Credit EA 4 indicating that clean agents comply.
3. Shop Drawings: Signed and sealed by a qualified professional engineer. Include design calculations.

4. Permit Approved Drawings: Working plans, prepared according to NFPA 2001, that have been approved by authorities having jurisdiction. Include design calculations.
5. Field quality-control test reports.
6. Maintenance Data: For components to include in maintenance manuals.

G. Quality Assurance

1. Professional Engineer Qualifications: A professional engineer who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for installations of clean-agent extinguishing systems that are similar to those indicated for this Project in material, design, and extent.
2. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

1.2 PRODUCTS

A. Piping Materials

1. Refer to Part 1.3 piping applications Article retained for applications of pipe, tube, fitting, and joining materials.
2. Piping, Valves, and Discharge Nozzles: Comply with types and standards listed in NFPA 2001, Section "Distribution," for charging pressure of system.

B. Pipe And Fittings

1. Steel Pipe: ASTM A 53/A 53M, Type S, Grade B or ASTM A 106, Grade B; Schedule 40, or Schedule 80, seamless steel pipe.
 - a. Threaded Fittings:
 - 1) Malleable-Iron Fittings: ASME B16.3, Class 300.
 - 2) Flanges and Flanged Fittings: ASME B16.5, Class 300, unless Class 600 is indicated.
 - b. Forged-Steel Welding Fittings: ASME B16.11, Class 3000, socket pattern.
 - c. Grooved-End Fittings: FMG approved and NRTL listed, ASTM A 47/A 47M malleable iron or ASTM A 536 ductile iron, with dimensions matching steel pipe and ends factory grooved according to AWWA C606.Plain-End, Hard Copper Tube: **ASTM B 88, Type K OR L, as directed, (ASTM B 88M, Type A OR B, as directed),** water tube, drawn temper.
 - d. Copper, Solder-Joint Fittings: ASME B16.22, wrought-copper alloy, pressure.
 - e. Bronze Flanges and Flanged Fittings: ASME B16.24, Class 300.
2. Pipe-Flange Gasket Materials: Suitable for chemical and thermal conditions of piping system contents.
 - a. ASME B16.21, nonmetallic, flat, asbestos-free, **1/8-inch (3.2-mm)** maximum thickness, unless thickness or specific material is indicated.
3. Flange Bolts and Nuts: ASME B18.2.1, carbon steel.
4. Brazing Filler Metals: AWS A5.8, BCuP Series, copper-phosphorus alloys for general-duty brazing.
5. Welding Filler Metals: Comply with AWS D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.
6. Steel, Keyed Couplings: UL 213, AWWA C606, approved or listed for clean-agent service, and matching steel-pipe dimensions. Include ASTM A 536, ductile-iron housing, rubber gasket, and steel bolts and nuts.

C. Valves

1. General: Brass; suitable for intended operation.
2. Container Valves: With rupture disc or solenoid and manual-release lever, capable of immediate and total agent discharge and suitable for intended flow capacity.



3. Valves in Sections of Closed Piping and Manifolds: Fabricate to prevent entrapment of liquid, or install valve and separate pressure relief device.
 4. Valves in Manifolds: Check valve; installed to prevent loss of extinguishing agent when container is removed from manifold.
- D. Extinguishing-Agent Containers
1. Description: Steel tanks complying with ASME Boiler and Pressure Vessel Code: Section VIII, for unfired pressure vessels. Include minimum working-pressure rating that matches system charging pressure, valve, pressure switch, and pressure gage.
 - a. Finish: Red **OR** Manufacturer's standard color, **as directed**, enamel or epoxy paint.
 - b. Manifold: Fabricate with valves, pressure switches, and connections for multiple storage containers, as indicated.
OR
Manifold: Fabricate with valves, pressure switches, selector switch, and connections for main- and reserve-supply banks of multiple storage containers.
 - c. Storage-Tank Brackets: Factory- or field-fabricated retaining brackets consisting of steel straps and channels; suitable for container support, maintenance, and tank refilling or replacement.
- E. Fire-Extinguishing Clean Agent
1. Clean Agent: HFC 227ea, heptafluoropropane.
OR
Clean Agent: IG-541, mixture of nitrogen, argon, and carbon dioxide inert gases.
- F. Discharge Nozzles
1. Equipment manufacturer's standard one-piece brass or aluminum alloy of type, discharge pattern, and capacity required for application.
- G. Manifold And Orifice Unions
1. Description: NRTL-listed device with minimum **2175-psig (15-MPa)** pressure rating, to control flow and reduce pressure of IG-541 gas in piping.
 - a. **NPS 2 (DN 50)** and Smaller: Piping assembly with orifice, sized for system design requirements.
 - b. **NPS 2-1/2 (DN 65)** and Larger: Piping assembly with nipple, sized for system design requirements.
- H. Control Panels
1. Description: FMG approved or NRTL listed, including equipment and features required for testing, supervising, and operating fire-extinguishing system.
 2. Power Requirements: 120/240-V ac; with electrical contacts for connection to system components and fire alarm system, and transformer or rectifier as needed to produce power at voltage required for accessories and alarm devices.
 3. Enclosure: NEMA ICS 6, Type 1, enameled-steel cabinet.
 - a. Mounting: Recessed flush with surface **OR** Surface, **as directed**.
 4. Supervised Circuits: Separate circuits for each independent hazard area.
 - a. Detection circuits equal to the required number of zones, or addressable devices assigned to the required number of zones.
 - b. Manual pull-station circuit.
 - c. Alarm circuit.
 - d. Release circuit.
 - e. Abort circuit.
 - f. EPO circuit.
 5. Provide the following control-panel features:
 - a. Electrical contacts for shutting down fans, activating dampers, and operating system electrical devices.

- b. Automatic switchover to standby power at loss of primary power.
 - c. Storage container, low-pressure indicator.
 - d. Service disconnect to interrupt system operation for maintenance with visual status indication on the annunciator panel.
 - 6. Annunciator Panel: Graphic type showing protected, hazard-area plans and locations of detectors, abort, EPO, and manual stations. Include lamps to indicate device-initiating alarm, electrical contacts for connection to control panel, and stainless-steel or aluminum enclosure.
 - 7. Standby Power: Lead-acid or nickel-cadmium batteries with capacity to operate system for 72 hours and alarm for minimum of 15 minutes. Include automatic battery charger, with varying charging rate between trickle and high depending on battery voltage, that is capable of maintaining batteries fully charged. Include manual voltage control, dc voltmeter, dc ammeter, electrical contacts for connection to control panel, and suitable enclosure.
- I. Detection Devices
 - 1. Description: Comply with NFPA 2001 and NFPA 72, and include the following types:
 - a. Ionization Detectors: Comply with UL 268, dual-chamber type, having sampling and referencing chambers, with smoke-sensing element.
 - b. Photoelectric Detectors: Comply with UL 268, consisting of LED light source and silicon photodiode receiving element.
 - c. Remote Air-Sampling Detector System: Includes air-sampling pipe network, a laser-based photoelectric detector, a sample transport fan, and a control unit.
 - 1) Comply with UL 268 and NRTL listed, operating at 24-V dc, nominal.
 - 2) Pipe Network: CPVC tubing connects control unit with calibrated sampling holes.
 - 3) Smoke Detector: Particle-counting type with continuous laser beam. Sensitivity adjustable to a minimum of four preset values.
 - 4) Sample Transport Fan: Centrifugal type, creating a minimum static pressure of **0.05-inch wg (12.5 Pa)** at all sampling ports.
 - 5) Control Unit: Multizone unit as indicated on Drawings. Provides same system power supply, supervision, and alarm features as specified for the control panel plus separate trouble indication for airflow and detector problems.
 - 6) Signals to the Central Fire Alarm Control Panel: Any type of local system trouble is reported to the central fire alarm control panel as a composite "trouble" signal. Alarms on each system zone are individually reported to the central fire alarm control panel as separately identified zones.
- J. Manual Stations
 - 1. General Description: Surface **OR** Semirecessed, **as directed**, FMG approved or NRTL listed, with clear plastic hinged cover, 120-V ac or low voltage compatible with controls. Include contacts for connection to control panel.
 - 2. Manual Release: "MANUAL RELEASE" caption, and red finish. Unit can manually discharge extinguishing agent with operating device that remains engaged until unlocked.
 - 3. Abort Switch: "ABORT" caption, momentary contact, with green finish.
 - 4. EPO Switch: "EPO" caption, with yellow finish.
- K. Switches
 - 1. Description: FMG approved or NRTL listed, where available, 120-V ac or low voltage compatible with controls. Include contacts for connection to control panel.
 - a. Low-Agent Pressure Switches: Pneumatic operation.
 - b. Power Transfer Switches: Key-operation selector, for transfer of release circuit signal from main supply to reserve supply.
 - c. Door Closers: Magnetic retaining and release device or electrical interlock to cause the door operator to drive the door closed.
- L. Alarm Devices
 - 1. Description: FMG approved or NRTL listed, low voltage, and surface mounting, unless otherwise indicated.

2. Bells: Minimum **6-inch (150-mm)** diameter.
3. Horns: 90 to 94 dBA.
4. Strobe Lights: Translucent lens, with "FIRE" or similar caption.

M. Electrical Power And Wiring

1. Electrical power, wiring, and devices are specified in Division 22.

1.3 EXECUTION

A. Piping Applications

1. Flanged pipe and fittings and flanged joints may be used to connect to specialties and accessories and where required for maintenance.
2. Fittings Working Pressure: **620 psig (4278 kPa)** minimum.
3. Flanged Joints: Class 300 minimum.
4. **NPS 2 (DN 50)** and Smaller: **ASTM B 88, Type K OR L, as directed, (ASTM B 88M, Type A OR B, as directed,)** copper tube; copper, solder-joint fittings; and brazed joints.
OR
NPS 2 (DN 50) and Smaller: Schedule 40, steel pipe; malleable-iron threaded fittings; and threaded joints.
5. **NPS 2-1/2 and NPS 3 (DN 65 and DN 80):** **ASTM B 88, Type K OR L, as directed, (ASTM B 88M, Type A OR B, as directed,)** copper tube; copper, solder-joint fittings; and brazed joints.
OR
NPS 2-1/2 and NPS 3 (DN 65 and DN 80): Schedule 40, steel pipe; forged-steel welding fittings; and welded joints.
OR
NPS 2-1/2 and NPS 3 (DN 65 and DN 80): Schedule 40, steel pipe; steel, grooved-end fittings; steel, keyed couplings; and grooved joints.
6. **NPS 4 (DN 100)** and Larger: Schedule 40, steel pipe; steel, grooved-end fittings; steel, keyed couplings; and grooved joints.
OR
NPS 4 (DN 100) and Larger: Schedule 40, steel pipe; forged-steel welding fittings; and welded joints.

B. Piping Applications

1. Piping between Storage Containers and Orifice Union:
 - a. Flanged pipe and fittings and flanged joints may be used to connect to specialties and accessories and where required for maintenance.
 - b. Fittings Working Pressure: **2175 psig (15 MPa)** minimum.
 - c. Flanged Joints: Class 600 minimum.
 - d. All Sizes: Schedule 80, steel pipe; forged-steel welding fittings; and welded joints.
2. Piping Downstream from Orifice Union:
 - a. Flanged pipe and fittings and flanged joints may be used to connect to specialties and accessories and where required for maintenance.
 - b. Fittings Working Pressure: **1000 psig (6900 kPa)** minimum.
 - c. Flanged Joints: Class 300 minimum.
 - d. All Sizes: Schedule 40 **OR** 80, **as directed**, steel pipe; forged-steel welding fittings; and welded joints.

C. Clean-Agent Extinguishing Piping Installation

1. Install clean-agent extinguishing piping and other components level and plumb and according to manufacturers' written instructions.
2. Refer to Division 21 Section "Common Work Results For Fire Suppression" for basic pipe installation and joint construction.

3. Grooved Piping Joints: Groove pipe ends according to AWWA C606 dimensions. Assemble grooved-end steel pipe and steel, grooved-end fittings with steel, keyed couplings and lubricant according to manufacturer's written instructions.
 4. Install extinguishing-agent containers anchored to substrate.
 5. Install pipe and fittings, valves, and discharge nozzles according to requirements listed in NFPA 2001, Section "Distribution," and in ASME B31.1.
 - a. Install valves designed to prevent entrapment of liquid or install pressure relief devices in valved sections of piping systems.
 - b. Support piping using supports and methods according to NFPA 13.
 - c. Install seismic restraints for extinguishing-agent containers and piping systems.
 - d. Install control panels, detection system components, alarms, and accessories, complying with requirements of NFPA 2001, Section "Detection, Actuation, and Control Systems," as required for supervised system application.
- D. Connections
1. Drawings indicate general arrangement of piping, fittings, and specialties.
 2. Install piping adjacent to extinguishing-agent containers to allow service and maintenance.
 3. Connect electrical devices to control panel and to building's fire alarm system. Electrical power, wiring, and devices are specified in Division 28 Section(s) "Digital, Addressable Fire-alarm System" OR "Zoned (dc Loop) Fire-alarm System".
- E. Labeling
1. Install labeling on piping, extinguishing-agent containers, other equipment, and panels according to NFPA 2001.
 2. Install signs at entry doors for protected areas to warn occupants that they are entering a room protected with a clean-agent fire extinguishing system.
 3. Install signs at entry doors to advise persons outside the room the meaning of the horn(s), bell(s), and strobe light(s) outside the protected space.
- F. Field Quality Control
1. Comply with operating instructions and procedures of NFPA 2001, Section "Approval of Installations." Include the following tests and inspections to demonstrate compliance with requirements:
 - a. Check mechanical items.
 - b. Inspect extinguishing-agent containers and extinguishing agent, and check mountings for adequate anchoring to substrate.
 - c. Check electrical systems.
 - d. Check enclosure integrity. Comply with NFPA 2001, Section "Enclosure Inspection," and Appendix C, "Enclosure Integrity Procedure."
 - e. Perform functional pre-discharge test.
 - f. Perform system functional operational test including, EPO, abort, and manual release.
 - g. Check remote monitoring operations.
 - h. Check control-panel primary power source.
 - i. Perform "puff" test on piping system, using nitrogen.
 2. Perform field-acceptance tests of each clean-agent extinguishing system when installation is complete. Perform system testing only after hazard-area enclosure construction has been completed and openings sealed. Comply with operating instructions and procedures of NFPA 2001, Section "Approval of Installations." Include the following to demonstrate compliance with requirements:
 - a. Perform functional predischage test.
 - b. Perform system functional operational test.
 - c. Check remote monitoring operations.
 - d. Check control-panel primary power source.
 - e. Perform "puff" test on piping system, using nitrogen.

3. Correct malfunctioning equipment, then retest to demonstrate compliance. Replace equipment that cannot be corrected or does not perform as specified and indicated, then retest to demonstrate compliance. Repeat procedure until satisfactory results are obtained.
 - a. Report test results promptly and in writing to the Owner and authorities having jurisdiction.
 4. Perform the following field tests and inspections and prepare test reports:
 - a. After installing clean-agent extinguishing piping system and after electrical circuitry has been energized, test for compliance with requirements.
 - b. Perform each electrical test and visual and mechanical inspection stated in NETA ATS, Sections "Inspection and Test Procedures" and "System Function Tests." Certify compliance with test parameters.
 - c. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
 - d. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation. Remove malfunctioning units, replace with new units, and retest.
 - e. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
 5. Remove and replace malfunctioning units and retest as specified above.
- G. Cleaning
1. Each pipe section shall be cleaned internally after preparation and before assembly by means of swabbing, using a suitable nonflammable cleaner. Pipe network shall be free of particulate matter and oil residue before installing nozzles or discharge devices.
- H. System Filling
1. Preparation:
 - a. Verify that piping system installation is completed and cleaned.
 - b. Check for complete enclosure integrity.
 - c. Check operation of ventilation and exhaust systems.
 2. Filling Procedures:
 - a. Fill extinguishing-agent containers with extinguishing agent and pressurize to indicated charging pressure.
 - b. Install filled extinguishing-agent containers.
 - c. Energize circuits.
 - d. Adjust operating controls.
- I. Demonstration
1. Train the Owner's maintenance personnel to adjust, operate, and maintain clean-agent extinguishing systems.

END OF SECTION 21 22 16 00



Task	Specification	Specification Description
21 22 16 00	01 22 16 00	No Specification Required

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SECTION 21 24 00 00 - FIBERGLASS REINFORCED POLYESTER (FRP) FLUSH DOORS

1.1 GENERAL

A. Description of Work

1. This specification covers the furnishing and installation of materials for fiberglass reinforced polyester (FRP) flush doors and aluminum frames. Products shall be as follows or as directed by the Owner. Installation procedures shall be in accordance with the product manufacturer's recommendations. Demolition and removal of materials shall be as required to support the work.

B. Performance Requirements

1. General: Provide door assemblies that have been designed and fabricated to comply with specified performance requirements, as demonstrated by testing manufacturer's corresponding standard systems.
2. Air Infiltration: For a single door 3'-0" x 7'-0", test specimen shall be tested in accordance with ASTM E 283 at pressure differential of 6.24 psf. Door shall not exceed 0.90 cfm per linear foot of perimeter crack.
3. Water Resistance: For a single door 3'-0" x 7'-0", test specimen shall be tested in accordance with ASTM E 331 at pressure differential of 7.50 psf. Door shall not have water leakage.
4. Hurricane Test Standards, Single Door with Single-Point Latching:
 - a. Uniform Static Load, ASTM E 330: Plus or minus 75 pounds per square foot.
 - b. Forced Entry Test, 300 Pound Load Applied, SFBC 3603.2 (b)(5): Passed.
 - c. Cyclic Load Test, SFBC PA 203: Plus or minus 53 pounds per square foot.
 - d. Large Missile Impact Test, SFBC PA 201: Passed.
5. Swinging Door Cycle Test, Doors and Frames, ANSI A250.4: Minimum of 20,000,000 cycles.
6. Swinging Security Door Assembly, Doors and Frames, ASTM F 476: Grade 40.
7. Salt Spray, Exterior Doors and Frames, ASTM B 117: Minimum of 500 hours.
8. Sound Transmission, Exterior Doors, STC, ASTM E 90: Minimum of 25.
9. Thermal Transmission, Exterior Doors, U-Value, AAMA 1503-98: Maximum of 0.29 BTU/hr x sf x degrees F. Minimum of 55 CRF value.
10. Surface Burning Characteristics, FRP Doors and Panels, ASTM E 84:
 - a. Flame Spread: Maximum of 200, Class C.
 - b. Smoke Developed: Maximum of 450, Class C.
11. Surface Burning Characteristics, Class A Option On Interior Faces of FRP Exterior Panels and Both Faces of FRP Interior Panels, ASTM E 84:
 - a. Flame Spread: Maximum of 25.
 - b. Smoke Developed: Maximum of 450.
12. Impact Strength, FRP Doors and Panels, Nominal Value, ASTM D 256: 15.0 foot-pounds per inch of notch.
13. Tensile Strength, FRP Doors and Panels, Nominal Value, ASTM D 638: 14,000 psi.
14. Flexural Strength, FRP Doors and Panels, Nominal Value, ASTM D 790: 21,000 psi.
15. Water Absorption, FRP Doors and Panels, Nominal Value, ASTM D 570: 0.20 percent after 24 hours.
16. Indentation Hardness, FRP Doors and Panels, Nominal Value, ASTM D 2583: 55.
17. Abrasion Resistance, Face Sheet, Taber Abrasion Test, 25 Cycles at 1,000 Gram Weight with CS-17 Wheel: Maximum of 0.029 average weight loss percentage.
18. Stain Resistance, ASTM D 1308: Face sheet unaffected after exposure to red cabbage, tea, and tomato acid. Stain removed easily with mild abrasive or FRP cleaner when exposed to Sharpie ink pen and white spray paint.
19. Chemical Resistance, ASTM D 543. Excellent rating.
 - a. Acetic acid, 5 percent solution.
 - b. Chlorine bleach, 10 percent solution.
 - c. Sodium hypochlorite, 4 to 6 percent solution.
 - d. Citric acid, 10 percent solution.
 - e. Sodium carbonate, 20 percent solution.



- f. Turpentine.
- 20. Compressive Strength, Foam Core, Nominal Value, ASTM D 1621: 84.2 psi.
- 21. Compressive Modulus, Foam Core, Nominal Value, ASTM D 1621: 448 psi.
- 22. Tensile Adhesion, Foam Core, Nominal Value, ASTM D 1623: 48 psi.
- 23. Thermal and Humid Aging, Nominal Value, 158 Degrees F and 100 Percent Humidity for 14 Days, ASTM D 2126: Minus 4.89 percent volume change.

C. Submittals

- 1. Product Data: Submit manufacturer's product data, including description of materials, components, fabrication, finishes, and installation.
- 2. Shop Drawings: Submit manufacturer's shop drawings, including elevations, sections, and details, indicating dimensions, tolerances, materials, fabrication, doors, panels, framing, hardware schedule, and finish.
- 3. Samples:
 - a. Door: Submit manufacturer's sample of door showing face sheets, core, framing, and finish.
 - b. Color: Submit manufacturer's samples of standard colors of doors and frames.
- 4. Test Reports: Submit certified test reports from qualified independent testing agency indicating doors comply with specified performance requirements.
- 5. Manufacturer's Project References: Submit list of successfully completed projects including project name and location, name of architect, and type and quantity of doors manufactured.
- 6. Maintenance Manual: Submit manufacturer's maintenance and cleaning instructions for doors, including maintenance and operating instructions for hardware.
- 7. Warranty: Submit manufacturer's standard warranty.

D. Quality Assurance

- 1. Manufacturer's Qualifications:
 - a. Continuously engaged in manufacturing of doors of similar type to that specified, with a minimum of 25 years successful experience.
 - b. Door and frame components from same manufacturer.
 - c. Evidence of a compliant documented quality management system.

E. Delivery, Storage, And Handling

- 1. Delivery: Deliver materials to site in manufacturer's original, unopened containers and packaging, with labels clearly identifying opening door mark and manufacturer.
- 2. Storage: Store materials in clean, dry area indoors in accordance with manufacturer's instructions.
- 3. Handling: Protect materials and finish from damage during handling and installation.

F. Warranty

- 1. Warrant doors, frames, and factory hardware against failure in materials and workmanship, including excessive deflection, faulty operation, defects in hardware installation, and deterioration of finish or construction in excess of normal weathering.
- 2. Warranty Period: Ten years starting on date of shipment.

1.2 PRODUCTS

A. Manufacturer: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

- 1. Special-Lite, Inc., PO Box 6, Decatur, Michigan 49045. Toll Free (800) 821-6531. Phone (269) 423-7068. Fax (800) 423-7610. Web Site www.special-lite.com. E-Mail info@special-lite.com.

B. FRP Flush Doors

- 1. Model: SL-17 Flush Doors with SpecLite3 fiberglass reinforced polyester (FRP) face sheets.
- 2. Door Opening Size: As indicated on the Drawings **OR as directed**.

3. Construction:
 - a. Door Thickness: 1-3/4 inches.
 - b. Stiles and Rails: Aluminum Alloy 6063-T5, minimum of 2-5/16-inch depth.
 - c. Corners: Mitered.
 - d. Provide joinery of 3/8-inch diameter full-width tie rods through extruded splines top and bottom as standard tubular shaped stiles and rails reinforced to accept hardware as specified.
 - e. Securing Internal Door Extrusions: 3/16-inch angle blocks and locking hex nuts for joinery. Welds, glue, or other methods are not acceptable.
 - f. Furnish extruded stiles and rails with integral reglets to accept face sheets. Lock face sheets into place to permit flush appearance.
 - g. Rail caps or other face sheet capture methods are not acceptable.
 - h. Extrude top and bottom rail legs for interlocking continuous weather bar.
 - i. Meeting Stiles: Pile brush weatherseals. Extrude meeting stile to include integral pocket to accept pile brush weatherseals.
 - j. Bottom of Door: Install bottom weather bar with nylon brush weatherstripping into extruded interlocking edge of bottom rail.
4. Face Sheet:
 - a. Material: SpecLite3 FRP, 0.120-inch thickness, finish color throughout. Abuse-resistant engineered surface.
 - b. Texture: Pebble.
 - c. Color: **As directed**.
5. Core:
 - a. Material: Poured-in-place polyurethane foam.
 - b. Density: Minimum of 5 pounds per cubic foot.
 - c. R-Value: Minimum of 9.
6. Cutouts:
 - a. Manufacture doors with cutouts for required vision lites, louvers, and panels.
 - b. Factory install vision lites, louvers, and panels.
7. Hardware:
 - a. Premachine doors in accordance with templates from specified hardware manufacturers and hardware schedule.
 - b. Factory install hardware.
- C. Materials
 1. Aluminum Members:
 - a. Extrusions: ASTM B 221.
 - b. Sheet and Plate: ASTM B 209.
 - c. Alloy and Temper: As required by manufacturer for strength, corrosion resistance, application of required finish, and control of color.
 2. Components: Door and frame components from same manufacturer.
 3. Fasteners:
 - a. Material: Aluminum, 18-8 stainless steel, or other noncorrosive metal.
 - b. Compatibility: Compatible with items to be fastened.
 - c. Exposed Fasteners: Screws with finish matching items to be fastened.
- D. Fabrication
 1. Sizes and Profiles: Required sizes for door and frame units, and profile requirements shall be as indicated on the Drawings.
 2. Coordination of Fabrication: Field measure before fabrication and show recorded measurements on shop drawings.
 3. Assembly:
 - a. Complete cutting, fitting, forming, drilling, and grinding of metal before assembly.
 - b. Remove burrs from cut edges.
 4. Welding: Welding of doors or frames is not acceptable.
 5. Fit:



- a. Maintain continuity of line and accurate relation of planes and angles.
- b. Secure attachments and support at mechanical joints with hairline fit at contacting members.

E. Architectural Panels

- 1. FRP Panels:
 - a. Model: SL-37 Architectural Panels with SpecLite3 FRP face sheets.
 - b. Size: As indicated on the Drawings **OR as directed**.
 - c. Thickness: 1/4 inch **OR** 1 inch **OR** As indicated on the Drawings **OR as directed**.
- 2. Face Sheets:
 - a. Material: SpecLite3 FRP, 0.120-inch thickness, finish color throughout. Abuse-resistant engineered surface.
 - b. Texture: Pebble.
 - c. Color: **As directed**.
- 3. Insulated SpecLite3 FRP Panels:
 - a. Insulated Panels: Two 0.120-inch minimum thickness sheets.
 - b. Core: Foamed polyurethane core of a minimum of 5 pounds per cubic foot density.
 - c. Form components to function as single unit.
 - d. U-Value: Minimum of 0.23 for 1-inch panels.
- 4. Class A Flame Spread and Smoke Developed Rating, **as directed**:
 - a. Class A flame spread and smoke developed rating on interior faces of exterior panels and both faces of interior panels.
 - b. Flame Spread, ASTM E 84: Maximum of 25.
 - c. Smoke Developed, ASTM E 84: Maximum of 450.

F. Aluminum Door Framing Systems

- 1. Tubular Framing:
 - a. Size and Type: As indicated on the Drawings.
 - b. Materials: Aluminum Alloy 6063-T5, 1/8-inch minimum wall thickness.
 - c. Applied Door Stops: 0.625-inch high, with screws and weatherstripping. Door stop shall incorporate pressure gasketing for weathering seal. Counterpunch fastener holes in door stop to preserve full metal thickness under fastener head.
 - d. Frame Members: Box type with 4 enclosed sides. Open-back framing is not acceptable.
 - e. Caulking: Caulk joints before assembling frame members.
 - f. Joints:
 - 1) Secure joints with fasteners.
 - 2) Provide hairline butt joint appearance.
 - g. Field Fabrication: Field fabrication of framing using stick material is not acceptable.
 - h. Applied Stops: For side, transom, and borrowed lites and panels. Applied stops shall incorporate pressure gasketing for weathering seal. Reinforce with solid bar stock fill for frame hardware attachments.
 - i. Hardware:
 - 1) Premachine and reinforce frame members for hardware in accordance with manufacturer's standards and hardware schedule.
 - 2) Factory install hardware.
 - j. Anchors:
 - 1) Anchors appropriate for wall conditions to anchor framing to wall materials.
 - 2) Door Jamb and Header Mounting Holes: Maximum of 24-inch centers.
 - 3) Secure head and sill members of transom, side lites, and similar conditions.
 - k. Side Lites:
 - 1) Factory preassemble side lites to greatest extent possible.
 - 2) Mark frame assemblies according to location.
- 2. Insert Framing System:
 - a. Model: SL-1030 Series, SL-1031 **OR** SL-1032 **OR** SL-1034, **as directed**.
 - b. Insert frame as indicated on the Drawings, using integral stop fitted with weatherstripping.

- c. Corner joints of miter design, secure with furnished aluminum clips, and screw into place.
 - d. Hardware:
 - 1) Premachine and reinforce insert frame members for hardware in accordance with manufacturer's standards and hardware schedule.
 - 2) Factory install hardware.
 - e. Anchors:
 - 1) Anchors of suitable type to fasten insert framing to existing frame materials.
 - 2) Minimum of 5 anchors on jambs up to 7'-4" height, 3 anchors on headers, and 1 additional anchor for each additional foot of frame.
 3. Frame Capping:
 - a. Model: SL-70.
 - b. Capping: With insert frame as indicated on the Drawings, **OR as directed**.
 - c. Finish: Match framing.
- G. Hardware
1. Premachine doors in accordance with templates from specified hardware manufacturers and hardware schedule.
 2. Factory install hardware.
 3. Hardware Schedule: As specified in Division 08 Section "Door Hardware" **OR** As indicated on the Drawings, **OR as directed**.
 - a. Hinges shall be continuous type.
 4. Finish: As specified in Division 08 Section "Door Hardware" **OR** As indicated on the Drawings, **OR as directed**.
- H. Vision Lites
1. Factory Glazing: 1/4-inch glass **OR** 1-inch glass insulating units, **as directed**.
 2. Lites in Exterior Doors: Allow for thermal expansion.
 3. Rectangular Lites:
 - a. Size: 12 inches by 12 inches **OR** Half lite **OR** Full lite **OR** Narrow lite **OR** Double lite **OR** As indicated on the Drawings **OR as directed**.
 - b. Factory glazed with screw-applied aluminum stops anodized to match perimeter door rails.
 4. Security Grate: SL-SG349.
 - a. Frame Perimeter: 1-inch by 1-inch by 1/8-inch steel angle.
 - b. Expanded Metal: 1/4-inch diameter, round hole perforated, 14-gauge steel sheet.
 - c. Finish: Factory painted to match door finish.
 5. Vandal Screen: SL-SG350.
 - a. Frame Perimeter: Aluminum. Finish to match vision lite.
 - b. Expanded Metal: 1/4-inch diameter, round hole perforated, 16-gauge stainless steel sheet. Powder coat black finish.
- I. Louvers
1. Type: Aluminum, inverted Y-type, fixed blade, 12 inches minimum from bottom of door.
 2. Size: As indicated on the Drawings **OR** as directed.
 3. Installation: Factory installed into standard vision lite kit. Exterior side of louver shall be free of fasteners.
 4. Insect screen.
- J. Aluminum Finishes
1. Anodized Finish: Class I finish, 0.7 mils thick.
 - a. Clear 215 R1, AA-M10C12C22A41, Class I, 0.7 mils thick.
 - b. Champagne, AA-M10C12C22A44, Class I, 0.7 mils thick.
 - c. Light Bronze, AA-M10C12C22A44, Class I, 0.7 mils thick.
 - d. Medium Bronze, AA-M10C12C22A44, Class I, 0.7 mils thick.
 - e. Dark Bronze, AA-M10C12C22A44, Class I, 0.7 mils thick.
 - f. Black, AA-M10C12C22A44, Class I, 0.7 mils thick.
 2. Painted: as directed by the Owner.



1.3 EXECUTION

A. Preparation

1. Ensure openings to receive frames are plumb, level, square, and in tolerance.

B. Installation

1. Install doors in accordance with manufacturer's instructions.
2. Install doors plumb, level, square, true to line, and without warp or rack.
3. Anchor frames securely in place.
4. Separate aluminum from other metal surfaces with bituminous coatings or other means approved by the Owner.
5. Set thresholds in bed of mastic and backseal.
6. Install exterior doors to be weathertight in closed position.
7. Repair minor damages to finish in accordance with manufacturer's instructions and as approved by the Owner.
8. Remove and replace damaged components that cannot be successfully repaired as determined by the Owner.

C. Field Quality Control

1. Manufacturer's Field Services: Manufacturer's representative shall provide technical assistance and guidance for installation of doors.

D. Adjusting

1. Adjust doors, hinges, and locksets for smooth operation without binding.

E. Cleaning

1. Clean doors promptly after installation in accordance with manufacturer's instructions.
2. Do not use harsh cleaning materials or methods that would damage finish.

F. Protection

1. Protect installed doors to ensure that, except for normal weathering, doors will be without damage or deterioration at time of Final Completion.

END OF SECTION 21 24 00 00



Task	Specification	Specification Description
21 24 16 00	21 24 00 00	Fiberglass Reinforced Polyester (FRP) Flush Doors

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SECTION 21 30 00 00 - ELECTRIC-DRIVE, CENTRIFUGAL FIRE PUMPS

1.1 GENERAL

A. Description Of Work

1. This specification covers the furnishing and installation of materials for electric-drive, centrifugal fire pumps. Products shall be as follows or as directed by the Owner. Installation procedures shall be in accordance with the product manufacturer's recommendations. Demolition and removal of materials shall be as required to support the work.

B. Summary

1. Section Includes:
 - a. End-suction, In-line, and Split-case fire pumps.
 - b. Fire-pump accessories and specialties.
 - c. Flowmeter systems.

C. Performance Requirements

1. Seismic Performance: Fire pumps shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.
 - a. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."
2. Pump Equipment, Accessory, and Specialty Pressure Rating: **175 psig (1200 kPa)** minimum unless higher pressure rating is indicated.

D. Submittals

1. Product Data: For each type of product indicated.
2. Shop Drawings: For fire pumps, motor drivers, and fire-pump accessories and specialties. Include plans, elevations, sections, details, and attachments to other work.
 - a. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
 - b. Wiring Diagrams: For power, signal, and control wiring.
3. Seismic Qualification Certificates: For fire pumps, accessories, and components, from manufacturer.
 - a. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
 - b. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
 - c. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
4. Product Certificates: For each fire pump, from manufacturer.
5. Source quality-control reports.
6. Field quality-control reports.
7. Operation and maintenance data.

E. Quality Assurance

1. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
2. NFPA Compliance: Comply with NFPA 20, "Installation of Stationary Pumps for Fire Protection."

1.2 PRODUCTS

A. General Requirements For Centrifugal Fire Pumps

1. Description: Factory-assembled and -tested fire-pump and driver unit.
2. Base: Fabricated and attached to fire-pump and driver unit with reinforcement to resist movement of pump during seismic events when base is anchored to building substrate.
3. Finish: Red paint applied to factory-assembled and -tested unit before shipping.

B. End-Suction Fire Pumps

1. Pump:
 - a. Standard: UL 448, for end-suction pumps for fire service.
 - b. Casing: Radially split case, cast iron with ASME B16.1 pipe-flange connections.
 - c. Impeller: Cast bronze, statically and dynamically balanced, and keyed to shaft.
 - d. Wear Rings: Replaceable bronze.
 - e. Shaft and Sleeve: Steel shaft with bronze sleeve.
 - 1) Shaft Bearings: Grease-lubricated ball bearings in cast-iron housing.
 - 2) Seals: Stuffing box with minimum of four rings of graphite-impregnated braided yarn and bronze packing gland.
 - f. Mounting: Pump and driver shafts are horizontal, with pump and driver on same base.
2. Coupling: Flexible and capable of absorbing torsional vibration and shaft misalignment. Include metal coupling guard.
3. Driver:
 - a. Standard: UL 1004A.
 - b. Type: Electric motor; NEMA MG 1, polyphase Design B.

C. In-Line Fire Pumps

1. Pump:
 - a. Standard: UL 448, for in-line pumps for fire service.
 - b. Casing: Radially split case, cast iron with ASME B16.1 pipe-flange connections.
 - c. Impeller: Cast bronze, statically and dynamically balanced, and keyed to shaft.
 - d. Wear Rings: Replaceable bronze.
 - e. Shaft and Sleeve: Steel shaft with bronze sleeve.
 - 1) Shaft Bearings: Grease-lubricated ball bearings in cast-iron housing.
 - 2) Seals: Stuffing box with minimum of four rings of graphite-impregnated braided yarn and bronze packing gland.
 - f. Mounting: Pump and driver shaft is vertical, with motor above pump and pump on base.
2. Coupling: None or rigid.
3. Driver:
 - a. Standard: UL 1004A.
 - b. Type: Electric motor; NEMA MG 1, polyphase Design B.

D. Horizontally Mounted, Single-Stage, Split-Case Fire Pumps

1. Pump:
 - a. Standard: UL 448, for split-case pumps for fire service.
 - b. Casing: Axially split case, cast iron with ASME B16.1 pipe-flange connections.
 - c. Impeller: Cast bronze, statically and dynamically balanced, and keyed to shaft.
 - d. Wear Rings: Replaceable bronze.
 - e. Shaft and Sleeve: Steel shaft with bronze sleeve.
 - 1) Shaft Bearings: Grease-lubricated ball bearings in cast-iron housing.
 - 2) Seals: Stuffing box with minimum of four rings of graphite-impregnated braided yarn and bronze packing gland.
 - f. Mounting: Pump and driver shafts are horizontal, with pump and driver on same base.
2. Coupling: Flexible and capable of absorbing torsional vibration and shaft misalignment. Include metal coupling guard.
3. Driver:
 - a. Standard: UL 1004A.
 - b. Type: Electric motor; NEMA MG 1, polyphase Design B.

- E. Horizontally Mounted, Multistage, Split-Case Fire Pumps
1. Pump:
 - a. Standard: UL 448, for split-case pumps for fire service.
 - b. Number of Stages: Two.
 - c. Casing: Axially split case, cast iron with ASME B16.1 pipe-flange connections.
 - d. Impeller: Cast bronze, statically and dynamically balanced, and keyed to shaft.
 - e. Wear Rings: Replaceable bronze.
 - f. Shaft and Sleeve: Steel shaft with bronze sleeve.
 - 1) Shaft Bearings: Grease-lubricated ball bearings in cast-iron housing.
 - 2) Seals: Stuffing box with minimum of four rings of graphite-impregnated braided yarn and bronze packing gland.
 - g. Mounting: Pump and driver shafts are horizontal, with pump and driver on same base.
 2. Coupling: Flexible and capable of absorbing torsional vibration and shaft misalignment. Include metal coupling guard.
 3. Driver:
 - a. Standard: UL 1004A.
 - b. Type: Electric motor; NEMA MG 1, polyphase Design B.
- F. Vertically Mounted, Single-Stage, Split-Case Fire Pumps
1. Pump:
 - a. Standard: UL 448, for split-case pumps for fire service.
 - b. Casing: Axially split case, cast iron with ASME B16.1 pipe-flange connections.
 - c. Impeller: Cast bronze, statically and dynamically balanced, and keyed to shaft.
 - d. Wear Rings: Replaceable bronze.
 - e. Shaft and Sleeve: Steel shaft with bronze sleeve.
 - 1) Shaft Bearings: Grease-lubricated ball bearings in cast-iron housing.
 - 2) Seals: Stuffing box with minimum of four rings of graphite-impregnated braided yarn and bronze packing gland.
 - f. Mounting: Pump and driver shafts are vertical, with motor above pump and pump on base.
 2. Coupling: Flexible and capable of absorbing torsional vibration and shaft misalignment. Include metal coupling guard.
 3. Driver:
 - a. Standard: UL 1004A.
 - b. Type: Electric motor; NEMA MG 1, polyphase Design B.
- G. Fire-Pump Accessories And Specialties
1. Automatic Air-Release Valves: Comply with NFPA 20 for installation in fire-pump casing.
 2. Circulation Relief Valves: UL 1478, brass, spring loaded; for installation in pump discharge piping.
 3. Relief Valves:
 - a. Description: UL 1478, bronze or cast iron, spring loaded; for installation in fire-suppression water-supply piping.
 4. Inlet Fitting: Eccentric tapered reducer at pump suction inlet.
 5. Outlet Fitting: Concentric tapered reducer at pump discharge outlet.
 6. Discharge Cone: Closed **OR** Open, **as directed**, type.
 7. Hose Valve Manifold Assembly:
 - a. Standard: Comply with requirements in NFPA 20.
 - b. Header Pipe: ASTM A 53/A 53M, Schedule 40, galvanized steel with ends threaded according to ASME B1.20.1.
 - c. Header Pipe Fittings: ASME B16.4, galvanized cast-iron threaded fittings.
 - d. Automatic Drain Valve: UL 1726.
 - e. Manifold:
 - 1) Test Connections: Comply with UL 405 except provide outlets without clappers instead of inlets.
 - 2) Body: Flush type, brass or ductile iron, with number of outlets required by NFPA 20.



- 3) Nipples: ASTM A 53/A 53M, Schedule 40, galvanized-steel pipe with ends threaded according to ASME B1.20.1.
 - 4) Adapters and Caps with Chain: Brass or bronze, with outlet threaded according to NFPA 1963 and matching local fire-department threads.
 - 5) Escutcheon Plate: Brass or bronze; rectangular.
 - 6) Hose Valves: UL 668, bronze, with outlet threaded according to NFPA 1963 and matching local fire-department threads.
 - 7) Exposed Parts Finish: Polished **OR** Rough, **as directed**, brass, chrome plated, **as directed**.
 - 8) Escutcheon Plate Marking: Equivalent to "FIRE PUMP TEST."
- OR**
- Manifold:
- 1) Test Connections: Comply with UL 405 except provide outlets without clappers instead of inlets.
 - 2) Body: Exposed type, brass, with number of outlets required by NFPA 20.
 - 3) Escutcheon Plate: Brass or bronze; round.
 - 4) Hose Valves: UL 668, bronze, with outlet threaded according to NFPA 1963 and matching local fire-department threads. Include caps and chains.
 - 5) Exposed Parts Finish: Polished **OR** Rough, **as directed**, brass, chrome plated, **as directed**.
 - 6) Escutcheon Plate Marking: Equivalent to "FIRE PUMP TEST."

H. Flowmeter Systems

1. Description: UL-listed or FM-Approved, fire-pump flowmeter system with capability to indicate flow to not less than 175 percent of fire-pump rated capacity.
 2. Pressure Rating: **175 psig (1200 kPa)** minimum **OR 250 psig (1725 kPa)**, **as directed**.
 3. Sensor: Annubar probe, orifice plate, or venturi unless otherwise indicated. Sensor size shall match pipe, tubing, flowmeter, and fittings.
 4. Permanently Mounted Flowmeter: Compatible with flow sensor; with dial not less than **4-1/2 inches (115 mm)** in diameter. Include bracket or device for wall mounting.
 - a. Tubing Package: **NPS 1/8 or NPS 1/4 (DN 6 or DN 10)** soft copper **OR** plastic, **as directed**, tubing with copper or brass fittings and valves.
- OR**
- Portable Flowmeter: Compatible with flow sensor; with dial not less than **4-1/2 inches (115 mm)** in diameter and with two **12-foot- (3.7-m-)** long hoses in carrying case.

I. Grout

1. Standard: ASTM C 1107, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.
2. Characteristics: Nonshrink and recommended for interior and exterior applications.
3. Design Mix: **5000-psi (34-MPa)**, 28-day compressive strength.
4. Packaging: Premixed and factory packaged.

J. Source Quality Control

1. Testing: Test and inspect fire pumps according to UL 448 requirements for "Operation Test" and "Manufacturing and Production Tests."
 - a. Verification of Performance: Rate fire pumps according to UL 448.
2. Fire pumps will be considered defective if they do not pass tests and inspections.
3. Prepare test and inspection reports.

1.3 EXECUTION

A. Installation

1. Fire-Pump Installation Standard: Comply with NFPA 20 for installation of fire pumps, relief valves, and related components.
 2. Equipment Mounting: Install fire pumps on concrete bases. Comply with requirements for concrete bases specified in Division 03 Section "Cast-in-place Concrete".
 - a. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on **18-inch (450-mm)** centers around the full perimeter of concrete base.
 - b. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.
 - c. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 - d. Install anchor bolts to elevations required for proper attachment to supported equipment.
 3. Install fire-pump suction and discharge piping equal to or larger than sizes required by NFPA 20.
 4. Support piping and pumps separately so weight of piping does not rest on pumps.
 5. Install valves that are same size as connecting piping. Comply with requirements for fire-protection valves specified in Division 21 Section(s) "Fire-suppression Standpipes" OR "Wet-pipe Sprinkler Systems", **as directed**.
 6. Install pressure gages on fire-pump suction and discharge flange pressure-gage tappings. Comply with requirements for pressure gages specified in Division 21 Section(s) "Fire-suppression Standpipes" OR "Wet-pipe Sprinkler Systems", **as directed**.
 7. Install piping hangers and supports, anchors, valves, gages, and equipment supports according to NFPA 20.
 8. Install flowmeters and sensors. Install flowmeter-system components and make connections according to NFPA 20 and manufacturer's written instructions.
 9. Electrical Wiring: Install electrical devices furnished by equipment manufacturers but not factory mounted. Furnish copies of manufacturers' wiring diagram submittals to electrical Installer.
 10. Wiring Method: Conceal conductors and cables in accessible ceilings, walls, and floors where possible.
- B. Alignment
1. Align end-suction and split-case pump and driver shafts after complete unit has been leveled on concrete base, grout has set, and anchor bolts have been tightened.
 2. After alignment is correct, tighten anchor bolts evenly. Fill baseplate completely with grout, with metal blocks and shims or wedges in place. Tighten anchor bolts after grout has hardened. Check alignment and make required corrections.
 3. Align piping connections.
 4. Align pump and driver shafts for angular and parallel alignment according to HI 1.4 and to tolerances specified by manufacturer.
- C. Connections
1. Comply with requirements for piping and valves specified in Division 21 Section(s) "Fire-suppression Standpipes" OR "Wet-pipe Sprinkler Systems", **as directed**. Drawings indicate general arrangement of piping, fittings, and specialties.
 2. Install piping adjacent to pumps and equipment to allow service and maintenance.
 3. Connect relief-valve discharge to drainage piping or point of discharge.
 4. Connect flowmeter-system meters, sensors, and valves to tubing.
 5. Connect fire pumps to their controllers.
- D. Identification
1. Identify system components. Comply with requirements for fire-pump marking according to NFPA 20.
- E. Field Quality Control
1. Test each fire pump with its controller as a unit. Comply with requirements for electric-motor-driver fire-pump controllers specified in Division 21 Section(s) "Electric-drive, Centrifugal Fire Pumps" OR "Diesel-drive, Centrifugal Fire Pumps" OR "Electric-drive, Vertical-turbine Fire Pumps" OR "Diesel-drive, Vertical-turbine Fire Pumps".

2. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.
 3. Perform tests and inspections.
 - a. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.
 4. Tests and Inspections:
 - a. After installing components, assemblies, and equipment including controller, test for compliance with requirements.
 - b. Test according to NFPA 20 for acceptance and performance testing.
 - c. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
 - d. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
 - e. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
 5. Components, assemblies, and equipment will be considered defective if they do not pass tests and inspections.
 6. Prepare test and inspection reports.
 7. Furnish fire hoses in number, size, and length required to reach storm drain or other acceptable location to dispose of fire-pump test water. Hoses are for tests only and do not convey to the Owner.
- F. Demonstration
1. Train the Owner's maintenance personnel to adjust, operate, and maintain fire pumps.

END OF SECTION 21 30 00 00

SECTION 21 30 00 00a - DIESEL-DRIVE, CENTRIFUGAL FIRE PUMPS

1.1 GENERAL

A. Description Of Work

1. This specification covers the furnishing and installation of materials for diesel-drive, centrifugal fire pumps. Products shall be as follows or as directed by the Owner. Installation procedures shall be in accordance with the product manufacturer's recommendations. Demolition and removal of materials shall be as required to support the work.

B. Summary

1. Section Includes:
 - a. End-suction and Split-case fire pumps.
 - b. Fire-pump accessories and specialties.
 - c. Flowmeter systems.

C. Performance Requirements

1. Seismic Performance: Fire pumps shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.
 - a. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."
2. Pump Equipment, Accessory, and Specialty Pressure Rating: **175 psig (1200 kPa)** minimum unless higher pressure rating is indicated.

D. Submittals

1. Product Data: For each type of product indicated. Include rated capacities, operating characteristics, performance curves, electrical characteristics, and furnished specialties and accessories.
2. Shop Drawings: For fire pumps, engine drivers, and fire-pump accessories and specialties. Include plans, elevations, sections, details, and attachments to other work.
 - a. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
 - b. Wiring Diagrams: For power, signal, and control wiring.
3. Seismic Qualification Certificates: For fire pumps, accessories, and components, from manufacturer.
 - a. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
 - b. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
 - c. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
4. Product Certificates: For each fire pump, from manufacturer.
5. Source quality-control reports.
6. Field quality-control reports.
7. Operation and maintenance data.

E. Quality Assurance

1. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
2. NFPA Compliance: Comply with NFPA 20, "Installation of Stationary Pumps for Fire Protection."

1.2 PRODUCTS



- A. General Requirements For Centrifugal Fire Pumps
1. Description: Factory-assembled and -tested fire-pump and driver unit.
 2. Base: Fabricated and attached to fire-pump and driver unit with reinforcement to resist movement of pump during seismic events when base is anchored to building substrate.
 3. Finish: Red paint applied to factory-assembled and -tested unit before shipping.
- B. End-Suction Fire Pumps
1. Pump:
 - a. Standard: UL 448, for end-suction pumps for fire service.
 - b. Casing: Radially split case, cast iron with ASME B16.1 pipe-flange connections.
 - c. Impeller: Cast bronze, statically and dynamically balanced, and keyed to shaft.
 - d. Wear Rings: Replaceable bronze.
 - e. Shaft and Sleeve: Steel shaft with bronze sleeve.
 - 1) Shaft Bearings: Grease-lubricated ball bearings in cast-iron housing.
 - 2) Seals: Stuffing box with minimum of four rings of graphite-impregnated braided yarn and bronze packing gland.
 - f. Mounting: Pump and driver shafts are horizontal, with pump and driver on same base.
 2. Coupling: Flexible and capable of absorbing torsional vibration and shaft misalignment. Include metal coupling guard.
 3. Driver:
 - a. Standard: UL 1247.
 - b. Type: Diesel engine.
 - c. Emergency Manual Operator: Factory wired for starting and operating standby engine in case of malfunction in main controller or wiring.
 - d. Engine Cooling System: Factory-installed radiator.
 - 1) Coolant: Type recommended by driver manufacturer.

OR

Engine Cooling System: Factory-installed water piping, valves, strainer, pressure regulator, heat exchanger, coolant pump, bypass piping, and fittings.
 - 1) Piping: **ASTM B 88, Type L (ASTM B 88M, Type B)**, copper water tube; ASME B16.22, wrought-copper, solder-joint pressure fittings; AWS A5.8/A5.8M, BCuP Series brazing filler metal; and brazed joints.
 - e. Engine-Jacket Water Heater: Factory-installed electric elements.
 - f. Dual Batteries: Lead-acid-storage type with 100 percent standby reserve capacity.
 - g. Fuel System: Comply with NFPA 20.
 - 1) Fuel Storage Tank: Size indicated but not less than required by NFPA 20. Include floor legs, direct-reading level gage, and secondary containment tank with capacity at least equal to fuel storage tank.
 - h. Exhaust System: ASTM A 53/A 53M, Type E or S, Schedule 40, black steel pipe; ASME B16.9, weld-type pipe fittings; ASME B16.5, steel flanges; and ASME B16.21, nonmetallic gaskets. Fabricate double-wall, ventilated thimble from steel pipe.
 - 1) Exhaust Connector: Flexible type.
 - 2) Exhaust Silencer: Industrial **OR** Residential, **as directed**, type.
- C. Single-Stage, Split-Case Fire Pumps
1. Pump:
 - a. Standard: UL 448, for split-case pumps for fire service.
 - b. Casing: Axially split case, cast iron with ASME B16.1 pipe-flange connections.
 - c. Impeller: Cast bronze, statically and dynamically balanced, and keyed to shaft.
 - d. Wear Rings: Replaceable bronze.
 - e. Shaft and Sleeve: Steel shaft with bronze sleeve.
 - 1) Shaft Bearings: Grease-lubricated ball bearings in cast-iron housing.
 - 2) Seals: Stuffing box with minimum of four rings of graphite-impregnated braided yarn and bronze packing gland.
 - f. Mounting: Pump and driver shafts are horizontal, with pump and driver on same base.

2. Coupling: Flexible and capable of absorbing torsional vibration and shaft misalignment. Include metal coupling guard.
 3. Driver:
 - a. Standard: UL 1247.
 - b. Type: Diesel engine.
 - c. Emergency Manual Operator: Factory wired for starting and operating standby engine in case of malfunction in main controller or wiring.
 - d. Engine Cooling System: Factory-installed radiator.
 - 1) Coolant: Type recommended by driver manufacturer.

OR

Engine Cooling System: Factory-installed water piping, valves, strainer, pressure regulator, heat exchanger, coolant pump, bypass piping, and fittings.
 - 1) Piping: **ASTM B 88, Type L** (**ASTM B 88M, Type B**), copper water tube; ASME B16.22, wrought-copper, solder-joint pressure fittings; AWS A5.8/A5.8M, BCuP Series brazing filler metal; and brazed joints.
 - e. Engine-Jacket Water Heater: Factory-installed electric elements.
 - f. Dual Batteries: Lead-acid-storage type with 100 percent standby reserve capacity.
 - g. Fuel System: Comply with NFPA 20.
 - 1) Fuel Storage Tank: Size indicated but not less than required by NFPA 20. Include floor legs, direct-reading level gage, and secondary containment tank with capacity at least equal to fuel storage tank.
 - h. Exhaust System: ASTM A 53/A 53M, Type E or S, Schedule 40, black steel pipe; ASME B16.9, weld-type pipe fittings; ASME B16.5, steel flanges; and ASME B16.21, nonmetallic gaskets. Fabricate double-wall, ventilated thimble from steel pipe.
 - 1) Exhaust Connector: Flexible type.
 - 2) Exhaust Silencer: Industrial **OR** Residential, **as directed**, type.
- D. Multistage, Split-Case Fire Pumps
1. Pump:
 - a. Standard: UL 448, for split-case pumps for fire service.
 - b. Number Stages: Two.
 - c. Casing: Axially split case, cast iron with ASME B16.1 pipe-flange connections.
 - d. Impeller: Cast bronze, statically and dynamically balanced, and keyed to shaft.
 - e. Wear Rings: Replaceable bronze.
 - f. Shaft and Sleeve: Steel shaft with bronze sleeve.
 - 1) Shaft Bearings: Grease-lubricated ball bearings in cast-iron housing.
 - 2) Seals: Stuffing box with minimum of four rings of graphite-impregnated braided yarn and bronze packing gland.
 - g. Mounting: Pump and driver shafts are horizontal, with pump and driver on same base.
 2. Coupling: Flexible and capable of absorbing torsional vibration and shaft misalignment. Include metal coupling guard.
 3. Driver:
 - a. Standard: UL 1247.
 - b. Type: Diesel engine.
 - c. Emergency Manual Operator: Factory wired for starting and operating standby engine in case of malfunction in main controller or wiring.
 - d. Engine Cooling System: Factory-installed radiator.
 - 1) Coolant: Type recommended by driver manufacturer.

OR

Engine Cooling System: Factory-installed water piping, valves, strainer, pressure regulator, heat exchanger, coolant pump, bypass piping, and fittings.
 - 1) Piping: **ASTM B 88, Type L** (**ASTM B 88M, Type B**), copper water tube; ASME B16.22, wrought-copper, solder-joint pressure fittings; AWS A5.8/A5.8M, BCuP Series brazing filler metal; and brazed joints.
 - e. Engine-Jacket Water Heater: Factory-installed electric elements.
 - f. Dual Batteries: Lead-acid-storage type with 100 percent standby reserve capacity.



- g. Fuel System: Comply with NFPA 20.
 - 1) Fuel Storage Tank: Size indicated but not less than required by NFPA 20. Include floor legs, direct-reading level gage, and secondary containment tank with capacity at least equal to fuel storage tank.
 - h. Exhaust System: ASTM A 53/A 53M, Type E or S, Schedule 40, black steel pipe; ASME B16.9, weld-type pipe fittings; ASME B16.5, steel flanges; and ASME B16.21, nonmetallic gaskets. Fabricate double-wall, ventilated thimble from steel pipe.
 - 1) Exhaust Connector: Flexible type.
 - 2) Exhaust Silencer: Industrial **OR** Residential, **as directed**, type.
- E. Fire-Pump Accessories And Specialties
- 1. Automatic Air-Release Valves: Comply with NFPA 20 for installation in fire-pump casing.
 - 2. Circulation Relief Valves: UL 1478, brass, spring loaded; for installation in pump discharge piping.
 - 3. Relief Valves:
 - a. Description: UL 1478, bronze or cast iron, spring loaded; for installation in fire-suppression water-supply piping.
 - 4. Inlet Fitting: Eccentric tapered reducer at pump suction inlet.
 - 5. Outlet Fitting: Concentric tapered reducer at pump discharge outlet.
 - 6. Discharge Cone: Closed **OR** Open, **as directed**, type.
 - 7. Hose Valve Manifold Assembly:
 - a. Standard: Comply with requirements in NFPA 20.
 - b. Header Pipe: ASTM A 53/A 53M, Schedule 40, galvanized steel with ends threaded according to ASME B1.20.1.
 - c. Header Pipe Fittings: ASME B16.4, galvanized cast-iron threaded fittings.
 - d. Automatic Drain Valve: UL 1726.
 - e. Manifold:
 - 1) Test Connections: Comply with UL 405 except provide outlets without clappers instead of inlets.
 - 2) Body: Flush type, brass or ductile iron, with number of outlets required by NFPA 20.
 - 3) Nipples: ASTM A 53/A 53M, Schedule 40, galvanized-steel pipe with ends threaded according to ASME B1.20.1.
 - 4) Adapters and Caps with Chain: Brass or bronze, with outlet threaded according to NFPA 1963 and matching local fire-department threads.
 - 5) Escutcheon Plate: Brass or bronze; rectangular.
 - 6) Hose Valves: UL 668, bronze, with outlet threaded according to NFPA 1963 and matching local fire-department threads.
 - 7) Exposed Parts Finish: Polished **OR** Rough, **as directed**, brass, **as directed**, chrome plated, **as directed**.
 - 8) Escutcheon Plate Marking: Equivalent to "FIRE PUMP TEST."
- OR**
- Manifold:
 - 1) Test Connections: Comply with UL 405 except provide outlets without clappers instead of inlets.
 - 2) Body: Exposed type, brass, with number of outlets required by NFPA 20.
 - 3) Escutcheon Plate: Brass or bronze; round.
 - 4) Hose Valves: UL 668, bronze, with outlet threaded according to NFPA 1963 and matching local fire-department threads. Include caps and chains.
 - 5) Exposed Parts Finish: Polished **OR** Rough, **as directed**, brass, **as directed**, chrome plated, **as directed**.
 - 6) Escutcheon Plate Marking: Equivalent to "FIRE PUMP TEST."
- F. Flowmeter Systems
- 1. Description: UL-listed or FM-Approved, fire-pump flowmeter system with capability to indicate flow to not less than 175 percent of fire-pump rated capacity.

2. Pressure Rating: **175 psig (1200 kPa)** minimum **OR 250 psig (1725 kPa), as directed.**
3. Sensor: Annubar probe, orifice plate, or venturi unless otherwise indicated. Sensor size shall match pipe, tubing, flowmeter, and fittings.
4. Permanently Mounted Flowmeter: Compatible with flow sensor; with dial not less than **4-1/2 inches (115 mm)** in diameter. Include bracket or device for wall mounting.
 - a. Tubing Package: **NPS 1/8 or NPS 1/4 (DN 6 or DN 10)** soft copper **OR** plastic, **as directed**, tubing with copper or brass fittings and valves.
- OR**
- Portable Flowmeter: Compatible with flow sensor; with dial not less than **4-1/2 inches (115 mm)** in diameter and with two **12-foot- (3.7-m-)** long hoses in carrying case.

G. Grout

1. Standard: ASTM C 1107, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.
2. Characteristics: Nonshrink and recommended for interior and exterior applications.
3. Design Mix: **5000-psi (34-MPa)**, 28-day compressive strength.
4. Packaging: Premixed and factory packaged.

H. Source Quality Control

1. Testing: Test and inspect fire pumps according to UL 448 requirements for "Operation Test" and "Manufacturing and Production Tests."
 - a. Verification of Performance: Rate fire pumps according to UL 448.
2. Fire pumps will be considered defective if they do not pass tests and inspections.
3. Prepare test and inspection reports.

1.3 EXECUTION

A. Installation

1. Fire-Pump Installation Standard: Comply with NFPA 20 for installation of fire pumps, relief valves, and related components.
2. Equipment Mounting: Install fire pumps on concrete bases. Comply with requirements for concrete bases specified in Division 03 Section "Cast-in-place Concrete".
 - a. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on **18-inch (450-mm)** centers around the full perimeter of concrete base.
 - b. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.
 - c. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 - d. Install anchor bolts to elevations required for proper attachment to supported equipment.
3. Install fire-pump suction and discharge piping equal to or larger than sizes required by NFPA 20.
4. Support piping and pumps separately so weight of piping does not rest on pumps.
5. Install valves that are same size as connecting piping. Comply with requirements for fire-protection valves specified in Division 21 Section(s) "Fire-suppression Standpipes" OR "Wet-pipe Sprinkler Systems", **as directed.**
6. Install pressure gages on fire-pump suction and discharge flange pressure-gage tappings. Comply with requirements for pressure gages specified in Division 21 Section(s) "Fire-suppression Standpipes" OR "Wet-pipe Sprinkler Systems", **as directed.**
7. Install piping hangers and supports, anchors, valves, gages, and equipment supports according to NFPA 20.
8. Install fuel system according to NFPA 20.
9. Install water supply and drain piping for diesel-engine heat exchangers. Extend drain piping from heat exchangers to point of disposal.
10. Install exhaust-system piping for diesel engines. Extend to point of termination outside structure. Install pipe and fittings with welded joints; install components having flanged connections with gasketed joints.



11. Install condensate-drain piping for diesel-engine exhaust system. Extend drain piping from low points of exhaust system to condensate traps and to point of disposal.
 12. Install flowmeters and sensors. Install flowmeter-system components and make connections according to NFPA 20 and manufacturer's written instructions.
 13. Electrical Wiring: Install electrical devices furnished by equipment manufacturers but not factory mounted. Furnish copies of manufacturers' wiring diagram submittals to electrical installer.
 14. Wiring Method: Conceal conductors and cables in accessible ceilings, walls, and floors where possible.
- B. Alignment
1. Align end-suction and split-case pump and driver shafts after complete unit has been leveled on concrete base, grout has set, and anchor bolts have been tightened.
 2. After alignment is correct, tighten anchor bolts evenly. Fill baseplate completely with grout, with metal blocks and shims or wedges in place. Tighten anchor bolts after grout has hardened. Check alignment and make required corrections.
 3. Align piping connections.
 4. Align pump and driver shafts for angular and parallel alignment according to HI 1.4 and to tolerances specified by manufacturer.
- C. Connections
1. Comply with requirements for piping and valves specified in Division 21 Section(s) "Fire-suppression Standpipes" OR "Wet-pipe Sprinkler Systems", **as directed**. Drawings indicate general arrangement of piping, fittings, and specialties.
 2. Install piping adjacent to pumps and equipment to allow service and maintenance.
 3. Connect relief-valve discharge to drainage piping or point of discharge.
 4. Connect flowmeter-system meters, sensors, and valves to tubing.
 5. Connect fire pumps to their controllers.
- D. Identification
1. Identify system components. Comply with requirements for fire-pump marking according to NFPA 20.
- E. Field Quality Control
1. Test each fire pump with its controller as a unit. Comply with requirements for diesel-engine-driver fire-pump controllers specified in Division 21 Section(s) "Electric-drive, Centrifugal Fire Pumps" OR "Diesel-drive, Centrifugal Fire Pumps" OR "Electric-drive, Vertical-turbine Fire Pumps" OR "Diesel-drive, Vertical-turbine Fire Pumps".
 2. Perform tests and inspections.
 - a. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.
 3. Tests and Inspections:
 - a. After installing components, assemblies, and equipment including controller, test for compliance with requirements.
 - b. Test according to NFPA 20 for acceptance and performance testing.
 - c. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
 - d. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
 - e. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
 4. Components, assemblies, and equipment will be considered defective if they do not pass tests and inspections.
 5. Prepare test and inspection reports.

6. Furnish fire hoses in number, size, and length required to reach storm drain or other acceptable location to dispose of fire-pump test water. Hoses are for tests only and do not convey to the Owner.
- F. Startup Service
 1. Perform startup service.
 - a. Complete installation and startup checks according to manufacturer's written instructions.
- G. Demonstration
 1. Train the Owner's maintenance personnel to adjust, operate, and maintain fire pumps.

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SECTION 21 31 13 00 - PRESSURE-MAINTENANCE PUMPS

1.1 GENERAL

A. Description Of Work

1. This specification covers the furnishing and installation of materials for pressure-maintenance pumps. Products shall be as follows or as directed by the Owner. Installation procedures shall be in accordance with the product manufacturer's recommendations. Demolition and removal of materials shall be as required to support the work.

B. Summary

1. Section Includes:
 - a. Multistage, pressure-maintenance pumps.
 - b. Regenerative-turbine, pressure-maintenance pumps.
 - c. Submersible, pressure-maintenance pumps.
 - d. Vertical-turbine, pressure-maintenance pumps.

C. Performance Requirements

1. Pump Equipment, Accessory, and Specialty Pressure Rating: **175 psig (1200 kPa)** minimum unless higher pressure rating is indicated.

D. Submittals

1. Product Data: For each type of product indicated. Include rated capacities, operating characteristics, performance curves, electrical characteristics, and furnished specialties and accessories.
2. Shop Drawings: For pumps, accessories, and specialties. Include plans, elevations, sections, details, and attachments to other work.
 - a. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
 - b. Wiring Diagrams: For power, signal, and control wiring.
3. Field quality-control reports.
4. Operation and maintenance data.

E. Quality Assurance

1. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

1.2 PRODUCTS

A. Multistage, Pressure-Maintenance Pumps

1. Description: Factory-assembled and -tested, multistage, barrel-type vertical pump as defined in HI 2.1-2.2 and HI 2.3; designed for surface installation with pump and motor direct coupled and mounted vertically.
2. Pump Construction:
 - a. Barrel: Stainless steel.
 - b. Suction and Discharge Chamber: Cast iron with flanged inlet and outlet.
 - c. Pump Head/Motor Mount: Cast iron.
 - d. Impellers: Stainless steel, balanced, and keyed to shaft.
 - e. Pump Shaft: Stainless steel.
 - f. Seal: Mechanical type with carbon rotating face and silicon-carbide stationary seat.
 - g. Intermediate Chamber Bearings: Aluminum-oxide ceramic or bronze.
 - h. Chamber-Base Bearing: Tungsten carbide.
 - i. O-Rings: EPDM or NBR.



3. Motor: Single speed with permanently lubricated ball bearings and rigidly mounted to pump head. Comply with requirements in Division 15 Section "Common Motor Requirements for Fire Suppression Equipment."
 - a. Power Cord: Factory-connected to motor for field connection to controller and at least **10 feet (3 m)** long.
 4. Nameplate: Permanently attached to pump and indicating capacity and characteristics.
- B. Regenerative-Turbine, Pressure-Maintenance Pumps
1. Description: Factory-assembled and -tested, close-coupled, single-stage, regenerative-turbine centrifugal pump as defined in HI 1.1-1.2 and HI 1.3; with pump and motor mounted horizontally.
 2. Pump Construction:
 - a. Casing: Radially split, cast iron, with threaded inlet and outlet.
 - b. Impeller: Bronze, balanced, and keyed to shaft.
 - c. Pump Shaft: Stainless steel **OR** steel, **as directed**, with deflector.
 - d. Shaft Sleeve: Bronze.
 - e. Seal: Mechanical type with spring-loaded rotating head.
 3. Motor: Single speed with permanently lubricated ball bearings. Comply with requirements in Division 15 Section "Common Motor Requirements for Fire Suppression Equipment."
 - a. Power Cord: Factory-connected to motor for field connection to controller and at least **10 feet (3 m)** long.
 4. Nameplate: Permanently attached to pump and indicating capacity and characteristics.
- C. Submersible, Pressure-Maintenance Pumps
1. Description: Factory-assembled and -tested, vertical, multistage, submersible pump as defined in HI 2.1-2.2 and HI 2.3; with pump motor mounted below pump.
 2. Pump Construction:
 - a. Pump Head or Elbow: Cast iron, for surface discharge, with flanged or threaded connections.
 - b. Pump Shaft: Stainless steel.
 - c. Bearings: Bronze.
 - d. Bowl Section: Multiple cast-iron bowls with closed-type bronze or stainless-steel impellers.
 - e. Column Pipe: ASTM A 53/A 53M, Schedule 40, galvanized-steel pipe with threaded ends and cast-iron or steel fittings, in sections **10 feet (3 m)** or less, with strainer of cast or fabricated bronze or stainless steel between pump and bowl section.
 3. Motor: Single speed with permanently lubricated ball bearings and capable of continuous operation under water. Comply with requirements in Division 15 Section "Common Motor Requirements for Fire Suppression Equipment."
 - a. Power Cord: Capable of continuous under-water operation, factory-connected to motor for field connection to controller, and at least **10 feet (3 m)** long.
 4. Base: Cast iron or steel with hole for electrical cable.
 5. Nameplate: Permanently attached to pump and indicating capacity and characteristics.
- D. Vertical-Turbine, Pressure-Maintenance Pumps
1. Description: Factory-assembled and -tested, vertical, multistage, open-line-shaft turbine pump as defined in HI 2.1-2.2 and HI 2.3; with pump motor mounted above pump head.
 2. Pump Construction:
 - a. Pump Head: Cast iron, for surface discharge, with flange except connections may be threaded in sizes in which flanges are not available.
 - b. Pump Head Seal: Stuffing box and stuffing.
 - c. For static water levels of 50 feet (15 m) or less and for water-lubricated bearings.
 - 1) Line Shaft: Stainless steel or steel, with corrosion-resistant shaft sleeves.
 - 2) Line Shaft Bearings: Rubber sleeve, water lubricated.
 - d. For static water levels between 50 and 200 feet (15 and 61 m) and for oil-lubricated bearings.
 - 1) Line Shaft: Steel.

- 2) Line Shaft Bearings: Corrosion resistant, oil lubricated.
 - e. Impeller Shaft: Monel metal or stainless steel.
 - f. Bowl Section: Multiple cast-iron bowls with closed-type bronze or stainless-steel impellers.
 - g. Column Pipe: ASTM A 53/A 53M, Schedule 40, galvanized-steel pipe with threaded ends and cast-iron or steel fittings, in sections 10 feet (3 m) or less, with strainer of cast or fabricated bronze or stainless steel at bottom.
 3. Motor: Single speed with permanently lubricated ball bearings. Comply with requirements in Division 15 Section "Common Motor Requirements for Fire Suppression Equipment."
 - a. Power Cord: Factory-connected to motor for field connection to controller and at least 10 feet (3 m) long.
 4. Base: Cast iron or steel with hole for electrical cable.
 5. Nameplate: Permanently attached to pump and indicating capacity and characteristics.
- E. Motors
 1. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in Division 15 Section "Common Motor Requirements for Fire Suppression Equipment."
 - a. Motor Sizes: Minimum size as indicated; if not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.
 - b. Electrical Devices, and Wiring: Comply with requirements for electrical devices and connections specified in Division 16 Sections.

1.3 EXECUTION

- A. Equipment Installation
 1. NFPA Standard: Comply with NFPA 20 for installation of pressure-maintenance pumps.
 2. Base-Mounted Pump Mounting: Install pumps on concrete bases. Comply with requirements for concrete bases specified in Division 3 Section "Cast-in-Place Concrete."
 - a. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch (450-mm) centers around the full perimeter of concrete base.
 - b. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.
 - c. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 - d. Install anchor bolts to elevations required for proper attachment to supported equipment.
 - e. Attach pumps to equipment base using anchor bolts.
 3. Install multistage and regenerative-turbine, pressure-maintenance pumps according to HI 1.4.
 4. Install submersible and vertical-turbine, pressure-maintenance pumps according to HI 2.4.
- B. Field Quality Control
 1. Perform tests and inspections.
 - a. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.
 2. Tests and Inspections:
 - a. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
 - b. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
 3. Pressure-maintenance pumps will be considered defective if they do not pass tests and inspections.
 4. Prepare test and inspection reports.
- C. Adjusting
 1. Lubricate pumps as recommended by manufacturer.



2. Set field-adjustable pressure-switch ranges as indicated.

END OF SECTION 21 31 13 00

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SECTION 21 31 13 00a - CONTROLLERS FOR FIRE-PUMP DRIVERS

1.1 GENERAL

A. Description Of Work

1. This specification covers the furnishing and installation of materials for controllers for fire-pump drivers. Products shall be as follows or as directed by the Owner. Installation procedures shall be in accordance with the product manufacturer's recommendations. Demolition and removal of materials shall be as required to support the work.

B. Summary

1. Section Includes:
 - a. Full-service, full-voltage **OR** reduced-voltage, **as directed**, controllers rated 600 V and less.
 - b. Limited-service controllers rated 600 V and less.
 - c. Controllers for diesel-drive fire pumps.
 - d. Remote alarm panels.
 - e. Low-suction-shutdown panels.

C. Definitions

1. ATS: Automatic transfer switch(es).
2. ECM: Electronic control module.
3. MCCB: Molded-case circuit breaker.
4. N.O.: Normally open.

D. Performance Requirements

1. Seismic Performance: Fire-pump controllers and alarm panels shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.
 - a. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."

E. Submittals

1. Product Data: For each type of product indicated. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
2. Shop Drawings: For each type of product indicated. Include dimensioned plans, elevations, sections, details, and attachments to other work, including required clearances and service spaces around controller enclosures.
 - a. Show tabulations of the following:
 - 1) Each installed unit's type and details.
 - 2) Enclosure types and details for types other than NEMA 250, Type 2.
 - 3) Factory-installed devices.
 - 4) Nameplate legends.
 - 5) Short-circuit current (withstand) rating of integrated unit.
 - 6) Features, characteristics, ratings, and factory settings of individual overcurrent protective devices.
 - 7) Specified modifications.
 - b. Detail equipment assemblies and indicate dimensions, weights, loads, method of field assembly, components, and location and size of each field connection.
 - c. Schematic and Connection Diagrams: For power, signal, alarm, and control wiring and for pressure-sensing tubing.
3. Qualification Data: For qualified testing agency.
4. Seismic Qualification Certificates: For each type of product indicated, from manufacturer.



- a. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
 - b. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
 - c. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
5. Product Certificates: For each type of product indicated, from manufacturer.
 6. Manufacturer's factory test reports of fully assembled and tested equipment.
 7. Source quality-control reports.
 8. Field quality-control reports.
 9. Operation and Maintenance Data: For each type of product indicated to include in emergency, operation, and maintenance manuals. Include the following:
 - a. Manufacturer's written instructions for setting field-adjustable timers, controls, and status and alarm points.
 - b. Manufacturer's written instructions for testing, adjusting, and reprogramming microprocessor-based logic controls.
- F. Quality Assurance
1. Testing Agency Qualifications: Member company of an NRTL.
 2. Source Limitations: Obtain fire-pump controllers and all associated equipment from single source or producer.
 3. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
 4. Comply with standards of authorities having jurisdiction pertaining to materials and installation.
 5. Comply with NFPA 20 and NFPA 70.
 6. IEEE Compliance: Fabricate and test enclosed controllers according to IEEE 344 to withstand seismic forces defined in Division 16 Section "Vibration and Seismic Controls for Electrical Systems."
- G. Delivery, Storage, And Handling
1. Store controllers indoors in clean, dry space with uniform temperature to prevent condensation. Protect enclosed controllers from exposure to dirt, fumes, water, corrosive substances, and physical damage.
 2. If stored in areas subject to weather, protect controllers from weather, dirt, dust, corrosive substances, and physical damage. Remove loose packing and flammable materials from inside controllers; install temporary electric heating, with at least 250 W per controller **OR** connect factory-installed space heaters to temporary electrical service, **as directed**.
- H. Project Conditions
1. Environmental Limitations:
 - a. Ambient Temperature Rating: Not less than **40 deg F (5 deg C)** and not exceeding **122 deg F (50 deg C)** unless otherwise indicated.
 - b. Altitude Rating: Not exceeding **6600 feet (2010 m)** unless otherwise indicated.
 2. Interruption of Existing Electric Service: Notify the Owner no fewer than seven days in advance of proposed interruption of electric service, and comply with NFPA 70E.
- I. Coordination
1. Coordinate layout and installation of controllers with other construction including conduit, piping, fire-pump equipment, and adjacent surfaces. Maintain required clearances for workspace and equipment access doors and panels. Ensure that controllers are within sight of fire-pump drivers.
 2. Coordinate sizes and locations of concrete bases with actual equipment provided.

1.2 PRODUCTS

A. Full-Service Controllers

1. General Requirements for Full-Service Controllers:
 - a. Comply with NFPA 20 and UL 218.
 - b. Listed by an NRTL for electric-motor driver for fire-pump service.
 - c. Combined automatic and nonautomatic **OR** Nonautomatic, **as directed**, operation.
 - d. Factory assembled, wired, and tested; continuous-duty rated.
 - e. Service Equipment Label: NRTL labeled for use as service equipment.
2. Method of Starting:
 - a. Pressure **OR** Nonpressure, **as directed**, -switch actuated.
 - 1) Water-pressure-actuated switch and pressure transducer with independent high- and low-calibrated adjustments responsive to water pressure in fire-suppression piping.
 - 2) System pressure recorder, electric ac driven, with spring backup.
 - 3) Programmable minimum-run-time relay to prevent short cycling.
 - 4) Programmable timer for weekly tests.
 - b. Magnetic Controller: Across-the-line **OR** Autotransformer **OR** Part-winding **OR** Primary-resistor **OR** Wye-delta (open transition) **OR** Wye-delta (closed transition), **as directed**, type.
OR
Solid-State Controller: Reduced-voltage type.
 - c. Emergency Start: Mechanically operated start handle that closes and retains the motor RUN contactor independent of all electric or pressure actuators.
3. Method of Stopping: Automatic and nonautomatic shutdown after automatic starting **OR** Nonautomatic, **as directed**.
4. Capacity: Rated for fire-pump-driver horsepower and short-circuit-current (withstand) rating equal to or greater than short-circuit current available at controller location.
5. Method of Isolation and Overcurrent Protection: Interlocked isolating switch and nonthermal MCCB; with a common, externally mounted operating handle, and providing locked-rotor protection.
6. Door-Mounted Operator Interface and Controls:
 - a. Monitor, display, and control the devices, alarms, functions, and operations listed in NFPA 20 as required for drivers and controller types used.
 - b. Method of Control and Indication:
 - 1) Microprocessor-based logic controller, with multiline digital readout.
 - 2) Membrane keypad.
 - 3) LED alarm and status indicating lights.
 - c. Local and Remote, **as directed**, Alarm and Status Indications:
 - 1) Controller power on.
 - 2) Motor running condition.
 - 3) Loss-of-line power.
 - 4) Line-power phase reversal.
 - 5) Line-power single-phase condition.
 - d. Audible alarm, with silence push button.
 - e. Nonautomatic START and STOP push buttons or switches.
7. Optional Features:
 - a. Extra Output Contacts:
 - 1) One N.O. contact(s) for motor running condition.
 - 2) One set(s) of contacts for loss-of-line power.
 - 3) One each, Form C contacts for high and low reservoir level.
 - b. Local alarm bell.
 - c. Door-mounted thermal or impact printer for alarm and status logs.
 - d. Operator Interface Communications Ports: USB, Ethernet, and RS485.
8. ATS:
 - a. Complies with NFPA 20, UL 218, and UL 1008.



- b. Integral with controller as a listed combination fire-pump controller and power transfer switch.
- c. Automatically transfers fire-pump controller from normal power supply to alternate power supply in event of power failure.
- d. Allows manual transfer from one source to the other.
- e. Alternate-Source Isolating and Disconnecting Means: Integral molded-case switch, with an externally mounted operating handle.
OR
Alternate-Source Isolating and Disconnecting Means: Mechanically interlocked isolation switch and circuit breaker rated at a minimum of 115 percent of rated motor full-load current, with an externally mounted operating handle; circuit breaker shall be provided with nonthermal sensing, instantaneous-only short-circuit overcurrent protection to comply with available fault currents.
- f. Local and Remote, **as directed**, Alarm and Status Indications:
 - 1) Normal source available.
 - 2) Alternate source available.
 - 3) In normal position.
 - 4) In alternate position.
 - 5) Isolating means open.
- g. Audible alarm, with silence push button.
- h. Nonautomatic (manual, nonelectric) means of transfer.
- i. Engine test push button.
- j. Start generator output contacts.
- k. Timer for weekly generator tests.

B. Limited-Service Controllers

1. General Requirements for Limited-Service Controllers:
 - a. Comply with NFPA 20 and UL 218.
 - b. Listed by an NRTL for electric-motor driver for fire-pump service.
 - c. Combined automatic and nonautomatic **OR** Nonautomatic, **as directed**, operation.
 - d. Factory assembled, wired, and tested; continuous-duty rated.
 - e. Service Equipment Label: NRTL labeled for use as service equipment.
2. Method of Starting:
 - a. Pressure **OR** Nonpressure, **as directed**, -switch actuated.
 - 1) Water-pressure-actuated switch and pressure transducer with independent high- and low-calibrated adjustments responsive to water pressure in fire-suppression piping.
 - 2) System pressure recorder, electric ac driven, with spring backup.
 - 3) Programmable minimum-run-time relay to prevent short cycling.
 - 4) Programmable timer for weekly tests.
 - b. Across-the-line magnetic controller.
 - c. Emergency Start: Mechanically operated start handle that closes and retains the motor RUN contactor independent of all electric or pressure actuators.
3. Method of Stopping: Automatic and nonautomatic shutdown after automatic starting **OR** Nonautomatic, **as directed**.
4. Capacity: Rated for fire-pump-driver horsepower and short-circuit-current (withstand) rating equal to or greater than short-circuit current available at controller location.
5. Method of Isolation and Overcurrent Protection: Inverse-time, nonadjustable MCCB, with an externally mounted operating handle.
6. Door-Mounted Operator Interface and Controls:
 - a. Monitor, display, and control the devices, alarms, functions, and operations listed in NFPA 20 as required for drivers and controller types used.
 - b. Method of Control and Indication:
 - 1) Microprocessor-based logic controller, with multiline LCD digital readout.
 - 2) Membrane keypad.

- 3) LED alarm and status indicating lights.
- c. Local and Remote, **as directed** Alarm and Status Indications:
 - 1) Controller power on.
 - 2) Motor running condition.
 - 3) Loss-of-line power.
 - 4) Line-power phase reversal.
 - 5) Line-power single-phase condition.
- d. Audible alarm, with silence push button.
- e. Nonautomatic START and STOP push buttons.
7. Optional Features:
 - a. Extra Output Contacts:
 - 1) One N.O. contact(s) for motor running condition.
 - 2) One set(s) of contacts for loss-of-line power.
 - 3) One each, Form C contacts for high and low reservoir level.
 - b. Local alarm bell.
 - c. Door-mounted thermal or impact printer for alarm and status logs.
 - d. Operator Interface Communications Ports: USB, Ethernet, and RS485.
8. ATS:
 - a. Complies with NFPA 20, UL 218, and UL 1008.
 - b. Integral with controller as a listed combination fire-pump controller and power transfer switch.
 - c. Automatically transfers fire-pump controller from normal power supply to alternate power supply in event of power failure.
 - d. Allows manual transfer from one source to the other.
 - e. Alternate-Source Isolating and Disconnecting Means: Integral molded-case switch, with an externally mounted operating handle.
OR
 Alternate-Source Isolating and Disconnecting Means: Mechanically interlocked isolation switch and circuit breaker rated at a minimum of 115 percent of rated motor full-load current, with an externally mounted operating handle; circuit breaker shall be provided with nonthermal sensing, instantaneous-only short-circuit overcurrent protection to comply with available fault currents.
 - f. Local and Remote, **as directed**, Alarm and Status Indications:
 - 1) Normal source available.
 - 2) Alternate source available.
 - 3) In normal position.
 - 4) In alternate position.
 - 5) Isolating means open.
 - g. Audible alarm, with silence push button.
 - h. Nonautomatic (manual, nonelectric) means of transfer.
 - i. Engine test push button.
 - j. Start generator output contacts.
 - k. Timer for weekly generator tests.
- C. Standalone ATS
 1. General Requirements for Standalone ATS:
 - a. Complies with NFPA 20, UL 218, and UL 1008.
 - b. Listed by an NRTL for fire-pump service.
 - c. Automatic and nonautomatic operation.
 - d. Separate from controller and individually listed as a fire-pump-controller power transfer switch.
 - e. Automatically transfers fire-pump controller from normal power supply to alternate power supply in event of power failure.
 - f. Allows manual transfer from one source to the other; factory assembled, wired, and tested.
 2. Capacity: Rated for fire-pump-driver horsepower and short-circuit-current (withstand) rating equal to or greater than short-circuit current available at ATS location.

3. Alternate-Source Isolating and Disconnecting Means: Integral molded-case switch, with an externally mounted operating handle.
 4. Alternate-Source Isolating and Disconnecting Means:
 - a. Mechanically interlocked isolation switch and circuit breaker rated at a minimum of 115 percent of rated motor full-load current.
 - b. Externally mounted operating handle.
 - c. Circuit breaker provided with nonthermal sensing, instantaneous-only, short-circuit overcurrent protection.
 - d. Equipped with a voltage surge arrester.
 5. Door-Mounted Operator Interface and Controls:
 - a. Monitor, display, and control devices, alarms, functions, and operations listed in NFPA 20 as required for drivers and controller types used.
 - b. Method of Control and Indication:
 - 1) Microprocessor-based logic controller, with multiline LCD readout.
 - 2) Membrane keypad.
 - 3) LED alarm and status indicating lights.
 - c. Local and Remote, **as directed**, Alarm and Status Indications:
 - 1) Normal source available.
 - 2) Alternate source available.
 - 3) In normal position.
 - 4) In alternate position.
 - 5) Isolating means open.
 - d. Audible alarm, with silence push button.
 - e. Nonautomatic (manual, nonelectric) means of transfer.
 - f. Engine test push button.
 - g. Start generator output contacts.
 - h. Timer for weekly generator tests
 6. Optional Features:
 - a. Extra Output Contacts:
 - 1) One each, Form A; isolating means open.
 - 2) One each, Form C; in normal or alternate position
 - b. Door-mounted thermal or impact printer for alarm and status logs.
 - c. Operator Interface Communications Ports: USB, Ethernet, and RS485.
- D. Controllers For Diesel-Drive Fire Pumps
1. General Requirements for Controllers:
 - a. Comply with NFPA 20 and UL 218.
 - b. Listed by an NRTL for diesel-engine driver for fire-pump service.
 - c. Combined automatic and nonautomatic **OR** Nonautomatic, **as directed** operation.
 - d. Factory assembled, wired, and tested.
 2. Method of Starting:
 - a. Pressure **OR** Nonpressure, **as directed**, -switch actuated.
 - 1) Water-pressure-actuated switch and pressure transducer with independent high- and low-calibrated adjustments responsive to water pressure in fire-suppression piping.
 - 2) System pressure recorder, electric ac driven, with spring backup.
 - 3) Programmable minimum-run-time relay to prevent short cycling.
 - 4) Programmable timer for weekly tests.
 - b. Dual, redundant dc-voltage battery units, with automatic changeover.
 - c. Emergency Control: Bypasses all automatic control circuits during manual starting and running.
 - d. Automatic engine start on loss of ac power to the controller.
 3. Method of Stopping: Automatic and nonautomatic shutdown after automatic starting **OR** Nonautomatic, **as directed**.
 4. Door-Mounted Operator Interface and Controls:

- a. Monitor, display, and control devices, alarms, functions, and operations listed in NFPA 20 as required for drivers and controller types used.
 - b. Method of Control and Indication:
 - 1) Microprocessor-based logic controller, with multiline LCD readout.
 - 2) Membrane keypad.
 - 3) LED alarm and status indicating lights.
 - c. Local and Remote, **as directed**, Alarm and Status Indications:
 - 1) Controller power on.
 - 2) Engine-lubrication-system critically low oil pressure.
 - 3) Engine-jacket coolant high temperature.
 - 4) Engine fail-to-start.
 - 5) Engine overspeed shutdown.
 - 6) Low fuel level.
 - 7) Missing or failed battery.
 - 8) Battery charger failure.
 - 9) System overpressure.
 - 10) ECM selector switch in alternate ECM position.
 - 11) Fuel injector malfunction.
 - d. Audible alarm.
 - e. Nonautomatic START and STOP push buttons or switches.
 5. Optional Features:
 - a. Extra Output Contacts:
 - 1) One Form C contacts for low pump-room temperature.
 - 2) One each, Form C contacts for high and low fuel levels.
 - 3) One each, Form C contacts for high and low reservoir levels.
 - b. Door-mounted thermal or impact printer for alarm and status logs.
 - c. Operator Interface Communications Ports: USB, Ethernet, and RS485.
 - d. Powered louver contacts.
 - e. Powered engine-oil heater contacts.
 6. Battery Charger System:
 - a. Built-in, independent, dual battery chargers with automatic changeover; 12-V dc **OR** 24-V dc, **as directed**, for lead-acid **OR** nickel-cadmium, **as directed**, batteries.
 - b. Standard: UL 1236.
- E. Remote Alarm Panels
1. General Requirements for Remote Alarm Panels: Comply with NFPA 20 and UL 218; listed by an NRTL for fire-pump service.
 2. General Requirements for Remote Alarm Panels: Factory assembled, wired, and tested.
 3. Supervisory and Normal Control Voltage: 120-V ac **OR** 240-V ac, **as directed**; single **OR** dual, **as directed**, source.
 4. Audible and Visual Alarm and Status Indications:
 - a. Driver running.
 - b. Loss of phase.
 - c. Phase reversal.
 - d. Supervised power on.
 - e. Common **OR** Separate, **as directed**, trouble on the controller.
 - f. Controller connected to alternate power source.
 5. Audible and Visual Alarm and Status Indications: Manufacturer's standard indicating lights; push-to-test **OR** non-push-to-test, with separate test push button, **as directed**.
 - a. Engine running.
 - b. Controller main switch turned to the off or manual position.
 - c. Supervised power on.
 - d. Common **OR** Separate, **as directed**, trouble on the controller or engine.
 - e. Common pump room trouble.
 - f. Controller connected to alternate power source.
 6. Audible alarm, with silence push button.



7. Pump REMOTE START push button.

F. Low-Suction-Shutdown Panels

1. General Requirements for Low-Suction-Shutdown Panels:
 - a. Listed by an NRTL for fire-pump service.
 - b. Factory assembled, wired, and tested.
 - c. Prevents automatic start of fire pump, and shuts down automatically started fire pump, on low-suction pressure.
 - d. Automatic **OR** Manual, **as directed**, reset.
2. Operation: External contact input **OR** Integral pressure switch, **as directed**.
3. Supervisory and Normal Control Voltage: 120-V ac **OR** 240-V ac, **as directed**; single **OR** dual, **as directed**, source.
4. Include audible and visual alarms and status indications, with silence push button, for the following conditions:
 - a. Control power available.
 - b. Low-suction pressure.
 - c. Normal-suction pressure.

G. Enclosures

1. Fire-Pump Controllers, ATS, Remote Alarm Panels, and Low-Suction-Shutdown Panels: NEMA 250, to comply with environmental conditions at installed locations and NFPA 20.
 - a. Indoor, Dry and Clean Locations: Type 1 (IEC IP10).
 - b. Indoor Locations Subject to Dripping Noncorrosive Liquids: Type 2 (IEC IP11).
 - c. Outdoor Locations: Type 3R (IEC IP14) **OR** Type 4 (IEC IP56) **OR** Type 4X (IEC IP56), **as directed**.
 - d. Other Wet or Damp, Indoor Locations: Type 4 (IEC IP56) **OR** Type 4X (IEC IP56), **as directed**.
 - e. Indoor Locations Subject to Dust, Falling Dirt, and Dripping Noncorrosive Liquids: Type 12 (IEC IP12).
2. Enclosure Color: Manufacturer's standard "fire-pump-controller red".
3. Nameplates: Comply with NFPA 20; complete with capacity, characteristics, approvals, listings, and other pertinent data.
4. Optional Features:
 - a. Floor stands, 12 inches (305 mm) high, for floor-mounted controllers.
 - b. Space heater, 120-V ac **OR** 240-V ac, **as directed**, with humidistat, **as directed**, with thermostat, **as directed**.
 - c. Tropicalization.

H. Source Quality Control

1. Testing: Test and inspect fire-pump controllers according to requirements in NFPA 20 and UL 218.
 - a. Verification of Performance: Rate controllers according to operation of functions and features specified.
2. Fire-pump controllers will be considered defective if they do not pass tests and inspections.
3. Prepare test and inspection reports.

1.3 EXECUTION

A. Examination

1. Examine areas and surfaces to receive equipment, with Installer present, for compliance with requirements and other conditions affecting performance.
2. Examine equipment before installation. Reject equipment that is wet or damaged by moisture or mold.
3. Proceed with installation only after unsatisfactory conditions have been corrected.

B. Controller Installation

1. Install controllers within sight of their respective drivers.
2. Connect controllers to their dedicated pressure-sensing lines.
3. Wall-Mounting Controllers: Install controllers on walls with disconnect operating handles not higher than **79 inches (2006 mm)** above finished floor, and bottom of enclosure not less than **12 inches (305 mm)** above finished floor unless otherwise indicated. Bolt units to wall or mount on lightweight structural-steel channels bolted to wall. For controllers not on walls, provide freestanding racks complying with Division 16 Section "Hangers and Supports for Electrical Systems."
4. Floor-Mounting Controllers: Install controllers on **4-inch (100-mm)** nominal-thickness concrete bases, using floor stands high enough so that the bottom of enclosure cabinet is not less than **12 inches (305 mm)** above finished floor. Comply with requirements for concrete bases specified in Division 3 Section "Cast-in-Place Concrete."
 - a. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on **18-inch (450-mm)** centers around the full perimeter of concrete base.
 - b. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base, and anchor into structural concrete floor.
 - c. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 - d. Install anchor bolts to elevations required for proper attachment to supported equipment.
5. Seismic Bracing: Comply with requirements specified in Division 16 Section "Vibration and Seismic Controls for Electrical Systems."
6. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from enclosures and components.
7. Comply with NEMA ICS 15.

C. Standalone ATS Installation

1. Wall-Mounting ATS: Install ATS on walls with disconnect operating handles not higher than **79 inches (2006 mm)** above finished floor, and bottom of enclosure not less than **12 inches (305 mm)** above finished floor unless otherwise indicated. Bolt units to wall or mount on lightweight structural-steel channels bolted to wall. For ATS not on walls, provide freestanding racks complying with Division 16 Section "Hangers and Supports for Electrical Systems."
2. Floor-Mounting ATS: Install ATS on **4-inch (100-mm)** nominal-thickness concrete bases, using floor stands high enough so that the bottom of enclosure cabinet is not less than **12 inches (305 mm)** above finished floor. Comply with requirements for concrete bases specified in Division 3 Section "Cast-in-Place Concrete."
 - a. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on **18-inch (450-mm)** centers around the full perimeter of concrete base.
 - b. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base, and anchor into structural concrete floor.
 - c. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 - d. Install anchor bolts to elevations required for proper attachment to supported equipment.
3. Seismic Bracing: Comply with requirements specified in Division 16 Section "Vibration and Seismic Controls for Electrical Systems."
4. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from enclosures and components.

D. Remote Alarm And Low-Suction-Shutdown, **as directed**, Panel Installation

1. Install panels on walls with tops not higher than **72 inches (1829 mm)** above finished floor unless otherwise indicated. Bolt units to wall or mount on lightweight structural-steel channels bolted to wall. For ATS not on walls, provide freestanding racks complying with Division 16 Section "Hangers and Supports for Electrical Systems."

E. Power Wiring Installation



1. Install power wiring between controllers and their services or sources, and between controllers and their drivers. Comply with requirements in NFPA 20, NFPA 70, and Division 16 Section "Conductors and Cables."
 2. Comply with NECA 1.
- F. Control And Alarm Wiring Installation
1. Install wiring between controllers and remote devices and facility's central monitoring system, **as directed**. Comply with requirements in NFPA 20, NFPA 70, and Division 16 Section "Control-Voltage Electrical Power Cables."
 2. Install wiring between remote alarm and low-suction-shutdown, **as directed**, panels and controllers. Comply with requirements in NFPA 20, NFPA 70, and Division 16 Section "Control-Voltage Electrical Power Cables."
 3. Install wiring between controllers and the building's fire-alarm system. Comply with requirements specified in Division 13 Section "Digital, Addressable Fire-Alarm System."
 4. Bundle, train, and support wiring in enclosures.
 5. Connect remote manual and automatic activation devices where applicable.
- G. Identification
1. Comply with requirements in NFPA 20 for marking fire-pump controllers.
 2. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification in NFPA 20 and as specified in Division 16 Section "Electrical Identification."
- H. Field Quality Control
1. Perform tests and inspections.
 2. Acceptance Testing Preparation:
 - a. Inspect and Test Each Component:
 - 1) Inspect wiring, components, connections, and equipment installations. Test and adjust components and equipment.
 - 2) Test insulation resistance for each element, component, connecting supply, feeder, and control circuits.
 - 3) Test continuity of each circuit.
 - b. Verify and Test Each Electric-Driver Controller:
 - 1) Verify that voltages at controller locations are within plus 10 or minus 1 percent of motor nameplate rated voltages, with motors off. If outside this range for any motor, notify the Owner before starting the motor(s).
 - 2) Test each motor for proper phase rotation.
 - c. Operational Test: After electrical circuitry has been energized, start units to confirm proper unit operation.
 - d. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
 3. Field Acceptance Tests:
 - a. Do not begin field acceptance testing until suction piping has been flushed and hydrostatically tested and the certificate for flushing and testing has been submitted to the Owner and authorities having jurisdiction.
 - b. Prior to starting, notify authorities having jurisdiction of the time and place of the acceptance testing.
 - c. Engage manufacturer's factory-authorized service representative to be present during the testing.
 - d. Perform field acceptance tests as outlined in NFPA 20.
 4. Controllers will be considered defective if they do not pass tests and inspections.
 5. Prepare test and inspection reports.
- I. Startup Service
1. Perform startup service.
 - a. Complete installation and startup checks according to manufacturer's written instructions.

- J. Adjusting
 - 1. Adjust controllers and battery charger systems, **as directed**, to function smoothly and as recommended by manufacturer.
 - 2. Set field-adjustable switches, auxiliary relays, time-delay relays, and timers.
 - 3. Program microprocessors for required operational sequences, status indications, alarms, event recording, and display features. Clear events memory after final acceptance testing and prior to Final Completion.
 - 4. Set field-adjustable pressure switches.
- K. Protection
 - 1. Temporary Heating: Apply temporary heat to maintain temperature according to manufacturer's written instructions until enclosed controllers are ready to be energized and placed into service.
 - 2. Replace controllers whose interiors have been exposed to water or other liquids prior to Final Completion.
- L. Demonstration
 - 1. Train the Owner's maintenance personnel to adjust, operate, and maintain controllers, remote alarm panels, **as directed**, low-suction-shutdown panels, **as directed**, and to use and reprogram microprocessor-based controls within this equipment, **as directed**.

END OF SECTION 21 31 13 00a

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Task	Specification	Specification Description
21 31 13 00	21 30 00 00	Electric-Drive, Centrifugal Fire Pumps
21 31 16 00	21 30 00 00a	Diesel-Drive, Centrifugal Fire Pumps
21 31 16 00	21 31 13 00	Pressure-Maintenance Pumps
21 31 16 00	21 31 13 00a	Controllers for Fire-Pump Drivers
21 34 13 00	21 31 13 00	Pressure-Maintenance Pumps
21 34 13 00	21 31 13 00a	Controllers for Fire-Pump Drivers

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SECTION 22 01 40 81 - EMERGENCY PLUMBING FIXTURES

1.1 GENERAL

A. Description Of Work

1. This specification covers the furnishing and installation of materials for emergency plumbing fixtures. Products shall be as follows or as directed by the Owner. Installation procedures shall be in accordance with the products manufacturer's recommendations. Demolition and removal of materials shall be as required to support the work

B. Summary

1. This Section includes the following emergency plumbing fixtures:
 - a. Emergency showers.
 - b. Eyewash equipment.
 - c. Self-contained eyewash equipment.
 - d. Personal eyewash equipment.
 - e. Eye/face wash equipment.
 - f. Hand-held drench hoses.
 - g. Combination units.
 - h. Water-tempering equipment.

C. Definitions

1. Accessible Fixture: Emergency plumbing fixture that can be approached, entered, and used by people with disabilities.
2. Plumbed Emergency Plumbing Fixture: Fixture with fixed, potable-water supply.
3. Self-Contained Emergency Plumbing Fixture: Fixture with flushing-fluid-solution supply.
4. Tepid: Moderately warm.

D. Submittals

1. Product Data: For each type of product indicated. Include flow rates and capacities, furnished specialties, and accessories.
2. Shop Drawings: Diagram power, signal, and control wiring.
3. Operation and maintenance data.

E. Quality Assurance

1. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by testing agency acceptable to authorities having jurisdiction, and marked for intended use.
2. ANSI Standard: Comply with ANSI Z358.1, "Emergency Eyewash and Shower Equipment."
3. Regulatory Requirements: Comply with requirements in ICC A117.1, "Accessible and Usable Buildings and Facilities"; Public Law 90-480, "Architectural Barriers Act"; and Public Law 101-336, "Americans with Disabilities Act"; for plumbing fixtures for people with disabilities.
4. NSF Standard: Comply with NSF 61, "Drinking Water System Components--Health Effects," for fixture materials that will be in contact with potable water.

1.2 PRODUCTS

1.3 PERFORMANCE REQUIREMENTS

- A. Comply with ANSI/ISEA Z358.1 for emergency plumbing fixtures including third-party certification of fixtures.



- B. Comply with ASSE 1071 for temperature-actuated mixing valves for plumbed emergency fixtures.
- C. Comply with ASME A112.18.1/CSA B125.1 for water-supply fittings.
- D. Comply with ASME A112.18.2/CSA B125.2 for plumbing waste fittings.
- E. Comply with NSF 61 and NSF 372 for fixture materials that will be in contact with potable water.
- F. Comply with requirements in ICC A117.1 for plumbing fixtures for people with disabilities.
- G. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- H. Emergency Showers:
 - 1. Description: Plumbed, single-shower-head horizontal, wall-mounting **OR** vertical, ceiling-mounting **OR** freestanding, **as directed**, emergency shower.
 - a. Capacity: Deliver potable water at rate not less than **20 gpm (76 L/min.)** for at least 15 minutes.
 - b. Supply Piping: **NPS 1 (DN 25) OR NPS 1-1/4 (DN 32) OR** galvanized steel **OR** chrome-plated brass or stainless steel **OR** PVC, **as directed**, with flow regulator and stay-open control valve.
 - c. Control-Valve Actuator: Pull rod **OR** chain, **as directed**.
 - d. Shower Head: **8-inch (200-mm)** minimum diameter, chrome-plated brass or stainless steel **OR** plastic, **as directed**.
 - 2. Description: Plumbed, multiple-spray emergency shower with eight **OR** 12 **OR** 16, **as directed**, small shower heads or nozzles.
 - a. Capacity: Deliver potable water at rate not less than **20 gpm (76 L/min.)** for at least 15 minutes.
 - b. Supply Piping: **NPS 1-1/4 (DN 32)** minimum galvanized **OR** chrome-plated brass or stainless, **as directed**, steel with flow regulator and stay-open control valve.
 - c. Control-Valve Actuator: Paddle **OR** Treadle, **as directed**.
 - 3. Description: Plumbed, freeze-protected, freestanding emergency shower.
 - a. Capacity: Deliver potable water at rate not less than **20 gpm (76 L/min.)** for at least 15 minutes.
 - b. Supply Piping: **NPS 1-1/4 (DN 32)** galvanized steel with flow regulator and stay-open control valve.
 - c. Control-Valve Actuator: Pull rod **OR** chain, **as directed**.
 - d. Shower Head: **8-inch (200-mm)** minimum diameter, chrome-plated brass or stainless steel **OR** plastic, **as directed**.
 - e. Heating System: 120 **OR** 240, **as directed**, -V ac electric; and insulation with protective jacket.
- I. Eyewash Equipment
 - 1. Description: Plumbed, freestanding eyewash equipment.
 - a. Capacity: Deliver potable water at rate not less than **0.4 gpm (1.5 L/min.)** for at least 15 minutes.
 - b. Supply Piping: **NPS 1/2 (DN 15)** chrome-plated brass or stainless steel with flow regulator and stay-open control valve.
 - c. Control-Valve Actuator: Paddle **OR** Push bar **OR** Treadle, **as directed**.
 - d. Receptor: Chrome-plated brass or stainless-steel **OR** Plastic, **as directed**, bowl.
 - e. Drain Piping: **NPS 1-1/4 (DN 32)** minimum, chrome-plated brass, receptor drain, P-trap, waste to wall, and wall flange complying with ASME A112.18.2 **OR** Omit drain piping **OR** Include galvanized-steel indirect connection to drainage system, **as directed**.
 - 2. Description: Plumbed, accessible, **as directed**, wall-mounting eyewash equipment with receptor and wall bracket.

- a. Capacity: Deliver potable water at rate not less than **0.4 gpm (1.5 L/min.)** for at least 15 minutes.
 - b. Supply Piping: **NPS 1/2 (DN 15)** chrome-plated brass or stainless steel with flow regulator and stay-open control valve.
 - c. Control-Valve Actuator: Paddle.
 - d. Receptor: Chrome-plated brass or stainless-steel **OR** Plastic, **as directed**, bowl.
 - e. Drain Piping: **NPS 1-1/4 (DN 32)** minimum, chrome-plated brass, receptor drain, P-trap, waste to wall, and wall flange complying with ASME A112.18.2.
 3. Description: Plumbed, accessible, **as directed**, wall-mounting eyewash equipment with wall bracket.
 - a. Capacity: Deliver potable water at rate not less than **0.4 gpm (1.5 L/min.)** for at least 15 minutes.
 - b. Supply Piping: **NPS 1/2 (DN 15)** chrome-plated brass or stainless steel with flow regulator and stay-open control valve.
 - c. Control-Valve Actuator: Paddle **OR** Movement sensor, **as directed**.
 4. Description: Plumbed, adjacent-to-sink, swivel, counter-mounting eyewash equipment.
 - a. Capacity: Deliver potable water at rate not less than **0.4 gpm (1.5 L/min.)** for at least 15 minutes.
 - b. Supply Piping: **NPS 1/2 (DN 15)** chrome-plated brass or stainless steel with flow regulator and stay-open control valve.
 - c. Control-Valve Actuator: Paddle.
- J. Self-Contained Eyewash Equipment:
1. Description: Portable, pressurized, self-contained eyewash equipment.
 - a. Capacity: Deliver flushing fluid at rate not less than **0.4 gpm (1.5 L/min.)** for at least 15 minutes.
 - b. Tank: **10 gal. (3.8 L)**, stainless steel, cylindrical, and suitable for on-floor installation.
 - c. Flushing Fluid: Medically acceptable solution manufactured and labeled according to applicable regulations.
 - d. Piping: Chrome-plated copper alloy or stainless steel with flow regulator and stay-open control valve.
 - e. Control-Valve Actuator: Paddle.
 - f. Spray Heads: Twin with covers.
 2. Description: Static, nonpressurized, self-contained eyewash equipment.
 - a. Capacity: Deliver flushing fluid at rate not less than **0.4 gpm (1.5 L/min.)** for at least 15 minutes.
 - b. Tank: **14 gal. (53 L)** minimum, plastic, and suitable for shelf mounting.
 - c. Flushing Fluid: Medically acceptable solution manufactured and labeled according to applicable regulations.
 - d. Actuator: Pull-down front panel.
 - e. Spray Heads: Protected, twin.
 3. Description: Freeze-protected, static, nonpressurized, self-contained eyewash equipment with heating system.
 - a. Capacity: Deliver flushing fluid at rate not less than **0.4 gpm (1.5 L/min.)** for at least 15 minutes.
 - b. Tank: **14 gal. (53 L)** minimum **OR 20 gal. (76 L)** minimum, **as directed**, plastic, and suitable for shelf mounting.
 - c. Flushing Fluid: Medically acceptable solution manufactured and labeled according to applicable regulations.
 - d. Actuator: Pull-down front panel.
 - e. Spray Heads: Protected, twin.
 - f. Heating System: Electric, 120-V ac; and insulation with protective jacket.
- K. Personal Eyewash Equipment:
1. Description: Portable, pressurized, personal eyewash equipment with spray heads.
 - a. Capacity: Deliver flushing fluid at rate not less than **0.4 gpm (1.5 L/min.)**, **as directed**.

- b. Tank: **5 gal. (19 L)**, stainless steel, cylindrical, and with base suitable for on-floor installation.
 - c. Flushing Fluid: Medically acceptable solution manufactured and labeled according to applicable regulations.
 - d. Piping: Chrome-plated brass or stainless steel with flow regulator and stay-open control valve.
 - e. Control-Valve Actuator: Paddle.
 - f. Spray Heads: Twin with covers.
 - 2. Description: Portable, pressurized, personal eyewash equipment with spray heads and drench hose.
 - a. Capacity: Deliver flushing fluid at rate not less than **0.4 gpm (1.5 L/min.)**, **as directed**.
 - b. Tank: **5 gal. (19 L)**, stainless steel, cylindrical, and with base suitable for on-floor installation.
 - c. Flushing Fluid: Medically acceptable solution manufactured and labeled according to applicable regulations.
 - d. Piping: Chrome-plated brass or stainless steel with flow regulator and stay-open control valve.
 - e. Spray-Head, Control-Valve Actuator: Paddle.
 - f. Spray Heads: Twin with covers.
 - g. Drench Hose: Rubber or plastic.
 - 1) Control-Valve Actuator: Hand-held squeeze valve.
 - 2) Spray Head: Single with cover.
- L. Eye/Face Wash Equipment:
- 1. Description: Plumbed, freestanding, pedestal eye/face wash equipment.
 - a. Capacity: Deliver potable water at rate not less than **3.0 gpm (11.4 L/min.)** for at least 15 minutes.
 - b. Supply Piping: **NPS 1/2 (DN 15)** chrome-plated brass or stainless steel with flow regulator and stay-open control valve.
 - c. Control-Valve Actuator: Paddle **OR** Push bar **OR** Treadle, **as directed**.
 - d. Receptor: Chrome-plated brass or stainless-steel **OR** Plastic, **as directed**, bowl.
 - e. Drain Piping: **NPS 1-1/4 (DN 32)** minimum, chrome-plated brass, receptor drain, P-trap, waste to wall, and wall flange complying with ASME A112.18.2. Include galvanized-steel indirect connection to drainage system.
 - 2. Description: Plumbed, accessible, **as directed**, wall-mounting eye/face wash equipment with receptor and wall bracket.
 - a. Capacity: Deliver potable water at rate not less than **3.0 gpm (11.4 L/min.)** for at least 15 minutes.
 - b. Supply Piping: **NPS 1/2 (DN 15)** chrome-plated brass or stainless steel with flow regulator and stay-open control valve.
 - c. Control-Valve Actuator: Paddle.
 - d. Receptor: Chrome-plated brass or stainless-steel **OR** Plastic, **as directed**, bowl.
 - e. Drain Piping: **NPS 1-1/4 (DN 32)** minimum, chrome-plated brass, receptor drain, P-trap, waste to wall, and wall flange complying with ASME A112.18.2.
 - 3. Description: Plumbed, accessible, **as directed**, wall-mounting eye/face wash equipment without receptor and with wall bracket.
 - a. Capacity: Deliver potable water at rate not less than **3.0 gpm (11.4 L/min.)** for at least 15 minutes.
 - b. Supply Piping: **NPS 1/2 (DN 15)** chrome-plated brass or stainless steel with flow regulator and stay-open control valve.
 - c. Control-Valve Actuator: Paddle.
 - 4. Description: Plumbed, adjacent-to-sink, swivel, counter-mounting eye/face wash equipment.
 - a. Capacity: Deliver potable water at rate not less than **3.0 gpm (11.4 L/min.)** for at least 15 minutes.

- b. Supply Piping: **NPS 1/2 (DN 15)** chrome-plated brass or stainless steel with flow regulator and stay-open control valve.
 - c. Control-Valve Actuator: Paddle.
- M. Hand-Held Drench Hoses:
 - 1. Description: Plumbed, wall-mounting, hand-held drench hose with wall bracket.
 - a. Capacity: Deliver potable water at rate not less than **3.0 gpm (11.4 L/min.)** for at least 15 minutes.
 - b. Supply Piping: **NPS 1/2 (DN 15)** chrome-plated brass or stainless steel with flow regulator and stay-open control valve.
 - c. Control-Valve Actuator: Paddle.
 - d. Hose: Coiled **OR** Plain, **as directed**, rubber or plastic.
 - e. Spray Heads: Single **OR** Twin, **as directed**.
 - 2. Description: Plumbed, counter-mounting, hand-held drench hose.
 - a. Capacity: Deliver potable water at rate not less than **3.0 gpm (11.4 L/min.)** for at least 15 minutes.
 - b. Supply Fitting: **NPS 1/2 (DN 15)** brass with flow regulator.
 - c. Hose: Rubber or plastic.
 - d. Control-Valve Actuator: Hand-held squeeze valve.
 - e. Spray Heads: Single **OR** Twin, **as directed**.
- N. Combination Units:
 - 1. Description: Plumbed, accessible, **as directed**, freestanding, with emergency shower and eyewash **OR** eye/face wash **OR** drench hose, **as directed**, equipment.
 - a. Piping: Galvanized steel **OR** Chrome-plated brass or stainless steel **OR** PVC, **as directed**.
 - 1) Unit Supply: **NPS 1-1/4 (DN 32)** minimum **OR** **NPS 1-1/2 (DN 40)**, **as directed**, from top **OR** side, **as directed**.
 - 2) Unit Drain: Outlet at side near bottom.
 - 3) Shower Supply: **NPS 1 (DN 25)** with flow regulator and stay-open control valve.
 - 4) Eyewash **OR** Eye/Face Wash **OR** Drench Hose, **as directed**, Supply: **NPS 1/2 (DN 15)** with flow regulator and stay-open control valve.
 - b. Shower Capacity: Deliver potable water at rate not less than **20 gpm (76 L/min.)** for at least 15 minutes.
 - 1) Control-Valve Actuator: Pull rod **OR** Pull chain **OR** Treadle, **as directed**.
 - 2) Shower Head: **8-inch (200-mm)** minimum diameter, chrome-plated brass or stainless steel **OR** plastic, **as directed**.
 - c. Eyewash Equipment: With capacity to deliver potable water at rate not less than **0.4 gpm (1.5 L/min.)** for at least 15 minutes.
 - 1) Control-Valve Actuator: Paddle **OR** Push bar, **as directed**.
 - 2) Receptor: Chrome-plated brass or stainless-steel **OR** Plastic, **as directed**, bowl.
 - d. Eye/Face Wash Equipment: With capacity to deliver potable water at rate not less than **3.0 gpm (11.4 L/min.)** for at least 15 minutes.
 - 1) Control-Valve Actuator: Paddle **OR** Push bar, **as directed**.
 - 2) Receptor: Chrome-plated brass or stainless-steel **OR** Plastic, **as directed**, bowl.
 - e. Hand-Held Drench Hose: With capacity to deliver potable water at rate not less than **3.0 gpm (11.4 L/min.)** for at least 15 minutes.
 - 1) Hose: Rubber or plastic.
 - 2) Control-Valve Actuator: Hand-held squeeze valve.
 - 3) Spray Head(s): Single **OR** Twin, **as directed**.
 - 2. Description: Plumbed, accessible, **as directed**, freeze-protected, freestanding, with emergency shower and eye/face wash equipment.
 - a. Piping: Galvanized steel.
 - 1) Unit Supply: **NPS 1-1/4 (DN 32)** minimum **OR** **NPS 1-1/2 (DN 40)**, **as directed**, from top **OR** side **OR** bottom, **as directed**.
 - 2) Shower Supply: **NPS 1 (DN 25)** with flow regulator and stay-open control valve.

- 3) Eye/Face Wash Supply: **NPS 1/2 (DN 15)** with flow regulator and stay-open control valve.
- b. Heating System: Electric, 120 **OR** 240, **as directed**, -V ac; and insulation with protective jacket.
- c. Shower Capacity: Deliver potable water at rate not less than **20 gpm (76 L/min.)** for at least 15 minutes.
 - 1) Control-Valve Actuator: Pull rod **OR** Pull chain **OR** Treadle, **as directed**.
 - 2) Shower Head: **8-inch (200-mm)** minimum diameter, chrome-plated brass or stainless steel **OR** plastic, **as directed**.
- d. Eye/Face Wash Equipment: With capacity to deliver potable water at rate not less than **3.0 gpm (11.4 L/min.)** for at least 15 minutes.
 - 1) Control-Valve Actuator: Paddle **OR** Push bar, **as directed**.

O. Water-Tempering Equipment:

1. Description: Factory-fabricated, hot- and cold-water-tempering equipment with thermostatic mixing valve.
 - a. Thermostatic Mixing Valve: Designed to provide **85 deg F (29 deg C)** tepid, potable water at emergency plumbing fixtures, to maintain temperature at plus or minus **5 deg F (3 deg C)** throughout required 15-minute test period, and in case of unit failure to continue cold-water flow, with union connections, controls, metal piping, and corrosion-resistant enclosure.
2. Description: Factory-fabricated, steam and cold-water, water-tempering equipment with thermostatic mixing valve.
 - a. Thermostatic Mixing Valve: Designed to provide **85 deg F (29 deg C)** tepid, potable water at emergency plumbing fixtures, to maintain temperature at plus or minus **5 deg F (3 deg C)** throughout required 15-minute test period, and in case of unit failure to continue cold-water flow, with union connections, steam controls, heat exchanger, high-temperature-limit and freeze-protection devices, metal piping, and corrosion-resistant enclosure.
3. Description: Factory-fabricated, water-tempering equipment with electric heating.
 - a. Heating System: Electric, designed to provide **85 deg F (29 deg C)** tepid, potable water at emergency plumbing fixtures, to maintain temperature at plus or minus **5 deg F (3 deg C)** throughout required 15-minute test period, and in case of unit failure to continue cold-water flow, with union connections, controls, heating coils, high-temperature-limit device, metal piping, and corrosion-resistant enclosure.
 - 1) Electrical Characteristics: 208-V ac, 38 **OR** 220-V ac, 40 **OR** 277-V ac, 32, **as directed**, A, single phase, 60 Hz.

1.4 EXECUTION

A. Installation

1. Assemble emergency plumbing fixture piping, fittings, control valves, and other components.
2. Install fixtures level and plumb.
3. Fasten fixtures to substrate.
4. Install shutoff valves in water-supply piping to fixtures. Use ball, gate, or globe valve if specific type valve is not indicated. Install valves chained or locked in open position if permitted. Install valves in locations where they can easily be reached for operation. Valves are specified in Division 22 Section "General-duty Valves For Plumbing Piping".
 - a. Exception: Omit shutoff valve on supply to group of plumbing fixtures that includes emergency plumbing fixture.
 - b. Exception: Omit shutoff valve on supply to emergency equipment if prohibited by authorities having jurisdiction.
5. Install shutoff valve and strainer in steam piping and shutoff valve in condensate return piping.

6. Install dielectric fitting in supply piping to fixture if piping and fixture connections are made of different metals. Dielectric fittings are specified in Division 22 Section "Common Work Results For Plumbing".
 7. Install thermometers in supply and outlet piping connections to water-tempering equipment. Thermometers are specified in Division 22 Section "Meters And Gages For Plumbing Piping".
 8. Install trap and waste to wall on drain outlet of fixture receptors that are indicated to be directly connected to drainage system.
 9. Install indirect waste piping to wall on drain outlet of fixture receptors that are indicated to be indirectly connected to drainage system. Drainage piping is specified in Division 22 Section "Sanitary Waste And Vent Piping".
 10. Install escutcheons on piping wall and ceiling penetrations in exposed, finished locations. Escutcheons are specified in Division 22 Section "Common Work Results For Plumbing".
 11. Fill self-contained fixtures with flushing fluid.
 12. Install equipment nameplates or equipment markers on fixtures and equipment signs on water-tempering equipment. Identification materials are specified in Division 22 Section "Identification For Plumbing Piping And Equipment".
 13. Piping installation requirements are specified in other Division 14. Drawings indicate general arrangement of piping, fittings, and specialties.
 14. Connect cold-water-supply piping to plumbed emergency plumbing fixtures not having water-tempering equipment.
 15. Connect hot- and cold-water-supply piping to hot- and cold-water-tempering equipment. Connect output from water-tempering equipment to emergency plumbing fixtures.
 16. Connect cold-water and steam supply and condensate return piping to steam and cold-water-tempering equipment. Connect output from water-tempering equipment to emergency plumbing fixtures.
 17. Connect cold water and electrical power to electric heating water-tempering equipment.
 18. Directly connect emergency plumbing fixture receptors with trapped drain outlet to sanitary drainage and vent piping.
 19. Indirectly connect emergency plumbing fixture receptors without trapped drain outlet to sanitary or storm drainage piping.
 20. Ground equipment according to Division 26 Section "Grounding And Bonding For Electrical Systems".
 21. Connect wiring according to Division 26 Section "Low-voltage Electrical Power Conductors And Cables".
- B. Field Quality Control
1. Electrical-Component Testing: After electrical circuitry has been energized, test for compliance with requirements.
 - a. Test and adjust controls and safeties.
 2. Repair or replace malfunctioning units. Retest as specified above after repairs or replacements are made.
- C. Adjusting
1. Adjust or replace fixture flow regulators for proper flow.
 2. Adjust equipment temperature settings.

END OF SECTION 22 01 40 81

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Task	Specification	Specification Description
22 01 40 81	10 28 19 16	Plumbing Fixtures

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SECTION 22 05 13 00 - COMMON MOTOR REQUIREMENTS FOR PLUMBING EQUIPMENT

1.1 GENERAL

A. Description Of Work

1. This specification covers the furnishing and installation of materials for common motor requirements for plumbing equipment. Products shall be as follows or as directed by the Owner. Installation procedures shall be in accordance with the products manufacturer's recommendations. Demolition and removal of materials shall be as required to support the work.

B. Summary

1. Section includes general requirements for single-phase and polyphase, general-purpose, horizontal, small and medium, squirrel-cage induction motors for use on ac power systems up to 600 V and installed at equipment manufacturer's factory or shipped separately by equipment manufacturer for field installation.

C. Coordination

1. Coordinate features of motors, installed units, and accessory devices to be compatible with the following:
 - a. Motor controllers.
 - b. Torque, speed, and horsepower requirements of the load.
 - c. Ratings and characteristics of supply circuit and required control sequence.
 - d. Ambient and environmental conditions of installation location.

1.2 PRODUCTS

A. General Motor Requirements

1. Comply with requirements in this Section except when stricter requirements are specified in plumbing equipment schedules or Sections.
2. Comply with NEMA MG 1 unless otherwise indicated.
3. Comply with IEEE 841 for severe-duty motors.

B. Motor Characteristics

1. Duty: Continuous duty at ambient temperature of 40 deg C and at altitude of 3300 feet (1000 m) above sea level.
2. Capacity and Torque Characteristics: Sufficient to start, accelerate, and operate connected loads at designated speeds, at installed altitude and environment, with indicated operating sequence, and without exceeding nameplate ratings or considering service factor.

C. Polyphase Motors

1. Description: NEMA MG 1, Design B, medium induction motor.
2. Efficiency: Energy efficient, as defined in NEMA MG 1.
3. Service Factor: 1.15.
4. Multispeed Motors: Variable torque.
 - a. For motors with 2:1 speed ratio, consequent pole, single winding.
 - b. For motors with other than 2:1 speed ratio, separate winding for each speed.
5. Multispeed Motors: Separate winding for each speed.
6. Rotor: Random-wound, squirrel cage.
7. Bearings: Regreasable, shielded, antifriction ball bearings suitable for radial and thrust loading.
8. Temperature Rise: Match insulation rating.
9. Insulation: Class F.
10. Code Letter Designation:
 - a. Motors 15 HP and Larger: NEMA starting Code F or Code G.

- b. Motors Smaller than 15 HP: Manufacturer's standard starting characteristic.
- 11. Enclosure Material: Cast iron for motor frame sizes 324T and larger; rolled steel for motor frame sizes smaller than 324T.

D. Polyphase Motors With Additional Requirements

- 1. Motors Used with Reduced-Voltage and Multispeed Controllers: Match wiring connection requirements for controller with required motor leads. Provide terminals in motor terminal box, suited to control method.
- 2. Motors Used with Variable Frequency Controllers: Ratings, characteristics, and features coordinated with and approved by controller manufacturer.
 - a. Windings: Copper magnet wire with moisture-resistant insulation varnish, designed and tested to resist transient spikes, high frequencies, and short time rise pulses produced by pulse-width modulated inverters.
 - b. Energy- and Premium-Efficient Motors: Class B temperature rise; Class F insulation.
 - c. Inverter-Duty Motors: Class F temperature rise; Class H insulation.
 - d. Thermal Protection: Comply with NEMA MG 1 requirements for thermally protected motors.
- 3. Severe-Duty Motors: Comply with IEEE 841, with 1.15 minimum service factor.

E. Single-Phase Motors

- 1. Motors larger than 1/20 hp shall be one of the following, to suit starting torque and requirements of specific motor application:
 - a. Permanent-split capacitor.
 - b. Split phase.
 - c. Capacitor start, inductor run.
 - d. Capacitor start, capacitor run.
- 2. Multispeed Motors: Variable-torque, permanent-split-capacitor type.
- 3. Bearings: Prelubricated, antifriction ball bearings or sleeve bearings suitable for radial and thrust loading.
- 4. Motors 1/20 HP and Smaller: Shaded-pole type.
- 5. Thermal Protection: Internal protection to automatically open power supply circuit to motor when winding temperature exceeds a safe value calibrated to temperature rating of motor insulation. Thermal-protection device shall automatically reset when motor temperature returns to normal range.

1.3 EXECUTION (Not Applicable)

END OF SECTION 22 05 13 00

SECTION 22 05 16 00 - EXPANSION FITTINGS AND LOOPS FOR PLUMBING PIPING

1.1 GENERAL

A. Description Of Work

1. This specification covers the furnishing and installation of materials for expansion fittings and loops for plumbing piping. Products shall be as follows or as directed by the Owner. Installation procedures shall be in accordance with the products manufacturer's recommendations. Demolition and removal of materials shall be as required to support the work.

B. Summary

1. Section Includes:
 - a. Flexible-hose packless expansion joints.
 - b. Metal-bellows packless expansion joints.
 - c. Rubber packless expansion joints.
 - d. Grooved-joint expansion joints.
 - e. Pipe loops and swing connections.
 - f. Alignment guides and anchors.

C. Performance Requirements

1. Compatibility: Products shall be suitable for piping service fluids, materials, working pressures, and temperatures.
2. Capability: Products to absorb 200 percent of maximum axial movement between anchors.

D. Submittals

1. Product Data: For each type of product indicated.
2. Delegated-Design Submittal: For each anchor and alignment guide indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
 - a. Design Calculations: Calculate requirements for thermal expansion of piping systems and for selecting and designing expansion joints, loops, and swing connections.
 - b. Anchor Details: Detail fabrication of each anchor indicated. Show dimensions and methods of assembly and attachment to building structure.
 - c. Alignment Guide Details: Detail field assembly and attachment to building structure.
 - d. Schedule: Indicate type, manufacturer's number, size, material, pressure rating, end connections, and location for each expansion joint.
3. Welding certificates.
4. Product Certificates: For each type of expansion joint, from manufacturer.
5. Maintenance Data: For expansion joints to include in maintenance manuals.

E. Quality Assurance

1. Welding Qualifications: Qualify procedures and personnel according to the following:
 - a. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
 - b. ASME Boiler and Pressure Vessel Code: Section IX.

1.2 PRODUCTS

A. Packless Expansion Joints

1. Flexible-Hose Packless Expansion Joints:
 - a. Description: Manufactured assembly with inlet and outlet elbow fittings and two flexible-metal-hose legs joined by long-radius, 180-degree return bend or center section of flexible hose.
 - b. Flexible Hose: Corrugated-metal inner hoses and braided outer sheaths.

- c. Expansion Joints for Copper Tubing **NPS 2 (DN 50)** and Smaller: Copper-alloy fittings with solder-joint end connections.
 - 1) Bronze hoses and single-braid bronze sheaths with **450 psig at 70 deg F (3100 kPa at 21 deg C)** and **340 psig at 450 deg F (2340 kPa at 232 deg C)** ratings.
 - 2) Bronze hoses and double-braid bronze sheaths with **700 psig at 70 deg F (4830 kPa at 21 deg C)** and **500 psig at 450 deg F (3450 kPa at 232 deg C)** ratings.
- d. Expansion Joints for Copper Tubing **NPS 2-1/2 to NPS 4 (DN 65 to DN 100)**: Copper-alloy fittings with threaded end connections.
 - 1) Stainless-steel hoses and single-braid, stainless-steel sheaths with **300 psig at 70 deg F (2070 kPa at 21 deg C)** and **225 psig at 450 deg F (1550 kPa at 232 deg C)** ratings.
 - 2) Stainless-steel hoses and double-braid, stainless-steel sheaths with **420 psig at 70 deg F (2890 kPa at 21 deg C)** and **315 psig at 450 deg F (2170 kPa at 232 deg C)** ratings.
- e. Expansion Joints for Steel Piping **NPS 2 (DN 50)** and Smaller: Stainless-steel fittings with threaded end connections.
 - 1) Stainless-steel hoses and single-braid, stainless-steel sheaths with **450 psig at 70 deg F (3100 kPa at 21 deg C)** and **325 psig at 600 deg F (2250 kPa at 315 deg C)** ratings.
 - 2) Stainless-steel hoses and double-braid, stainless-steel sheaths with **700 psig at 70 deg F (4830 kPa at 21 deg C)** and **515 psig at 600 deg F (3550 kPa at 315 deg C)** ratings.
- f. Expansion Joints for Steel Piping **NPS 2-1/2 to NPS 6 (DN 65 to DN 150)**: Stainless-steel fittings with flanged end connections.
 - 1) Stainless-steel hoses and single-braid, stainless-steel sheaths with **200 psig at 70 deg F (1380 kPa at 21 deg C)** and **145 psig at 600 deg F (1000 kPa at 315 deg C)** ratings.
 - 2) Stainless-steel hoses and double-braid, stainless-steel sheaths with **275 psig at 70 deg F (1900 kPa at 21 deg C)** and **200 psig at 600 deg F (1380 kPa at 315 deg C)** ratings.
- g. Expansion Joints for Steel Piping **NPS 8 to NPS 12 (DN 200 to DN 300)**: Stainless-steel fittings with flanged end connections.
 - 1) Stainless-steel hoses and single-braid, stainless-steel sheaths with **125 psig at 70 deg F (860 kPa at 21 deg C)** and **90 psig at 600 deg F (625 kPa at 315 deg C)** ratings.
 - 2) Stainless-steel hoses and double-braid, stainless-steel sheaths with **165 psig at 70 deg F (1130 kPa at 21 deg C)** and **120 psig at 600 deg F (830 kPa at 315 deg C)** ratings.
- 2. Metal-Bellows Packless Expansion Joints:
 - a. Standards: ASTM F 1120 and EJMA's "Standards of the Expansion Joint Manufacturers Association, Inc."
 - b. Type: Circular, corrugated bellows with external tie rods.
 - c. Minimum Pressure Rating: **150 psig (1035 kPa) OR 175 psig (1200 kPa), as directed**, unless otherwise indicated.
 - d. Configuration: Single joint **OR** Single joint with base and double joint with base, **as directed**, class(es) unless otherwise indicated.
 - e. Expansion Joints for Copper Tubing: Single **OR** Multi, **as directed**, -ply phosphor-bronze bellows, copper pipe ends, and brass shrouds.
 - 1) End Connections for Copper Tubing **NPS 2 (DN 50)** and Smaller: Solder joint or threaded.
 - 2) End Connections for Copper Tubing **NPS 2-1/2 to NPS 4 (DN 65 to DN 100)**: Solder joint or threaded.
 - 3) End Connections for Copper Tubing **NPS 5 (DN 125)** and Larger: Flanged.
- 3. Rubber Packless Expansion Joints:

- a. Standards: ASTM F 1123 and FSA's "Technical Handbook: Non-Metallic Expansion Joints and Flexible Pipe Connectors."
 - b. Material: Fabric-reinforced rubber complying with FSA-NMEJ-703.
 - c. Arch Type: Single **OR** Multiple, **as directed**, arches with external control rods, **as directed**.
 - d. Spherical Type: Single **OR** Multiple, **as directed** spheres with external control rods, **as directed**.
 - e. Minimum Pressure Rating for NPS 1-1/2 to NPS 4 (DN 40 to DN 100): 150 psig (1035 kPa) at 220 deg F (104 deg C).
 - f. Minimum Pressure Rating for NPS 5 and NPS 6 (DN 125 and DN 150): 140 psig (966 kPa) at 200 deg F (93 deg C).
 - g. Minimum Pressure Rating for NPS 8 to NPS 12 (DN 200 to DN 300): 140 psig (966 kPa) at 180 deg F (82 deg C).
 - h. Material for Fluids Containing Acids, Alkalies, or Chemicals: BR **OR** CSM **OR** EPDM, **as directed**.
 - i. Material for Fluids Containing Gas, Hydrocarbons, or Oil: Buna-N **OR** CR, **as directed**.
 - j. Material for Water: BR **OR** Buna-N **OR** CR **OR** CSM **OR** EPDM **OR** NR, **as directed**.
 - k. End Connections: Full-faced, integral steel flanges with steel retaining rings.
- B. Grooved-Joint Expansion Joints
1. Description: Factory-assembled expansion joint made of several grooved-end pipe nipples, couplings, and grooved joints.
 2. Standard: AWWA C606, for grooved joints.
 3. Nipples: Galvanized, **as directed**, ASTM A 53/A 53M, Schedule 40, Type E or S, steel pipe with grooved ends.
 4. Couplings: Five **OR** Seven **OR** 10 **OR** 12, **as directed**, flexible type for steel-pipe dimensions. Include ferrous housing sections, Buna-N gasket suitable for diluted acid, alkaline fluids, and cold and hot water **OR** EPDM gasket suitable for cold and hot water, **as directed**, and bolts and nuts.
- C. Alignment Guides And Anchors
1. Alignment Guides:
 - a. Description: Steel, factory-fabricated alignment guide, with bolted two-section outer cylinder and base for attaching to structure; with two-section guiding spider for bolting to pipe.
 2. Anchor Materials:
 - a. Steel Shapes and Plates: ASTM A 36/A 36M.
 - b. Bolts and Nuts: ASME B18.10 or ASTM A 183, steel hex head.
 - c. Washers: ASTM F 844, steel, plain, flat washers.
 - d. Mechanical Fasteners: Insert-wedge-type stud with expansion plug anchor for use in hardened portland cement concrete, with tension and shear capacities appropriate for application.
 - 1) Stud: Threaded, zinc-coated carbon steel.
 - 2) Expansion Plug: Zinc-coated steel.
 - 3) Washer and Nut: Zinc-coated steel.
 - e. Chemical Fasteners: Insert-type-stud, bonding-system anchor for use with hardened portland cement concrete, with tension and shear capacities appropriate for application.
 - 1) Bonding Material: ASTM C 881/C 881M, Type IV, Grade 3, two-component epoxy resin suitable for surface temperature of hardened concrete where fastener is to be installed.
 - 2) Stud: ASTM A 307, zinc-coated carbon steel with continuous thread on stud unless otherwise indicated.
 - 3) Washer and Nut: Zinc-coated steel.

1.3 EXECUTION

A. Expansion-Joint Installation

1. Install expansion joints of sizes matching sizes of piping in which they are installed.
2. Install metal-bellows expansion joints according to EJMA's "Standards of the Expansion Joint Manufacturers Association, Inc."
3. Install rubber packless expansion joints according to FSA-NMEJ-702.
4. Install grooved-joint expansion joints to grooved-end steel piping

B. Pipe Loop And Swing Connection Installation

1. Install pipe loops cold-sprung in tension or compression as required to partly absorb tension or compression produced during anticipated change in temperature.
2. Connect risers and branch connections to mains with at least five pipe fittings including tee in main.
3. Connect risers and branch connections to terminal units with at least four pipe fittings including tee in riser.
4. Connect mains and branch connections to terminal units with at least four pipe fittings including tee in main.

C. Alignment-Guide And Anchor Installation

1. Install alignment guides to guide expansion and to avoid end-loading and torsional stress.
2. Install one **OR** two, **as directed**, guide(s) on each side of pipe expansion fittings and loops. Install guides nearest to expansion joint not more than four pipe diameters from expansion joint.
3. Attach guides to pipe and secure guides to building structure.
4. Install anchors at locations to prevent stresses from exceeding those permitted by ASME B31.9 and to prevent transfer of loading and stresses to connected equipment.
5. Anchor Attachments:
 - a. Anchor Attachment to Black-Steel Pipe: Attach by welding. Comply with ASME B31.9 and ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."
 - b. Anchor Attachment to Galvanized-Steel Pipe: Attach with pipe hangers. Use MSS SP-69, Type 42, riser clamp welded to anchor.
 - c. Anchor Attachment to Copper Tubing: Attach with pipe hangers. Use MSS SP-69, Type 24, U-bolts bolted to anchor.
6. Fabricate and install steel anchors by welding steel shapes, plates, and bars. Comply with ASME B31.9 and AWS D1.1/D1.1M.
 - a. Anchor Attachment to Steel Structural Members: Attach by welding.
 - b. Anchor Attachment to Concrete Structural Members: Attach by fasteners. Follow fastener manufacturer's written instructions.
7. Use grout to form flat bearing surfaces for guides and anchors attached to concrete.

END OF SECTION 22 05 16 00



Task	Specification	Specification Description
22 05 19 00	21 05 19 00	Meters and Gages for Plumbing Piping

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SECTION 22 05 29 00 - HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT

1.1 GENERAL

A. Description Of Work

1. This specification covers the furnishing and installation of materials for hangers and supports for plumbing piping and equipment. Products shall be as follows or as directed by the Owner. Installation procedures shall be in accordance with the products manufacturer's recommendations. Demolition and removal of materials shall be as required to support the work.

B. Summary

1. Section Includes:
 - a. Metal pipe hangers and supports.
 - b. Trapeze pipe hangers.
 - c. Fiberglass pipe hangers.
 - d. Metal framing systems.
 - e. Fiberglass strut systems.
 - f. Thermal-hanger shield inserts.
 - g. Fastener systems.
 - h. Pipe stands.
 - i. Pipe positioning systems.
 - j. Equipment supports.

C. Definitions

1. MSS: Manufacturers Standardization Society of The Valve and Fittings Industry Inc.

D. Performance Requirements

1. Delegated Design: Design trapeze pipe hangers and equipment supports, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.
2. Structural Performance: Hangers and supports for plumbing piping and equipment shall withstand the effects of gravity loads and stresses within limits and under conditions indicated according to ASCE/SEI 7.
 - a. Design supports for multiple pipes, including pipe stands, capable of supporting combined weight of supported systems, system contents, and test water.
 - b. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.
 - c. Design seismic-restraint hangers and supports for piping and equipment and obtain approval from authorities having jurisdiction.

E. Submittals

1. Product Data: For each type of product indicated.
2. Shop Drawings: Signed and sealed by a qualified professional engineer. Show fabrication and installation details and include calculations for the following; include Product Data for components:
 - a. Trapeze pipe hangers.
 - b. Metal framing systems.
 - c. Fiberglass strut systems.
 - d. Pipe stands.
 - e. Equipment supports.
3. Delegated-Design Submittal: For trapeze hangers indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
 - a. Detail fabrication and assembly of trapeze hangers.

- b. Design Calculations: Calculate requirements for designing trapeze hangers.
4. Welding certificates.

F. Quality Assurance

1. Structural Steel Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
2. Pipe Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.

1.2 PRODUCTS

A. Metal Pipe Hangers And Supports

1. Carbon-Steel Pipe Hangers and Supports:
 - a. Description: MSS SP-58, Types 1 through 58, factory-fabricated components.
 - b. Galvanized Metallic Coatings: Pregalvanized or hot dipped.
 - c. Nonmetallic Coatings: Plastic coating, jacket, or liner.
 - d. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion to support bearing surface of piping.
 - e. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon steel **OR** stainless steel, **as directed**.
2. Stainless-Steel Pipe Hangers and Supports:
 - a. Description: MSS SP-58, Types 1 through 58, factory-fabricated components.
 - b. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion to support bearing surface of piping.
 - c. Hanger Rods: Continuous-thread rod, nuts, and washer made of stainless steel.
3. Copper Pipe Hangers:
 - a. Description: MSS SP-58, Types 1 through 58, copper-coated-steel, factory-fabricated components.
 - b. Hanger Rods: Continuous-thread rod, nuts, and washer made of copper-coated steel **OR** stainless steel, **as directed**.

B. Trapeze Pipe Hangers

1. Description: MSS SP-69, Type 59, shop- or field-fabricated pipe-support assembly made from structural carbon-steel shapes with MSS SP-58 carbon-steel hanger rods, nuts, saddles, and U-bolts.

C. Fiberglass Pipe Hangers

1. Clevis-Type, Fiberglass Pipe Hangers:
 - a. Description: Similar to MSS SP-58, Type 1, steel pipe hanger except hanger is made of fiberglass or fiberglass-reinforced resin.
 - b. Hanger Rods: Continuous-thread rod, washer, and nuts made of fiberglass, polyurethane or stainless steel.
2. Strap-Type, Fiberglass Pipe Hangers:
 - a. Description: Similar to MSS SP-58, Type 9 or Type 10, steel pipe hanger except hanger is made of fiberglass-reinforced resin.
 - b. Hanger Rod and Fittings: Continuous-thread rod, washer, and nuts made of stainless steel.

D. Metal Framing Systems

1. MFMA Manufacturer Metal Framing Systems:
 - a. Description: Shop- or field-fabricated pipe-support assembly for supporting multiple parallel pipes.
 - b. Standard: MFMA-4.

- c. Channels: Continuous slotted steel channel with inturned lips.
- d. Channel Nuts: Formed or stamped steel nuts or other devices designed to fit into channel slot and, when tightened, prevent slipping along channel.
- e. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon steel **OR** stainless steel, **as directed**.
- f. Metallic Coating: Electroplated zinc **OR** Hot-dipped galvanized **OR** Mill galvanized **OR** In-line, hot galvanized **OR** Mechanically-deposited zinc, **as directed**.
OR
Paint Coating: Vinyl **OR** Vinyl alkyd **OR** Epoxy **OR** Polyester **OR** Acrylic **OR** Amine **OR** Alkyd, **as directed**.
OR
Plastic Coating: PVC **OR** Polyurethane **OR** Epoxy **OR** Polyester, **as directed**.
OR
Combination Coating: **<Insert coating materials in order of application>**.
- 2. Non-MFMA Manufacturer Metal Framing Systems:
 - a. Description: Shop- or field-fabricated pipe-support assembly made of steel channels, accessories, fittings, and other components for supporting multiple parallel pipes.
 - b. Standard: Comply with MFMA-4.
 - c. Channels: Continuous slotted steel channel with inturned lips.
 - d. Channel Nuts: Formed or stamped steel nuts or other devices designed to fit into channel slot and, when tightened, prevent slipping along channel.
 - e. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon steel **OR** stainless steel, **as directed**.
 - f. Coating: Zinc **OR** Paint **OR** PVC, **as directed**.
- E. Fiberglass Strut Systems
 - 1. Description: Shop- or field-fabricated pipe-support assembly similar to MFMA-4 for supporting multiple parallel pipes.
 - a. Channels: Continuous slotted fiberglass or other plastic channel with inturned lips.
 - b. Channel Nuts: Fiberglass nuts or other devices designed to fit into channel slot and, when tightened, prevent slipping along channel.
 - c. Hanger Rods: Continuous-thread rod, nuts, and washer made of fiberglass **OR** stainless steel, **as directed**.
- F. Thermal-Hanger Shield Inserts
 - 1. Insulation-Insert Material for Cold Piping: ASTM C 552, Type II cellular glass with **100-psig (688-kPa)** or ASTM C 591, Type VI, Grade 1 polyisocyanurate with **125-psig (862-kPa)** minimum compressive strength and vapor barrier.
 - 2. Insulation-Insert Material for Hot Piping: Water-repellent treated, ASTM C 533, Type I calcium silicate with **100-psig (688-kPa)**, ASTM C 552, Type II cellular glass with **100-psig (688-kPa)** or ASTM C 591, Type VI, Grade 1 polyisocyanurate with **125-psig (862-kPa)** minimum compressive strength.
 - 3. For Trapeze or Clamped Systems: Insert and shield shall cover entire circumference of pipe.
 - 4. For Clevis or Band Hangers: Insert and shield shall cover lower 180 degrees of pipe.
 - 5. Insert Length: Extend **2 inches (50 mm)** beyond sheet metal shield for piping operating below ambient air temperature.
- G. Fastener Systems
 - 1. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.
 - 2. Mechanical-Expansion Anchors: Insert-wedge-type, zinc-coated **OR** stainless-, **as directed**, steel anchors, for use in hardened portland cement concrete; with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.
- H. Pipe Stands

1. General Requirements for Pipe Stands: Shop- or field-fabricated assemblies made of manufactured corrosion-resistant components to support roof-mounted piping.
2. Compact Pipe Stand: One-piece plastic unit with integral-rod roller, pipe clamps, or V-shaped cradle to support pipe, for roof installation without membrane penetration.
3. Low-Type, Single-Pipe Stand: One-piece plastic **OR** stainless-steel, **as directed**, base unit with plastic roller, for roof installation without membrane penetration.
4. High-Type, Single-Pipe Stand:
 - a. Description: Assembly of base, vertical and horizontal members, and pipe support, for roof installation without membrane penetration.
 - b. Base: Plastic **OR** Stainless steel, **as directed**.
 - c. Vertical Members: Two or more cadmium-plated-steel or stainless-steel, continuous-thread rods.
 - d. Horizontal Member: Cadmium-plated-steel or stainless-steel rod with plastic or stainless-steel, roller-type pipe support.
5. High-Type, Multiple-Pipe Stand:
 - a. Description: Assembly of bases, vertical and horizontal members, and pipe supports, for roof installation without membrane penetration.
 - b. Bases: One or more; plastic.
 - c. Vertical Members: Two or more protective-coated-steel channels.
 - d. Horizontal Member: Protective-coated-steel channel.
 - e. Pipe Supports: Galvanized-steel, clevis-type pipe hangers.
6. Curb-Mounting-Type Pipe Stands: Shop- or field-fabricated pipe supports made from structural-steel shapes, continuous-thread rods, and rollers, for mounting on permanent stationary roof curb.

I. Pipe Positioning Systems

1. Description: IAPMO PS 42, positioning system of metal brackets, clips, and straps for positioning piping in pipe spaces; for plumbing fixtures in commercial applications.

J. Equipment Supports

1. Description: Welded, shop- or field-fabricated equipment support made from structural carbon-steel shapes.

K. Miscellaneous Materials

1. Structural Steel: ASTM A 36/A 36M, carbon-steel plates, shapes, and bars; black and galvanized.
2. Grout: ASTM C 1107, factory-mixed and -packaged, dry, hydraulic-cement, nonshrink and nonmetallic grout; suitable for interior and exterior applications.
 - a. Properties: Nonstaining, noncorrosive, and nongaseous.
 - b. Design Mix: **5000-psi (34.5-MPa)**, 28-day compressive strength.

1.3 EXECUTION

A. Hanger And Support Installation

1. Metal Pipe-Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Install hangers, supports, clamps, and attachments as required to properly support piping from the building structure.
2. Metal Trapeze Pipe-Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Arrange for grouping of parallel runs of horizontal piping, and support together on field-fabricated trapeze pipe hangers.
 - a. Pipes of Various Sizes: Support together and space trapezes for smallest pipe size or install intermediate supports for smaller diameter pipes as specified for individual pipe hangers.

- b. Field fabricate from ASTM A 36/A 36M, carbon-steel shapes selected for loads being supported. Weld steel according to AWS D1.1/D1.1M.
3. Fiberglass Pipe-Hanger Installation: Comply with applicable portions of MSS SP-69 and MSS SP-89. Install hangers and attachments as required to properly support piping from building structure.
4. Metal Framing System Installation: Arrange for grouping of parallel runs of piping, and support together on field-assembled metal framing systems.
5. Fiberglass Strut System Installation: Arrange for grouping of parallel runs of piping, and support together on field-assembled fiberglass struts.
6. Thermal-Hanger Shield Installation: Install in pipe hanger or shield for insulated piping.
7. Fastener System Installation:
 - a. Install powder-actuated fasteners for use in lightweight concrete or concrete slabs less than 4 inches (100 mm) thick in concrete after concrete is placed and completely cured. Use operators that are licensed by powder-actuated tool manufacturer. Install fasteners according to powder-actuated tool manufacturer's operating manual.
 - b. Install mechanical-expansion anchors in concrete after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions.
8. Pipe Stand Installation:
 - a. Pipe Stand Types except Curb-Mounted Type: Assemble components and mount on smooth roof surface. Do not penetrate roof membrane.
 - b. Curb-Mounted-Type Pipe Stands: Assemble components or fabricate pipe stand and mount on permanent, stationary roof curb. See Division 7 Section "Roof Accessories" for curbs.
9. Pipe Positioning-System Installation: Install support devices to make rigid supply and waste piping connections to each plumbing fixture. See Division 15 plumbing fixture Sections for requirements for pipe positioning systems for plumbing fixtures.
10. Install hangers and supports complete with necessary attachments, inserts, bolts, rods, nuts, washers, and other accessories.
11. Equipment Support Installation: Fabricate from welded-structural-steel shapes.
12. Install hangers and supports to allow controlled thermal and seismic movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.
13. Install lateral bracing with pipe hangers and supports to prevent swaying.
14. Install building attachments within concrete slabs or attach to structural steel. Install additional attachments at concentrated loads, including valves, flanges, and strainers, NPS 2-1/2 (DN 65) and larger and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten inserts to forms and install reinforcing bars through openings at top of inserts.
15. Load Distribution: Install hangers and supports so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.
16. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and to not exceed maximum pipe deflections allowed by ASME B31.9 for building services piping.
17. Insulated Piping:
 - a. Attach clamps and spacers to piping.
 - 1) Piping Operating above Ambient Air Temperature: Clamp may project through insulation.
 - 2) Piping Operating below Ambient Air Temperature: Use thermal-hanger shield insert with clamp sized to match OD of insert.
 - 3) Do not exceed pipe stress limits allowed by ASME B31.9 for building services piping.
 - b. Install MSS SP-58, Type 39, protection saddles if insulation without vapor barrier is indicated. Fill interior voids with insulation that matches adjoining insulation.
 - 1) Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 (DN 100) and larger if pipe is installed on rollers.
 - c. Install MSS SP-58, Type 40, protective shields on cold piping with vapor barrier. Shields shall span an arc of 180 degrees.

- 1) Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe **NPS 4 (DN 100)** and larger if pipe is installed on rollers.
 - d. Shield Dimensions for Pipe: Not less than the following:
 - 1) **NPS 1/4 to NPS 3-1/2 (DN 8 to DN 90): 12 inches (305 mm)** long and **0.048 inch (1.22 mm)** thick.
 - 2) **NPS 4 (DN 100): 12 inches (305 mm)** long and **0.06 inch (1.52 mm)** thick.
 - 3) **NPS 5 and NPS 6 (DN 125 and DN 150): 18 inches (457 mm)** long and **0.06 inch (1.52 mm)** thick.
 - 4) **NPS 8 to NPS 14 (DN 200 to DN 350): 24 inches (610 mm)** long and **0.075 inch (1.91 mm)** thick.
 - 5) **NPS 16 to NPS 24 (DN 400 to DN 600): 24 inches (610 mm)** long and **0.105 inch (2.67 mm)** thick.
 - e. Pipes **NPS 8 (DN 200)** and Larger: Include wood or reinforced calcium-silicate-insulation inserts of length at least as long as protective shield.
 - f. Thermal-Hanger Shields: Install with insulation same thickness as piping insulation.
- B. Equipment Supports**
1. Fabricate structural-steel stands to suspend equipment from structure overhead or to support equipment above floor.
 2. Grouting: Place grout under supports for equipment and make bearing surface smooth.
 3. Provide lateral bracing, to prevent swaying, for equipment supports.
- C. Metal Fabrications**
1. Cut, drill, and fit miscellaneous metal fabrications for trapeze pipe hangers and equipment supports.
 2. Fit exposed connections together to form hairline joints. Field weld connections that cannot be shop welded because of shipping size limitations.
 3. Field Welding: Comply with AWS D1.1/D1.1M procedures for shielded, metal arc welding; appearance and quality of welds; and methods used in correcting welding work; and with the following:
 - a. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
 - b. Obtain fusion without undercut or overlap.
 - c. Remove welding flux immediately.
 - d. Finish welds at exposed connections so no roughness shows after finishing and so contours of welded surfaces match adjacent contours.
- D. Adjusting**
1. Hanger Adjustments: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.
 2. Trim excess length of continuous-thread hanger and support rods to **1-1/2 inches (40 mm)**.
- E. Painting**
1. Touchup: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.
 - a. Apply paint by brush or spray to provide a minimum dry film thickness of **2.0 mils (0.05 mm)**.

OR

Touchup: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal are specified in Division 9 painting Sections **OR** Section "High-Performance Coatings", **as directed**.
 2. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

F. Hanger And Support Schedule

1. Specific hanger and support requirements are in Sections specifying piping systems and equipment.
2. Comply with MSS SP-69 for pipe-hanger selections and applications that are not specified in piping system Sections.
3. Use hangers and supports with galvanized metallic coatings for piping and equipment that will not have field-applied finish.
4. Use nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.
5. Use carbon-steel pipe hangers and supports, metal trapeze pipe hangers and metal framing systems and attachments for general service applications.
6. Use stainless-steel pipe hangers and fiberglass pipe hangers and fiberglass strut systems and stainless-steel or corrosion-resistant attachments for hostile environment applications.
7. Use copper-plated pipe hangers and copper or stainless-steel attachments for copper piping and tubing.
8. Use padded hangers for piping that is subject to scratching.
9. Use thermal-hanger shield inserts for insulated piping and tubing.
10. Horizontal-Piping Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
 - a. Adjustable, Steel Clevis Hangers (MSS Type 1): For suspension of noninsulated or insulated, stationary pipes **NPS 1/2 to NPS 30 (DN 15 to DN 750)**.
 - b. Yoke-Type Pipe Clamps (MSS Type 2): For suspension of up to **1050 deg F (566 deg C)**, pipes **NPS 4 to NPS 24 (DN 100 to DN 600)**, requiring up to **4 inches (100 mm)** of insulation.
 - c. Carbon- or Alloy-Steel, Double-Bolt Pipe Clamps (MSS Type 3): For suspension of pipes **NPS 3/4 to NPS 36 (DN 20 to DN 900)**, requiring clamp flexibility and up to **4 inches (100 mm)** of insulation.
 - d. Steel Pipe Clamps (MSS Type 4): For suspension of cold and hot pipes **NPS 1/2 to NPS 24 (DN 15 to DN 600)** if little or no insulation is required.
 - e. Pipe Hangers (MSS Type 5): For suspension of pipes **NPS 1/2 to NPS 4 (DN 15 to DN 100)**, to allow off-center closure for hanger installation before pipe erection.
 - f. Adjustable, Swivel Split- or Solid-Ring Hangers (MSS Type 6): For suspension of noninsulated, stationary pipes **NPS 3/4 to NPS 8 (DN 20 to DN 200)**.
 - g. Adjustable, Steel Band Hangers (MSS Type 7): For suspension of noninsulated, stationary pipes **NPS 1/2 to NPS 8 (DN 15 to DN 200)**.
 - h. Adjustable Band Hangers (MSS Type 9): For suspension of noninsulated, stationary pipes **NPS 1/2 to NPS 8 (DN 15 to DN 200)**.
 - i. Adjustable, Swivel-Ring Band Hangers (MSS Type 10): For suspension of noninsulated, stationary pipes **NPS 1/2 to NPS 8 (DN 15 to DN 200)**.
 - j. Split Pipe Ring with or without Turnbuckle Hangers (MSS Type 11): For suspension of noninsulated, stationary pipes **NPS 3/8 to NPS 8 (DN 10 to DN 200)**.
 - k. Extension Hinged or Two-Bolt Split Pipe Clamps (MSS Type 12): For suspension of noninsulated, stationary pipes **NPS 3/8 to NPS 3 (DN 10 to DN 80)**.
 - l. U-Bolts (MSS Type 24): For support of heavy pipes **NPS 1/2 to NPS 30 (DN 15 to DN 750)**.
 - m. Clips (MSS Type 26): For support of insulated pipes not subject to expansion or contraction.
 - n. Pipe Saddle Supports (MSS Type 36): For support of pipes **NPS 4 to NPS 36 (DN 100 to DN 900)**, with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate.
 - o. Pipe Stanchion Saddles (MSS Type 37): For support of pipes **NPS 4 to NPS 36 (DN 100 to DN 900)**, with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate, and with U-bolt to retain pipe.
 - p. Adjustable Pipe Saddle Supports (MSS Type 38): For stanchion-type support for pipes **NPS 2-1/2 to NPS 36 (DN 65 to DN 900)** if vertical adjustment is required, with steel-pipe base stanchion support and cast-iron floor flange.

- q. Single-Pipe Rolls (MSS Type 41): For suspension of pipes **NPS 1 to NPS 30 (DN 25 to DN 750)**, from two rods if longitudinal movement caused by expansion and contraction might occur.
- r. Adjustable Roller Hangers (MSS Type 43): For suspension of pipes **NPS 2-1/2 to NPS 24 (DN 65 to DN 600)**, from single rod if horizontal movement caused by expansion and contraction might occur.
- s. Complete Pipe Rolls (MSS Type 44): For support of pipes **NPS 2 to NPS 42 (DN 50 to DN 1050)** if longitudinal movement caused by expansion and contraction might occur but vertical adjustment is not necessary.
- t. Pipe Roll and Plate Units (MSS Type 45): For support of pipes **NPS 2 to NPS 24 (DN 50 to DN 600)** if small horizontal movement caused by expansion and contraction might occur and vertical adjustment is not necessary.
- u. Adjustable Pipe Roll and Base Units (MSS Type 46): For support of pipes **NPS 2 to NPS 30 (DN 50 to DN 750)** if vertical and lateral adjustment during installation might be required in addition to expansion and contraction.
- 11. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
 - a. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers **NPS 3/4 to NPS 24 (DN 24 to DN 600)**.
 - b. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers **NPS 3/4 to NPS 24 (DN 20 to DN 600)** if longer ends are required for riser clamps.
- 12. Hanger-Rod Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
 - a. Steel Turnbuckles (MSS Type 13): For adjustment up to **6 inches (150 mm)** for heavy loads.
 - b. Steel Clevises (MSS Type 14): For **120 to 450 deg F (49 to 232 deg C)** piping installations.
 - c. Swivel Turnbuckles (MSS Type 15): For use with MSS Type 11, split pipe rings.
 - d. Malleable-Iron Sockets (MSS Type 16): For attaching hanger rods to various types of building attachments.
 - e. Steel Weldless Eye Nuts (MSS Type 17): For **120 to 450 deg F (49 to 232 deg C)** piping installations.
- 13. Building Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
 - a. Steel or Malleable Concrete Inserts (MSS Type 18): For upper attachment to suspend pipe hangers from concrete ceiling.
 - b. Top-Beam C-Clamps (MSS Type 19): For use under roof installations with bar-joist construction, to attach to top flange of structural shape.
 - c. Side-Beam or Channel Clamps (MSS Type 20): For attaching to bottom flange of beams, channels, or angles.
 - d. Center-Beam Clamps (MSS Type 21): For attaching to center of bottom flange of beams.
 - e. Welded Beam Attachments (MSS Type 22): For attaching to bottom of beams if loads are considerable and rod sizes are large.
 - f. C-Clamps (MSS Type 23): For structural shapes.
 - g. Top-Beam Clamps (MSS Type 25): For top of beams if hanger rod is required tangent to flange edge.
 - h. Side-Beam Clamps (MSS Type 27): For bottom of steel I-beams.
 - i. Steel-Beam Clamps with Eye Nuts (MSS Type 28): For attaching to bottom of steel I-beams for heavy loads.
 - j. Linked-Steel Clamps with Eye Nuts (MSS Type 29): For attaching to bottom of steel I-beams for heavy loads, with link extensions.
 - k. Malleable-Beam Clamps with Extension Pieces (MSS Type 30): For attaching to structural steel.
 - l. Welded-Steel Brackets: For support of pipes from below or for suspending from above by using clip and rod. Use one of the following for indicated loads:

- 1) Light (MSS Type 31): 750 lb (340 kg).
- 2) Medium (MSS Type 32): 1500 lb (680 kg).
- 3) Heavy (MSS Type 33): 3000 lb (1360 kg).
- m. Side-Beam Brackets (MSS Type 34): For sides of steel or wooden beams.
- n. Plate Lugs (MSS Type 57): For attaching to steel beams if flexibility at beam is required.
- o. Horizontal Travelers (MSS Type 58): For supporting piping systems subject to linear horizontal movement where headroom is limited.
14. Saddles and Shields: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
 - a. Steel-Pipe-Covering Protection Saddles (MSS Type 39): To fill interior voids with insulation that matches adjoining insulation.
 - b. Protection Shields (MSS Type 40): Of length recommended in writing by manufacturer to prevent crushing insulation.
 - c. Thermal-Hanger Shield Inserts: For supporting insulated pipe.
15. Spring Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
 - a. Restraint-Control Devices (MSS Type 47): Where indicated to control piping movement.
 - b. Spring Cushions (MSS Type 48): For light loads if vertical movement does not exceed 1-1/4 inches (32 mm).
 - c. Spring-Cushion Roll Hangers (MSS Type 49): For equipping Type 41, roll hanger with springs.
 - d. Spring Sway Braces (MSS Type 50): To retard sway, shock, vibration, or thermal expansion in piping systems.
 - e. Variable-Spring Hangers (MSS Type 51): Preset to indicated load and limit variability factor to 25 percent to allow expansion and contraction of piping system from hanger.
 - f. Variable-Spring Base Supports (MSS Type 52): Preset to indicated load and limit variability factor to 25 percent to allow expansion and contraction of piping system from base support.
 - g. Variable-Spring Trapeze Hangers (MSS Type 53): Preset to indicated load and limit variability factor to 25 percent to allow expansion and contraction of piping system from trapeze support.
 - h. Constant Supports: For critical piping stress and if necessary to avoid transfer of stress from one support to another support, critical terminal, or connected equipment. Include auxiliary stops for erection, hydrostatic test, and load-adjustment capability. These supports include the following types:
 - 1) Horizontal (MSS Type 54): Mounted horizontally.
 - 2) Vertical (MSS Type 55): Mounted vertically.
 - 3) Trapeze (MSS Type 56): Two vertical-type supports and one trapeze member.
16. Comply with MSS SP-69 for trapeze pipe-hanger selections and applications that are not specified in piping system Sections.
17. Comply with MFMA-103 for metal framing system selections and applications that are not specified in piping system Sections.
18. Use powder-actuated fasteners or mechanical-expansion anchors instead of building attachments where required in concrete construction.
19. Use pipe positioning systems in pipe spaces behind plumbing fixtures to support supply and waste piping for plumbing fixtures.

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SECTION 22 05 48 13 - VIBRATION AND SEISMIC CONTROLS FOR PLUMBING PIPING AND EQUIPMENT

1.1 GENERAL

A. Description Of Work

1. This specification covers the furnishing and installation of vibration and seismic controls for plumbing piping and equipment. Products shall be as follows or as directed by the Owner. Installation procedures shall be in accordance with the products manufacturer's recommendations. Demolition and removal of materials shall be as required to support the work.

B. Summary

1. This Section includes the following:
 - a. Isolation pads.
 - b. Isolation mounts.
 - c. Restrained elastomeric isolation mounts.
 - d. Freestanding and Restrained spring isolators.
 - e. Housed spring mounts.
 - f. Elastomeric hangers.
 - g. Spring hangers.
 - h. Spring hangers with vertical-limit stops.
 - i. Pipe riser resilient supports.
 - j. Resilient pipe guides.
 - k. Seismic snubbers.
 - l. Restraining braces and cables.
 - m. Steel and Inertia, vibration isolation equipment bases.

C. Definitions

1. IBC: International Building Code.
2. ICC-ES: ICC-Evaluation Service.
3. OSHPD: Office of Statewide Health Planning and Development for the State of California.

D. Performance Requirements

1. Seismic-Restraint Loading:
 - a. Site Class as Defined in the IBC: **A OR B OR C OR D OR E OR F, as directed.**
 - b. Assigned Seismic Use Group or Building Category as Defined in the IBC: **I OR II OR III, as directed.**
 - 1) Component Importance Factor: **1.0 OR 1.5, as directed.**
 - 2) Component Response Modification Factor: **1.5 OR 2.5 OR 3.5 OR 5.0, as directed.**
 - 3) Component Amplification Factor: **1.0 OR 2.5, as directed.**
 - c. Design Spectral Response Acceleration at Short Periods (0.2 Second): Percentage as directed.
 - d. Design Spectral Response Acceleration at 1-Second Period: Percentage as directed.

E. Submittals

1. Product Data: For each product indicated.
2. Delegated-Design Submittal: For vibration isolation and seismic-restraint calculations and details indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
3. Welding certificates.
4. Qualification Data: For professional engineer.
5. Field quality-control test reports.

F. Quality Assurance

Vibration And Seismic Controls For Plumbing Piping And
Equipment

1. Comply with seismic-restraint requirements in the IBC unless requirements in this Section are more stringent.
2. Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
3. Seismic-restraint devices shall have horizontal and vertical load testing and analysis and shall bear anchorage preapproval OPA number from OSHPD, preapproved by ICC-ES, or preapproved by another agency acceptable to authorities having jurisdiction, showing maximum seismic-restraint ratings. Ratings based on independent testing are preferred to ratings based on calculations. If preapproved ratings are not available, submittals based on independent testing are preferred. Calculations (including combining shear and tensile loads) to support seismic-restraint designs must be signed and sealed by a qualified professional engineer.

1.2 PRODUCTS

A. Vibration Isolators

1. Pads: Arranged in single or multiple layers of sufficient stiffness for uniform loading over pad area, molded with a nonslip pattern and galvanized-steel baseplates, and factory cut to sizes that match requirements of supported equipment.
 - a. Resilient Material: Oil- and water-resistant neoprene **OR** rubber **OR** hermetically sealed compressed fiberglass, **as directed**.
2. Mounts: Double-deflection type, with molded, oil-resistant rubber, hermetically sealed compressed fiberglass, or neoprene isolator elements with factory-drilled, encapsulated top plate for bolting to equipment and with baseplate for bolting to structure. Color-code or otherwise identify to indicate capacity range.
 - a. Materials: Cast-ductile-iron or welded steel housing containing two separate and opposing, oil-resistant rubber or neoprene elements that prevent central threaded element and attachment hardware from contacting the housing during normal operation.
 - b. Neoprene: Shock-absorbing materials compounded according to the standard for bridge-bearing neoprene as defined by AASHTO.
3. Restrained Mounts: All-directional mountings with seismic restraint.
 - a. Materials: Cast-ductile-iron or welded steel housing containing two separate and opposing, oil-resistant rubber or neoprene elements that prevent central threaded element and attachment hardware from contacting the housing during normal operation.
 - b. Neoprene: Shock-absorbing materials compounded according to the standard for bridge-bearing neoprene as defined by AASHTO.
4. Spring Isolators: Freestanding, laterally stable, open-spring isolators.
 - a. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
 - b. Minimum Additional Travel: 50 percent of the required deflection at rated load.
 - c. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
 - d. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
 - e. Baseplates: Factory drilled for bolting to structure and bonded to **1/4-inch- (6-mm-)** thick, rubber isolator pad attached to baseplate underside. Baseplates shall limit floor load to **500 psig (3447 kPa)**.
 - f. Top Plate and Adjustment Bolt: Threaded top plate with adjustment bolt and cap screw to fasten and level equipment.
5. Restrained Spring Isolators: Freestanding, steel, open-spring isolators with seismic or limit-stop restraint.
 - a. Housing: Steel with resilient vertical-limit stops to prevent spring extension due to weight being removed; factory-drilled baseplate bonded to **1/4-inch- (6-mm-)** thick, neoprene or rubber isolator pad attached to baseplate underside; and adjustable equipment mounting and leveling bolt that acts as blocking during installation.

- b. Restraint: Seismic or limit-stop as required for equipment and authorities having jurisdiction.
 - c. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
 - d. Minimum Additional Travel: 50 percent of the required deflection at rated load.
 - e. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
 - f. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
6. Housed Spring Mounts: Housed spring isolator with integral seismic snubbers.
 - a. Housing: Ductile-iron or steel housing to provide all-directional seismic restraint.
 - b. Base: Factory drilled for bolting to structure.
 - c. Snubbers: Vertically adjustable to allow a maximum of 1/4-inch (6-mm) travel up or down before contacting a resilient collar.
7. Elastomeric Hangers: Single or double-deflection type, fitted with molded, oil-resistant elastomeric isolator elements bonded to steel housings with threaded connections for hanger rods. Color-code or otherwise identify to indicate capacity range.
8. Spring Hangers: Combination coil-spring and elastomeric-insert hanger with spring and insert in compression.
 - a. Frame: Steel, fabricated for connection to threaded hanger rods and to allow for a maximum of 30 degrees of angular hanger-rod misalignment without binding or reducing isolation efficiency.
 - b. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
 - c. Minimum Additional Travel: 50 percent of the required deflection at rated load.
 - d. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
 - e. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
 - f. Elastomeric Element: Molded, oil-resistant rubber or neoprene. Steel-washer-reinforced cup to support spring and bushing projecting through bottom of frame.
 - g. Self-centering hanger rod cap to ensure concentricity between hanger rod and support spring coil.
9. Spring Hangers with Vertical-Limit Stop: Combination coil-spring and elastomeric-insert hanger with spring and insert in compression and with a vertical-limit stop.
 - a. Frame: Steel, fabricated for connection to threaded hanger rods and to allow for a maximum of 30 degrees of angular hanger-rod misalignment without binding or reducing isolation efficiency.
 - b. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
 - c. Minimum Additional Travel: 50 percent of the required deflection at rated load.
 - d. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
 - e. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
 - f. Elastomeric Element: Molded, oil-resistant rubber or neoprene.
 - g. Adjustable Vertical Stop: Steel washer with neoprene washer "up-stop" on lower threaded rod.
 - h. Self-centering hanger rod cap to ensure concentricity between hanger rod and support spring coil.
10. Pipe Riser Resilient Support: All-directional, acoustical pipe anchor consisting of 2 steel tubes separated by a minimum of 1/2-inch- (13-mm-) thick neoprene. Include steel and neoprene vertical-limit stops arranged to prevent vertical travel in both directions. Design support for a maximum load on the isolation material of 500 psig (3.45 MPa) and for equal resistance in all directions.
11. Resilient Pipe Guides: Telescopic arrangement of 2 steel tubes or post and sleeve arrangement separated by a minimum of 1/2-inch- (13-mm-) thick neoprene. Where clearances are not readily visible, a factory-set guide height with a shear pin to allow vertical motion due to pipe expansion

and contraction shall be fitted. Shear pin shall be removable and reinsertable to allow for selection of pipe movement. Guides shall be capable of motion to meet location requirements.

B. Vibration Isolation Equipment Bases

1. Steel Base: Factory-fabricated, welded, structural-steel bases and rails.
 - a. Design Requirements: Lowest possible mounting height with not less than **1-inch (25-mm)** clearance above the floor. Include equipment anchor bolts and auxiliary motor slide bases or rails.
 - 1) Include supports for suction and discharge elbows for pumps.
 - b. Structural Steel: Steel shapes, plates, and bars complying with ASTM A 36/A 36M. Bases shall have shape to accommodate supported equipment.
 - c. Support Brackets: Factory-welded steel brackets on frame for outrigger isolation mountings and to provide for anchor bolts and equipment support.
2. Inertia Base: Factory-fabricated, welded, structural-steel bases and rails ready for placement of cast-in-place concrete.
 - a. Design Requirements: Lowest possible mounting height with not less than **1-inch (25-mm)** clearance above the floor. Include equipment anchor bolts and auxiliary motor slide bases or rails.
 - 1) Include supports for suction and discharge elbows for pumps.
 - b. Structural Steel: Steel shapes, plates, and bars complying with ASTM A 36/A 36M. Bases shall have shape to accommodate supported equipment.
 - c. Support Brackets: Factory-welded steel brackets on frame for outrigger isolation mountings and to provide for anchor bolts and equipment support.
 - d. Fabrication: Fabricate steel templates to hold equipment anchor-bolt sleeves and anchors in place during placement of concrete. Obtain anchor-bolt templates from supported equipment manufacturer.

C. Seismic-Restraint Devices

1. General Requirements for Restraint Components: Rated strengths, features, and applications shall be as defined in reports by an evaluation service member of ICC-ES **OR** OSHPD **OR** an agency acceptable to authorities having jurisdiction, **as directed**.
 - a. Structural Safety Factor: Allowable strength in tension, shear, and pullout force of components shall be at least four times the maximum seismic forces to which they will be subjected.
2. Snubbers: Factory fabricated using welded structural-steel shapes and plates, anchor bolts, and replaceable resilient isolation washers and bushings.
 - a. Anchor bolts for attaching to concrete shall be seismic-rated, drill-in, and stud-wedge or female-wedge type.
 - b. Resilient Isolation Washers and Bushings: Oil- and water-resistant neoprene.
 - c. Maximum **1/4-inch (6-mm)** air gap, and minimum **1/4-inch- (6-mm-)** thick resilient cushion.
3. Channel Support System: MFMA-3, shop- or field-fabricated support assembly made of slotted steel channels with accessories for attachment to braced component at one end and to building structure at the other end and other matching components and with corrosion-resistant coating; and rated in tension, compression, and torsion forces.
4. Restraint Cables: ASTM A 603 galvanized-steel **OR** ASTM A 492 stainless-steel, **as directed**, cables with end connections made of steel assemblies with thimbles, brackets, swivel, and bolts designed for restraining cable service; and with a minimum of two clamping bolts for cable engagement.
5. Hanger Rod Stiffener: Steel tube or steel slotted-support-system sleeve with internally bolted connections **OR** Reinforcing steel angle clamped, **as directed**, to hanger rod.
6. Bushings for Floor-Mounted Equipment Anchor Bolts: Neoprene bushings designed for rigid equipment mountings, and matched to type and size of anchor bolts and studs.

7. Bushing Assemblies for Wall-Mounted Equipment Anchorage: Assemblies of neoprene elements and steel sleeves designed for rigid equipment mountings, and matched to type and size of attachment devices used.
8. Resilient Isolation Washers and Bushings: One-piece, molded, oil- and water-resistant neoprene, with a flat washer face.
9. Mechanical Anchor Bolts: Drilled-in and stud-wedge or female-wedge type in zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchor bolts with strength required for anchor and as tested according to ASTM E 488. Minimum length of eight times diameter.
10. Adhesive Anchor Bolts: Drilled-in and capsule anchor system containing polyvinyl or urethane methacrylate-based resin and accelerator, or injected polymer or hybrid mortar adhesive. Provide anchor bolts and hardware with zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchor bolts with strength required for anchor and as tested according to ASTM E 488.

D. Factory Finishes

1. Finish:
 - a. Manufacturer's standard prime-coat finish ready for field painting.
OR
Manufacturer's standard paint applied to factory-assembled and -tested equipment before shipping.
 - 1) Powder coating on springs and housings.
 - 2) All hardware shall be galvanized. Hot-dip galvanize metal components for exterior use.
 - 3) Baked enamel or powder coat for metal components on isolators for interior use.
 - 4) Color-code or otherwise mark vibration isolation and seismic-control devices to indicate capacity range.

1.3 EXECUTION

A. Applications

1. Multiple Pipe Supports: Secure pipes to trapeze member with clamps approved for application by an evaluation service member of ICC-ES **OR** OSHPD **OR** an agency acceptable to authorities having jurisdiction, **as directed**.
2. Hanger Rod Stiffeners: Install hanger rod stiffeners where indicated or scheduled on Drawings to receive them and where required to prevent buckling of hanger rods due to seismic forces.
3. Strength of Support and Seismic-Restraint Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static and seismic loads within specified loading limits.

B. Vibration-Control And Seismic-Restraint Device Installation

1. Equipment Restraints:
 - a. Install seismic snubbers on plumbing equipment mounted on vibration isolators. Locate snubbers as close as possible to vibration isolators and bolt to equipment base and supporting structure.
 - b. Install resilient bolt isolation washers on equipment anchor bolts where clearance between anchor and adjacent surface exceeds **0.125 inches (3.2 mm)**.
 - c. Install seismic-restraint devices using methods approved by an evaluation service member of ICC-ES **OR** OSHPD **OR** an agency acceptable to authorities having jurisdiction, **as directed**, providing required submittals for component.
2. Piping Restraints:
 - a. Comply with requirements in MSS SP-127.
 - b. Space lateral supports a maximum of **40 feet (12 m)** o.c., and longitudinal supports a maximum of **80 feet (24 m)** o.c.

- c. Brace a change of direction longer than **12 feet (3.7 m)**.
 3. Install cables so they do not bend across edges of adjacent equipment or building structure.
 4. Install seismic-restraint devices using methods approved by an evaluation service member of ICC-ES **OR** OSHPD **OR** an agency acceptable to authorities having jurisdiction, **as directed**, providing required submittals for component.
 5. Install bushing assemblies for anchor bolts for floor-mounted equipment, arranged to provide resilient media between anchor bolt and mounting hole in concrete base.
 6. Install bushing assemblies for mounting bolts for wall-mounted equipment, arranged to provide resilient media where equipment or equipment-mounting channels are attached to wall.
 7. Attachment to Structure: If specific attachment is not indicated, anchor bracing to structure at flanges of beams, at upper truss chords of bar joists, or at concrete members.
 8. Drilled-in Anchors:
 - a. Identify position of reinforcing steel and other embedded items prior to drilling holes for anchors. Do not damage existing reinforcing or embedded items during coring or drilling. Notify the structural engineer if reinforcing steel or other embedded items are encountered during drilling. Locate and avoid prestressed tendons, electrical and telecommunications conduit, and gas lines.
 - b. Do not drill holes in concrete or masonry until concrete, mortar, or grout has achieved full design strength.
 - c. Wedge Anchors: Protect threads from damage during anchor installation. Heavy-duty sleeve anchors shall be installed with sleeve fully engaged in the structural element to which anchor is to be fastened.
 - d. Adhesive Anchors: Clean holes to remove loose material and drilling dust prior to installation of adhesive. Place adhesive in holes proceeding from the bottom of the hole and progressing toward the surface in such a manner as to avoid introduction of air pockets in the adhesive.
 - e. Set anchors to manufacturer's recommended torque, using a torque wrench.
 - f. Install zinc-coated steel anchors for interior and stainless steel anchors for exterior applications.
- C. Accommodation Of Differential Seismic Motion
1. Install flexible connections in piping where they cross seismic joints, where adjacent sections or branches are supported by different structural elements, and where the connections terminate with connection to equipment that is anchored to a different structural element from the one supporting the connections as they approach equipment. Comply with requirements in Division 22 Section "Domestic Water Piping" for piping flexible connections.
- D. Field Quality Control
1. Perform tests and inspections.
 2. Tests and Inspections:
 - a. Provide evidence of recent calibration of test equipment by a testing agency acceptable to authorities having jurisdiction.
 - b. Schedule test with the Owner before connecting anchorage device to restrained component (unless postconnection testing has been approved), and with at least seven days' advance notice.
 - c. Obtain approval before transmitting test loads to structure. Provide temporary load-spreading members.
 - d. Test at least four of each type and size of installed anchors and fasteners selected.
 - e. Test to 90 percent of rated proof load of device.
 - f. Measure isolator restraint clearance.
 - g. Measure isolator deflection.
 - h. Verify snubber minimum clearances.
 - i. Air-Mounting System Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.

- j. Air-Mounting System Operational Test: Test the compressed-air leveling system.
 - k. Test and adjust air-mounting system controls and safeties.
 - l. If a device fails test, modify all installations of same type and retest until satisfactory results are achieved.
 3. Remove and replace malfunctioning units and retest as specified above.
 4. Prepare test and inspection reports.
- E. Adjusting
1. Adjust isolators after piping system is at operating weight.
 2. Adjust limit stops on restrained spring isolators to mount equipment at normal operating height. After equipment installation is complete, adjust limit stops so they are out of contact during normal operation.
 3. Adjust active height of sprint isolators.
 4. Adjust restraints to permit free movement of equipment within normal mode of operation.

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SECTION 22 05 53 00 - IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT

1.1 GENERAL

A. Description Of Work

1. This specification covers the furnishing and installation of materials for identification for plumbing piping and equipment. Products shall be as follows or as directed by the Owner. Installation procedures shall be in accordance with the products manufacturer's recommendations. Demolition and removal of materials shall be as required to support the work.

B. Summary

1. Section Includes:
 - a. Equipment labels.
 - b. Warning signs and labels.
 - c. Pipe labels.
 - d. Stencils.
 - e. Valve tags.
 - f. Warning tags.

C. Submittals

1. Product Data: For each type of product indicated.

1.2 PRODUCTS

A. Equipment Labels

1. Metal Labels for Equipment:
 - a. Material and Thickness: Brass, **0.032-inch (0.8-mm)** OR Stainless steel, **0.025-inch (0.64-mm)** OR Aluminum, **0.032-inch (0.8-mm)** OR anodized aluminum, **0.032-inch (0.8-mm)**, **as directed**, minimum thickness, and having predrilled or stamped holes for attachment hardware.
 - b. Minimum Label Size: Length and width vary for required label content, but not less than **2-1/2 by 3/4 inch (64 by 19 mm)**.
 - c. Minimum Letter Size: **1/4 inch (6.4 mm)** for name of units if viewing distance is less than **24 inches (600 mm)**, **1/2 inch (13 mm)** for viewing distances up to **72 inches (1830 mm)**, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
 - d. Fasteners: Stainless-steel rivets OR self-tapping screws, **as directed**.
 - e. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
2. Plastic Labels for Equipment:
 - a. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, **1/16 inch (1.6 mm)** OR **1/8 inch (3.2 mm)**, **as directed**, thick, and having predrilled holes for attachment hardware.
 - b. Letter Color: Black OR Blue OR Red OR White OR Yellow, **as directed**.
 - c. Background Color: Black OR Blue OR Red OR White OR Yellow, **as directed**.
 - d. Maximum Temperature: Able to withstand temperatures up to **160 deg F (71 deg C)**.
 - e. Minimum Label Size: Length and width vary for required label content, but not less than **2-1/2 by 3/4 inch (64 by 19 mm)**.
 - f. Minimum Letter Size: **1/4 inch (6.4 mm)** for name of units if viewing distance is less than **24 inches (600 mm)**, **1/2 inch (13 mm)** for viewing distances up to **72 inches (1830 mm)**, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
 - g. Fasteners: Stainless-steel rivets OR self-tapping screws, **as directed**.
 - h. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

3. Label Content: Include equipment's Drawing designation or unique equipment number, Drawing numbers where equipment is indicated (plans, details, and schedules), plus the Specification Section number and title where equipment is specified.
 4. Equipment Label Schedule: For each item of equipment to be labeled, on **8-1/2-by-11-inch (A4)** bond paper. Tabulate equipment identification number and identify Drawing numbers where equipment is indicated (plans, details, and schedules), plus the Specification Section number and title where equipment is specified. Equipment schedule shall be included in operation and maintenance data.
- B. Warning Signs And Labels
1. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, **1/16 inch (1.6 mm) OR 1/8 inch (3.2 mm), as directed**, thick, and having predrilled holes for attachment hardware.
 2. Letter Color: Black **OR** Blue **OR** Red **OR** White **OR** Yellow, **as directed**.
 3. Background Color: Black **OR** Blue **OR** Red **OR** White **OR** Yellow, **as directed**.
 4. Maximum Temperature: Able to withstand temperatures up to **160 deg F (71 deg C)**.
 5. Minimum Label Size: Length and width vary for required label content, but not less than **2-1/2 by 3/4 inch (64 by 19 mm)**.
 6. Minimum Letter Size: **1/4 inch (6.4 mm)** for name of units if viewing distance is less than **24 inches (600 mm)**, **1/2 inch (13 mm)** for viewing distances up to **72 inches (1830 mm)**, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
 7. Fasteners: Stainless-steel rivets **OR** self-tapping screws, **as directed**.
 8. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
 9. Label Content: Include caution and warning information, plus emergency notification instructions.
- C. Pipe Labels
1. General Requirements for Manufactured Pipe Labels: Preprinted, color-coded, with lettering indicating service, and showing flow direction.
 2. Pretensioned Pipe Labels: Precoiled, semirigid plastic formed to partially cover **OR** cover full, **as directed**, circumference of pipe and to attach to pipe without fasteners or adhesive.
 3. Self-Adhesive Pipe Labels: Printed plastic with contact-type, permanent-adhesive backing.
 4. Pipe Label Contents: Include identification of piping service using same designations or abbreviations as used on Drawings, pipe size, and an arrow indicating flow direction.
 - a. Flow-Direction Arrows: Integral with piping system service lettering to accommodate both directions, or as separate unit on each pipe label to indicate flow direction.
 - b. Lettering Size: At least **1-1/2 inches (38 mm)** high.
- D. Stencils
1. Stencils: Prepared with letter sizes according to ASME A13.1 for piping; and minimum letter height of **3/4 inch (19 mm)** for access panel and door labels, equipment labels, and similar operational instructions.
 - a. Stencil Material: Aluminum **OR** Brass **OR** Fiberboard, **as directed**.
 - b. Stencil Paint: Exterior, gloss, alkyd enamel **OR** acrylic enamel, **as directed**, black unless otherwise indicated. Paint may be in pressurized spray-can form.
 - c. Identification Paint: Exterior, alkyd enamel **OR** acrylic enamel, **as directed**, in colors according to ASME A13.1 unless otherwise indicated.
- E. Valve Tags
1. Valve Tags: Stamped or engraved with **1/4-inch (6.4-mm)** letters for piping system abbreviation and **1/2-inch (13-mm)** numbers.
 - a. Tag Material: Brass, **0.032-inch (0.8-mm) OR** Stainless steel, **0.025-inch (0.64-mm) OR** Aluminum, **0.032-inch (0.8-mm) OR** anodized aluminum, **0.032-inch (0.8-mm), as directed**, minimum thickness, and having predrilled or stamped holes for attachment hardware.

- b. Fasteners: Brass wire-link chain **OR** beaded chain **OR** S-hook, **as directed**.
- 2. Valve Schedules: For each piping system, on **8-1/2-by-11-inch (A4)** bond paper. Tabulate valve number, piping system, system abbreviation (as shown on valve tag), location of valve (room or space), normal-operating position (open, closed, or modulating), and variations for identification. Mark valves for emergency shutoff and similar special uses.
 - a. Valve-tag schedule shall be included in operation and maintenance data.

F. Warning Tags

- 1. Warning Tags: Preprinted or partially preprinted, accident-prevention tags, of plasticized card stock with matte finish suitable for writing.
 - a. Size: **3 by 5-1/4 inches (75 by 133 mm)** minimum **OR** Approximately **4 by 7 inches (100 by 178 mm)**, **as directed**.
 - b. Fasteners: Brass grommet and wire **OR** Reinforced grommet and wire or string, **as directed**.
 - c. Nomenclature: Large-size primary caption such as "DANGER," "CAUTION," or "DO NOT OPERATE."
 - d. Color: Yellow background with black lettering.

1.3 EXECUTION

A. Preparation

- 1. Clean piping and equipment surfaces of substances that could impair bond of identification devices, including dirt, oil, grease, release agents, and incompatible primers, paints, and encapsulants.

B. Equipment Label Installation

- 1. Install or permanently fasten labels on each major item of mechanical equipment.
- 2. Locate equipment labels where accessible and visible.

C. Pipe Label Installation

- 1. Piping Color-Coding: Painting of piping is specified in Division 09 Section(s) "Interior Painting" **OR** "High-performance Coatings", **as directed**.
- 2. Stenciled Pipe Label Option: Stenciled labels may be provided instead of manufactured pipe labels, at Installer's option. Install stenciled pipe labels with painted, color-coded bands or rectangles **OR** complying with ASME A13.1, **as directed**, on each piping system.
 - a. Identification Paint: Use for contrasting background.
 - b. Stencil Paint: Use for pipe marking.
- 3. Locate pipe labels where piping is exposed or above accessible ceilings in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior exposed locations as follows:
 - a. Near each valve and control device.
 - b. Near each branch connection, excluding short takeoffs for fixtures and terminal units. Where flow pattern is not obvious, mark each pipe at branch.
 - c. Near penetrations through walls, floors, ceilings, and inaccessible enclosures.
 - d. At access doors, manholes, and similar access points that permit view of concealed piping.
 - e. Near major equipment items and other points of origination and termination.
 - f. Spaced at maximum intervals of **50 feet (15 m)** along each run. Reduce intervals to **25 feet (7.6 m)** in areas of congested piping and equipment.
 - g. On piping above removable acoustical ceilings. Omit intermediately spaced labels.
- 4. Pipe Label Color Schedule:
 - a. Low-Pressure, Compressed-Air Piping:
 - 1) Background Color: Black **OR** Blue **OR** Red **OR** White **OR** Yellow, **as directed**.
 - 2) Letter Color: Black **OR** Blue **OR** Red **OR** White **OR** Yellow, **as directed**.
 - b. Medium-Pressure, Compressed-Air Piping:
 - 1) Background Color: Black **OR** Blue **OR** Red **OR** White **OR** Yellow, **as directed**.

- 2) Letter Color: Black **OR** Blue **OR** Red **OR** White **OR** Yellow, **as directed**.
- c. Domestic Water Piping:
 - 1) Background Color: Black **OR** Blue **OR** Red **OR** White **OR** Yellow, **as directed**.
 - 2) Letter Color: Black **OR** Blue **OR** Red **OR** White **OR** Yellow, **as directed**.
- d. Sanitary Waste and Storm Drainage Piping:
 - 1) Background Color: Black **OR** Blue **OR** Red **OR** White **OR** Yellow, **as directed**.
 - 2) Letter Color: Black **OR** Blue **OR** Red **OR** White **OR** Yellow, **as directed**.

D. Valve-Tag Installation

- 1. Install tags on valves and control devices in piping systems, except check valves; valves within factory-fabricated equipment units; shutoff valves; faucets; convenience and lawn-watering hose connections; and similar roughing-in connections of end-use fixtures and units. List tagged valves in a valve schedule.
- 2. Valve-Tag Application Schedule: Tag valves according to size, shape, and color scheme and with captions similar to those indicated in the following subparagraphs:
 - a. Valve-Tag Size and Shape:
 - 1) Cold Water: 1-1/2 inches (38 mm) **OR** 2 inches (50 mm), **as directed**, round **OR** square, **as directed**.
 - 2) Hot Water: 1-1/2 inches (38 mm) **OR** 2 inches (50 mm), **as directed**, round **OR** square, **as directed**.
 - 3) Low-Pressure Compressed Air: 1-1/2 inches (38 mm) **OR** 2 inches (50 mm), **as directed**, round **OR** square, **as directed**.
 - 4) High-Pressure Compressed Air: 1-1/2 inches (38 mm) **OR** 2 inches (50 mm), **as directed**, round **OR** square, **as directed**.
 - b. Valve-Tag Color:
 - 1) Cold Water: Natural **OR** Green, **as directed**.
 - 2) Hot Water: Natural **OR** Green, **as directed**.
 - 3) Low-Pressure Compressed Air: Natural **OR** Green, **as directed**.
 - 4) High-Pressure Compressed Air: Natural **OR** Green, **as directed**.
 - c. Letter Color:
 - 1) Cold Water: Black **OR** White, **as directed**.
 - 2) Hot Water: Black **OR** White, **as directed**.
 - 3) Low-Pressure Compressed Air: Black **OR** White, **as directed**.
 - 4) High-Pressure Compressed Air: Black **OR** White, **as directed**.

E. Warning-Tag Installation

- 1. Write required message on, and attach warning tags to, equipment and other items where required.

END OF SECTION 22 05 53 00

SECTION 22 05 76 00 - SANITARY SEWERAGE

1.1 GENERAL

A. Description Of Work

1. This specification covers the furnishing and installation of materials for sanitary sewerage. Products shall be as follows or as directed by the Owner. Installation procedures shall be in accordance with the product manufacturer's recommendations. Demolition and removal of materials shall be as required to support the work.

B. Summary

1. Section Includes:
 - a. Pipe and fittings.
 - b. Nonpressure and pressure couplings.
 - c. Expansion joints and deflection fittings.
 - d. Backwater valves.
 - e. Cleanouts.
 - f. Encasement for piping.
 - g. Manholes.

C. Definitions

1. FRP: Fiberglass-reinforced plastic.

D. Submittals

1. Product Data: For the following:
 - a. Expansion joints and deflection fittings.
 - b. Backwater valves.
2. Shop Drawings: For manholes. Include plans, elevations, sections, details, and frames and covers.
3. Coordination Drawings: Show pipe sizes, locations, and elevations. Show other piping in same trench and clearances from sewer system piping. Indicate interface and spatial relationship between manholes, piping, and proximate structures.
4. Profile Drawings: Show system piping in elevation. Draw profiles to horizontal scale of not less than **1 inch equals 50 feet (1:500)** and to vertical scale of not less than **1 inch equals 5 feet (1:50)**. Indicate manholes and piping. Show types, sizes, materials, and elevations of other utilities crossing system piping.
5. Product Certificates: For each type of cast-iron soil pipe and fitting, from manufacturer.
6. Field quality-control reports.

E. Delivery, Storage, And Handling

1. Do not store plastic manholes, pipe, and fittings in direct sunlight.
2. Protect pipe, pipe fittings, and seals from dirt and damage.
3. Handle manholes according to manufacturer's written rigging instructions.

F. Project Conditions

1. Interruption of Existing Sanitary Sewerage Service: Do not interrupt service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary service according to requirements indicated:
 - a. Notify the Owner no fewer than two days in advance of proposed interruption of service.
 - b. Do not proceed with interruption of service without the Owner written permission.

1.2 PRODUCTS

- A. Hub-And-Spigot, Cast-Iron Soil Pipe And Fittings
 - 1. Pipe and Fittings: ASTM A 74, Service class **OR** Service and Extra-Heavy classes **OR** Extra-Heavy class, **as directed**.
 - 2. Gaskets: ASTM C 564, rubber.
 - 3. Calking Materials: ASTM B 29, pure lead and oakum or hemp fiber.
- B. Hubless Cast-Iron Soil Pipe And Fittings
 - 1. Pipe and Fittings: ASTM A 888 or CISPI 301.
 - 2. CISPI-Trademark, Shielded Couplings:
 - a. Description: ASTM C 1277 and CISPI 310, with stainless-steel corrugated shield; stainless-steel bands and tightening devices; and ASTM C 564, rubber sleeve with integral, center pipe stop.
 - 3. Heavy-Duty, Shielded Couplings:
 - a. Description: ASTM C 1277 and ASTM C 1540, with stainless-steel shield; stainless-steel bands and tightening devices; and ASTM C 564, rubber sleeve with integral, center pipe stop.
 - 4. Cast-Iron, Shielded Couplings:
 - a. Description: ASTM C 1277 with ASTM A 48/A 48M, two-piece, cast-iron housing; stainless-steel bolts and nuts; and ASTM C 564, rubber sleeve with integral, center pipe stop.
 - 5. Unshielded Couplings:
 - a. Description: ASTM C 1277 and ASTM C 1461, rigid, sleeve-type, reducing- or transition-type mechanical coupling, with integral, center pipe stop, molded from ASTM C 1440, TPE material; with corrosion-resistant-metal tension band and tightening mechanism on each end.
- C. Ductile-Iron, Gravity Sewer Pipe And Fittings
 - 1. Pipe: ASTM A 746, for push-on joints.
 - 2. Standard Fittings: AWWA C110, ductile or gray iron, for push-on joints.
 - 3. Compact Fittings: AWWA C153, ductile iron, for push-on joints.
 - 4. Gaskets: AWWA C111, rubber.
- D. Ductile-Iron, Pressure Pipe And Fittings
 - 1. Push-on-Joint Piping:
 - a. Pipe: AWWA C151.
 - b. Standard Fittings: AWWA C110, ductile or gray iron.
 - c. Compact Fittings: AWWA C153.
 - d. Gaskets: AWWA C111, rubber, of shape matching pipe and fittings.
 - 2. Mechanical-Joint Piping:
 - a. Pipe: AWWA C151, with bolt holes in bell.
 - b. Standard Fittings: AWWA C110, ductile or gray iron, with bolt holes in bell.
 - c. Compact Fittings: AWWA C153, with bolt holes in bells.
 - d. Glands: Cast or ductile iron; with bolt holes and high-strength, cast-iron or high-strength, low-alloy steel bolts and nuts.
 - e. Gaskets: AWWA C111, rubber, of shape matching pipe, fittings, and glands.
- E. ABS Pipe And Fittings
 - 1. ABS Sewer Pipe and Fittings: ASTM D 2751, with bell-and-spigot ends for gasketed joints.
 - a. **NPS 3 to NPS 6 (DN 80 to DN 150):** SDR 35.
 - b. **NPS 8 to NPS 12 (DN 200 to DN 300):** SDR 42.
 - 2. Gaskets: ASTM F 477, elastomeric seals.
- F. PVC Pipe And Fittings

1. PVC Cellular-Core Sewer Piping:
 - a. Pipe: ASTM F 891, Sewer and Drain Series, PS 50 minimum stiffness, PVC cellular-core pipe with plain ends for solvent-cemented joints.
 - b. Fittings: ASTM D 3034, SDR 35, PVC socket-type fittings.
 2. PVC Corrugated Sewer Piping:
 - a. Pipe: ASTM F 949, PVC corrugated pipe with bell-and-spigot ends for gasketed joints.
 - b. Fittings: ASTM F 949, PVC molded or fabricated, socket type.
 - c. Gaskets: ASTM F 477, elastomeric seals.
 3. PVC Profile Sewer Piping:
 - a. Pipe: ASTM F 794, PVC profile, gravity sewer pipe with bell-and-spigot ends for gasketed joints.
 - b. Fittings: ASTM D 3034, PVC with bell ends.
 - c. Gaskets: ASTM F 477, elastomeric seals.
 4. PVC Type PSM Sewer Piping:
 - a. Pipe: ASTM D 3034, SDR 35, PVC Type PSM sewer pipe with bell-and-spigot ends for gasketed joints.
 - b. Fittings: ASTM D 3034, PVC with bell ends.
 - c. Gaskets: ASTM F 477, elastomeric seals.
 5. PVC Gravity Sewer Piping:
 - a. Pipe and Fittings: ASTM F 679, T-1 **OR** T-2, **as directed**, wall thickness, PVC gravity sewer pipe with bell-and-spigot ends and with integral ASTM F 477, elastomeric seals for gasketed joints.
 6. PVC Pressure Piping:
 - a. Pipe: AWWA C900, Class 100 **OR** Class 150 **OR** Class 200, **as directed**, PVC pipe with bell-and-spigot ends for gasketed joints.
 - b. Fittings: AWWA C900, Class 100 **OR** Class 150 **OR** Class 200, **as directed**, PVC pipe with bell ends.
 - c. Gaskets: ASTM F 477, elastomeric seals.
 7. PVC Water-Service Piping:
 - a. Pipe: ASTM D 1785, Schedule 40 **OR** Schedule 80, **as directed**, PVC, with plain ends for solvent-cemented joints.
 - b. Fittings: ASTM D 2466, Schedule 40 **OR** ASTM D 2467, Schedule 80, **as directed**, PVC, socket type.
- G. Fiberglass Pipe And Fittings
1. Fiberglass Sewer Pipe: ASTM D 3262, RTRP, for gasketed joints fabricated with Type 2, polyester **OR** Type 4, epoxy, **as directed**, resin.
 - a. Liner: Reinforced thermoset **OR** Nonreinforced thermoset **OR** Thermoplastic **OR** No liner, **as directed**.
 - b. Grade: Reinforced, surface layer matching pipe resin **OR** Nonreinforced, surface layer matching pipe resin **OR** No surface layer, **as directed**.
 - c. Stiffness: 9 psig (62 kPa) **OR** 18 psig (124 kPa) **OR** 36 psig (248 kPa) **OR** 72 psig (496 kPa), **as directed**.
 2. Fiberglass Nonpressure Fittings: ASTM D 3840, RTRF, for gasketed joints.
 - a. Laminating Resin: Type 1, polyester **OR** Type 2, epoxy, **as directed**, resin.
 - b. Reinforcement: Grade with finish compatible with resin.
 3. Gaskets: ASTM F 477, elastomeric seals.
- H. Concrete Pipe And Fittings
1. Nonreinforced-Concrete Sewer Pipe and Fittings: ASTM C 14 (ASTM C 14M), Class 1 **OR** Class 2 **OR** Class 3, **as directed**, with bell-and-spigot **OR** tongue-and-groove, **as directed**, ends for gasketed joints with ASTM C 443 (ASTM C 443M), rubber gaskets.
 2. Reinforced-Concrete Sewer Pipe and Fittings: ASTM C 76 (ASTM C 76M).
 - a. Bell-and-spigot **OR** tongue-and-groove, **as directed**, ends for gasketed joints, with ASTM C 443 (ASTM C 443M), rubber gaskets.
 - b. Class II, Wall A **OR** Wall B **OR** Wall C, **as directed**.

- c. Class III, Wall A **OR** Wall B **OR** Wall C, **as directed**.
 - d. Class IV, Wall A **OR** Wall B **OR** Wall C, **as directed**.
 - e. Class V, Wall A **OR** Wall B, **as directed**.
- I. Nonpressure-Type Transition Couplings
- 1. Comply with ASTM C 1173, elastomeric, sleeve-type, reducing or transition coupling, for joining underground nonpressure piping. Include ends of same sizes as piping to be joined and corrosion-resistant-metal tension band and tightening mechanism on each end.
 - 2. Sleeve Materials:
 - a. For Cast-Iron Soil Pipes: ASTM C 564, rubber.
 - b. For Concrete Pipes: **ASTM C 443 (ASTM C 443M)**, rubber.
 - c. For Fiberglass Pipes: ASTM F 477, elastomeric seal or ASTM D 5926, PVC.
 - d. For Plastic Pipes: ASTM F 477, elastomeric seal or ASTM D 5926, PVC.
 - e. For Dissimilar Pipes: ASTM D 5926, PVC or other material compatible with pipe materials being joined.
 - 3. Unshielded, Flexible Couplings:
 - a. Description: Elastomeric sleeve, with stainless-steel shear ring, **as directed**, and corrosion-resistant-metal tension band and tightening mechanism on each end.
 - 4. Shielded, Flexible Couplings:
 - a. Description: ASTM C 1460, elastomeric or rubber sleeve with full-length, corrosion-resistant outer shield and corrosion-resistant-metal tension band and tightening mechanism on each end.
 - 5. Ring-Type, Flexible Couplings:
 - a. Description: Elastomeric compression seal with dimensions to fit inside bell of larger pipe and for spigot of smaller pipe to fit inside ring.
 - 6. Nonpressure-Type, Rigid Couplings:
 - a. Description: ASTM C 1461, sleeve-type, reducing- or transition-type mechanical coupling, molded from ASTM C 1440, TPE material; with corrosion-resistant-metal tension band and tightening mechanism on each end.
- J. Pressure-Type Pipe Couplings
- 1. Tubular-Sleeve Couplings: AWWA C219, with center sleeve, gaskets, end rings, and bolt fasteners.
 - 2. Metal, bolted, sleeve-type, reducing or transition coupling, for joining underground pressure piping. Include **150-psig (1035-kPa) OR 200-psig (1380-kPa)**, **as directed**, minimum pressure rating and ends of same sizes as piping to be joined.
 - 3. Center-Sleeve Material: Manufacturer's standard **OR** Carbon steel **OR** Stainless steel **OR** Ductile iron **OR** Malleable iron, **as directed**.
 - 4. Gasket Material: Natural or synthetic rubber.
 - 5. Metal Component Finish: Corrosion-resistant coating or material.
- K. Expansion Joints And Deflection Fittings
- 1. Ductile-Iron, Flexible Expansion Joints:
 - a. Description: Compound fitting with combination of flanged and mechanical-joint ends complying with AWWA C110 or AWWA C153. Include two gasketed ball-joint sections and one or more gasketed sleeve sections, rated for **250-psig (1725-kPa)** minimum working pressure and for offset and expansion indicated.
 - 2. Ductile-Iron Expansion Joints:
 - a. Description: Three-piece assembly of telescoping sleeve with gaskets and restrained-type, ductile-iron, bell-and-spigot end sections complying with AWWA C110 or AWWA C153. Include rating for **250-psig (1725-kPa)** minimum working pressure and for expansion indicated.
 - 3. Ductile-Iron Deflection Fittings:

- a. Description: Compound coupling fitting with ball joint, flexing section, gaskets, and restrained-joint ends complying with AWWA C110 or AWWA C153. Include rating for **250-psig (1725-kPa)** minimum working pressure and for up to 15 degrees of deflection.
- L. Backwater Valves
- 1. Cast-Iron Backwater Valves:
 - a. Description: ASME A112.14.1, gray-iron body and bolted cover, with bronze seat.
 - b. Horizontal type; with swing check valve and hub-and-spigot ends.
 - c. Combination horizontal and manual gate-valve type; with swing check valve, integral gate valve, and hub-and-spigot ends.
 - d. Terminal type; with bronze seat, swing check valve, and hub inlet.
 - 2. PVC Backwater Valves:
 - a. Description: Horizontal type; with PVC body, PVC removable cover, and PVC swing check valve.
- M. Cleanouts
- 1. Cast-Iron Cleanouts:
 - a. Description: ASME A112.36.2M, round, gray-iron housing with clamping device and round, secured, scoriated, gray-iron cover. Include gray-iron ferrule with inside calk or spigot connection and countersunk, tapered-thread, brass closure plug.
 - b. Top-Loading Classification(s): Light Duty **OR** Medium Duty **OR** Heavy Duty **OR** Extra-Heavy Duty, **as directed**.
 - c. Sewer Pipe Fitting and Riser to Cleanout: ASTM A 74, Service class, cast-iron soil pipe and fittings.
 - 2. PVC Cleanouts:
 - a. Description: PVC body with PVC threaded plug. Include PVC sewer pipe fitting and riser to cleanout of same material as sewer piping.
- N. Encasement For Piping
- 1. Standard: ASTM A 674 or AWWA C105.
 - 2. Material: Linear low-density polyethylene film of 0.008-inch (0.20-mm) **OR** high-density, cross-laminated polyethylene film of 0.004-inch (0.10-mm), **as directed**, minimum thickness.
 - 3. Form: Sheet **OR** Tube, **as directed**.
 - 4. Color: Black **OR** Natural, **as directed**.
- O. Manholes
- 1. Standard Precast Concrete Manholes:
 - a. Description: **ASTM C 478 (ASTM C 478M)**, precast, reinforced concrete, of depth indicated, with provision for sealant joints.
 - b. Diameter: **48 inches (1200 mm)** minimum unless otherwise indicated.
 - c. Ballast: Increase thickness of precast concrete sections or add concrete to base section, as required to prevent flotation.
 - d. Base Section: **6-inch (150-mm)** minimum thickness for floor slab and **4-inch (100-mm)** minimum thickness for walls and base riser section; with separate base slab or base section with integral floor.
 - e. Riser Sections: **4-inch (100-mm)** minimum thickness, of length to provide depth indicated.
 - f. Top Section: Eccentric-cone type unless concentric-cone or flat-slab-top type is indicated; with top of cone of size that matches grade rings.
 - g. Joint Sealant: **ASTM C 990 (ASTM C 990M)**, bitumen or butyl rubber.
 - h. Resilient Pipe Connectors: **ASTM C 923 (ASTM C 923M)**, cast or fitted into manhole walls, for each pipe connection.
 - i. Steps: Individual FRP steps or FRP ladder **OR** Individual FRP steps, FRP ladder, or ASTM A 615/A 615M, deformed, **1/2-inch (13-mm)** steel reinforcing rods encased in ASTM D 4101, PP **OR** ASTM A 615/A 615M, deformed, **1/2-inch (13-mm)** steel reinforcing rods encased in ASTM D 4101, PP, **as directed**; wide enough to allow worker to place both feet on one step and designed to prevent lateral slippage off step. Cast or anchor

- steps into sidewalls at **12- to 16-inch (300- to 400-mm)** intervals. Omit steps if total depth from floor of manhole to finished grade is less than **60 inches (1500 mm)**.
- j. Adjusting Rings: Interlocking HDPE rings, with level or sloped edge in thickness and diameter matching manhole frame and cover, and with height as required to adjust manhole frame and cover to indicated elevation and slope. Include sealant recommended by ring manufacturer.
OR
Grade Rings: Reinforced-concrete rings, **6- to 9-inch (150- to 225-mm)** total thickness, with diameter matching manhole frame and cover, and with height as required to adjust manhole frame and cover to indicated elevation and slope.
2. Designed Precast Concrete Manholes:
 - a. Description: ASTM C 913; designed according to ASTM C 890 for A-16 (ASSHTO HS20-44), heavy-traffic, structural loading; of depth, shape, and dimensions indicated, with provision for sealant joints.
 - b. Ballast: Increase thickness of one or more precast concrete sections or add concrete to manhole as required to prevent flotation.
 - c. Joint Sealant: **ASTM C 990 (ASTM 990M)**, bitumen or butyl rubber.
 - d. Resilient Pipe Connectors: **ASTM C 923 (ASTM C 923M)**, cast or fitted into manhole walls, for each pipe connection.
 - e. Steps: Individual FRP steps or FRP ladder **OR** Individual FRP steps, FRP ladder, or ASTM A 615/A 615M, deformed, **1/2-inch (13-mm)** steel reinforcing rods encased in ASTM D 4101, PP **OR** ASTM A 615/A 615M, deformed, **1/2-inch (13-mm)** steel reinforcing rods encased in ASTM D 4101, PP, **as directed**; wide enough to allow worker to place both feet on one step and designed to prevent lateral slippage off step. Cast or anchor steps into sidewalls at **12- to 16-inch (300- to 400-mm)** intervals. Omit steps if total depth from floor of manhole to finished grade is less than **60 inches (1500 mm)**.
 - f. Adjusting Rings: Interlocking HDPE rings, with level or sloped edge in thickness and diameter matching manhole frame and cover, and with height as required to adjust manhole frame and cover to indicated elevation and slope. Include sealant recommended by ring manufacturer.
OR
Grade Rings: Reinforced-concrete rings, **6- to 9-inch (150- to 225-mm)** total thickness, with diameter matching manhole frame and cover, and with height as required to adjust manhole frame and cover to indicated elevation and slope.
 3. Fiberglass Manholes:
 - a. Description: ASTM D 3753.
 - b. Diameter: **48 inches (1200 mm)** minimum unless otherwise indicated.
 - c. Ballast: Increase thickness of concrete base as required to prevent flotation.
 - d. Base Section: Concrete, **6-inch (150-mm)** minimum thickness.
 - e. Resilient Pipe Connectors (if required): **ASTM C 923 (ASTM C 923M)**, cast or fitted into manhole walls, for each pipe connection.
 - f. Steps: Individual FRP steps or FRP ladder, wide enough to allow worker to place both feet on one step and designed to prevent lateral slippage off step. Cast or anchor steps into sidewalls at **12- to 16-inch (300- to 400-mm)** intervals. Omit steps if total depth from floor of manhole to finished grade is less than **60 inches (1500 mm)**.
 - g. Adjusting Rings: Interlocking HDPE rings, with level or sloped edge in thickness and diameter matching manhole frame and cover, and with height as required to adjust manhole frame and cover to indicated elevation and slope. Include sealant recommended by ring manufacturer.
OR
Grade Rings: Reinforced-concrete rings, **6- to 9-inch (150- to 225-mm)** total thickness, with diameter matching manhole frame and cover, and with height as required to adjust manhole frame and cover to indicated elevation and slope.
 4. Manhole Frames and Covers:

- a. Description: Ferrous; 24-inch (610-mm) ID by 7- to 9-inch (175- to 225-mm) riser, with 4-inch- (100-mm-) minimum-width flange and 26-inch- (660-mm-) diameter cover. Include indented top design with lettering cast into cover, using wording equivalent to "SANITARY SEWER."
 - b. Material: ASTM A 536, Grade 60-40-18 ductile **OR** ASTM A 48/A 48M, Class 35 gray, **as directed**, iron unless otherwise indicated.
5. Manhole-Cover Inserts:
- a. Description: Manufactured, plastic form, of size to fit between manhole frame and cover and designed to prevent stormwater inflow. Include handle for removal and gasket for gastight sealing.
 - b. Type: Solid **OR** Drainage with vent holes **OR** Valve, **as directed**.

P. Concrete

1. General: Cast-in-place concrete complying with ACI 318, **ACI 350/350R (ACI 350M/350RM)**, and the following:
 - a. Cement: ASTM C 150, Type II.
 - b. Fine Aggregate: ASTM C 33, sand.
 - c. Coarse Aggregate: ASTM C 33, crushed gravel.
 - d. Water: Potable.
2. Portland Cement Design Mix: **4000 psi (27.6 MPa)** minimum, with 0.45 maximum water/cementitious materials ratio.
 - a. Reinforcing Fabric: ASTM A 1064/A 1064M, steel, welded wire fabric, plain.
 - b. Reinforcing Bars: ASTM A 615/A 615M, Grade 60 (420 MPa) deformed steel.
3. Manhole Channels and Benches: Factory or field formed from concrete. Portland cement design mix, **4000 psi (27.6 MPa)** minimum, with 0.45 maximum water/cementitious materials ratio. Include channels and benches in manholes.
 - a. Channels: Concrete invert, formed to same width as connected piping, with height of vertical sides to three-fourths of pipe diameter. Form curved channels with smooth, uniform radius and slope.
 - 1) Invert Slope: **1 OR 2, as directed**, percent through manhole.
 - b. Benches: Concrete, sloped to drain into channel.
 - 1) Slope: **4 OR 8, as directed**, percent.
4. Ballast and Pipe Supports: Portland cement design mix, **3000 psi (20.7 MPa)** minimum, with 0.58 maximum water/cementitious materials ratio.
 - a. Reinforcing Fabric: ASTM A 1064/A 1064M, steel, welded wire fabric, plain.
 - b. Reinforcing Bars: ASTM A 615/A 615M, Grade 60 (420 MPa) deformed steel.

1.3 EXECUTION

A. Earthwork

1. Excavating, trenching, and backfilling are specified in Division 31 Section "Earth Moving".

B. Piping Installation

1. General Locations and Arrangements: Drawing plans and details indicate general location and arrangement of underground sanitary sewer piping. Location and arrangement of piping layout take into account design considerations. Install piping as indicated, to extent practical. Where specific installation is not indicated, follow piping manufacturer's written instructions.
2. Install piping beginning at low point, true to grades and alignment indicated with unbroken continuity of invert. Place bell ends of piping facing upstream. Install gaskets, seals, sleeves, and couplings according to manufacturer's written instructions for using lubricants, cements, and other installation requirements.
3. Install manholes for changes in direction unless fittings are indicated. Use fittings for branch connections unless direct tap into existing sewer is indicated.
4. Install proper size increasers, reducers, and couplings where different sizes or materials of pipes and fittings are connected. Reducing size of piping in direction of flow is prohibited.

5. When installing pipe under streets or other obstructions that cannot be disturbed, use pipe-jacking process of microtunneling.
6. Install gravity-flow, nonpressure, drainage piping according to the following:
 - a. Install piping pitched down in direction of flow, at minimum slope of 1 **OR** 2, **as directed**, percent unless otherwise indicated.
 - b. Install piping **NPS 6 (DN 150)** and larger with restrained joints at tee fittings and at changes in direction. Use corrosion-resistant rods, pipe or fitting manufacturer's proprietary restraint system, or cast-in-place-concrete supports or anchors.
 - c. Install piping with **36-inch (915-mm) OR 48-inch (1220-mm) OR 60-inch (1520-mm) OR 72-inch (1830-mm)**, **as directed**, minimum cover.
 - d. Install hub-and-spigot, cast-iron soil piping according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook."
 - e. Install hubless cast-iron soil piping according to CISPI 310 and CISPI's "Cast Iron Soil Pipe and Fittings Handbook."
 - f. Install ductile-iron, gravity sewer piping according to ASTM A 746.
 - g. Install ABS sewer piping according to ASTM D 2321 and ASTM F 1668.
 - h. Install PVC cellular-core sewer piping according to ASTM D 2321 and ASTM F 1668.
 - i. Install PVC corrugated sewer piping according to ASTM D 2321 and ASTM F 1668.
 - j. Install PVC profile sewer piping according to ASTM D 2321 and ASTM F 1668.
 - k. Install PVC Type PSM sewer piping according to ASTM D 2321 and ASTM F 1668.
 - l. Install PVC gravity sewer piping according to ASTM D 2321 and ASTM F 1668.
 - m. Install fiberglass sewer piping according to ASTM D 3839 and ASTM F 1668.
 - n. Install nonreinforced-concrete sewer piping according to ASTM C 1479 and ACPA's "Concrete Pipe Installation Manual."
 - o. Install reinforced-concrete sewer piping according to ASTM C 1479 and ACPA's "Concrete Pipe Installation Manual."
7. Install force-main, pressure piping according to the following:
 - a. Install piping with restrained joints at tee fittings and at horizontal and vertical changes in direction. Use corrosion-resistant rods, pipe or fitting manufacturer's proprietary restraint system, or cast-in-place-concrete supports or anchors.
 - b. Install piping with **36-inch (915-mm) OR 48-inch (1220-mm) OR 60-inch (1520-mm) OR 72-inch (1830-mm)**, **as directed**, minimum cover.
 - c. Install ductile-iron pressure piping according to AWWA C600 or AWWA M41.
 - d. Install ductile-iron special fittings according to AWWA C600.
 - e. Install PVC pressure piping according to AWWA M23 or to ASTM D 2774 and ASTM F 1668.
 - f. Install PVC water-service piping according to ASTM D 2774 and ASTM F 1668.
8. If required to provide protection for metal piping, install corrosion-protection piping encasement over the following underground metal piping according to ASTM A 674 or AWWA C105:
 - a. Hub-and-spigot, cast-iron soil pipe.
 - b. Hubless cast-iron soil pipe and fittings.
 - c. Ductile-iron pipe and fittings.
 - d. Expansion joints and deflection fittings.
9. Clear interior of piping and manholes of dirt and superfluous material as work progresses. Maintain swab or drag in piping, and pull past each joint as it is completed. Place plug in end of incomplete piping at end of day and when work stops.

C. Pipe Joint Construction

1. Join gravity-flow, nonpressure, drainage piping according to the following:
 - a. Join hub-and-spigot, cast-iron soil piping with gasket joints according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for compression joints.
 - b. Join hub-and-spigot, cast-iron soil piping with calked joints according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for lead and oakum calked joints.
 - c. Join hubless cast-iron soil piping according to CISPI 310 and CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for hubless-coupling joints.

- d. Join ductile-iron, gravity sewer piping according to AWWA C600 for push-on joints.
- e. Join ABS sewer piping according to ASTM D 2321 and ASTM D 2751 for elastomeric-seal joints.
- f. Join PVC cellular-core sewer piping according to ASTM D 2321 and ASTM F 891 for solvent-cemented joints.
- g. Join PVC corrugated sewer piping according to ASTM D 2321.
- h. Join PVC profile sewer piping according to ASTM D 2321 for elastomeric-seal joints or ASTM F 794 for gasketed joints.
- i. Join PVC Type PSM sewer piping according to ASTM D 2321 and ASTM D 3034 for elastomeric-seal joints or ASTM D 3034 for elastomeric-gasket joints.
- j. Join PVC gravity sewer piping according to ASTM D 2321 and ASTM D 3034 for elastomeric-seal joints or ASTM D 3034 for elastomeric-gasket joints.
- k. Join fiberglass sewer piping according to ASTM D 4161 for elastomeric-seal joints.
- l. Join nonreinforced-concrete sewer piping according to **ASTM C 14** (**ASTM C 14M**) and ACPA's "Concrete Pipe Installation Manual" for rubber-gasket joints.
- m. Join reinforced-concrete sewer piping according to ACPA's "Concrete Pipe Installation Manual" for rubber-gasket joints.
- n. Join dissimilar pipe materials with nonpressure-type, flexible **OR** rigid, **as directed**, couplings.
2. Join force-main, pressure piping according to the following:
 - a. Join ductile-iron pressure piping according to AWWA C600 or AWWA M41 for push-on joints.
 - b. Join ductile-iron special fittings according to AWWA C600 or AWWA M41 for push-on joints.
 - c. Join PVC pressure piping according to AWWA M23 for gasketed joints.
 - d. Join PVC water-service piping according to ASTM D 2855.
 - e. Join dissimilar pipe materials with pressure-type couplings.
3. Pipe couplings, expansion joints, and deflection fittings with pressure ratings at least equal to piping rating may be used in applications below unless otherwise indicated.
 - a. Use nonpressure flexible couplings where required to join gravity-flow, nonpressure sewer piping unless otherwise indicated.
 - 1) Unshielded **OR** Shielded, **as directed**, flexible **OR** rigid, **as directed**, couplings for pipes of same or slightly different OD.
 - 2) Unshielded, increaser/reducer-pattern, flexible **OR** rigid, **as directed**, couplings for pipes with different OD.
 - 3) Ring-type flexible couplings for piping of different sizes where annular space between smaller piping's OD and larger piping's ID permits installation.
 - b. Use pressure pipe couplings for force-main joints.
- D. Manhole Installation
 1. General: Install manholes complete with appurtenances and accessories indicated.
 2. Install precast concrete manhole sections with sealants according to ASTM C 891.
 3. Install FRP manholes according to manufacturer's written instructions.
 4. Form continuous concrete channels and benches between inlets and outlet.
 5. Set tops of frames and covers flush with finished surface of manholes that occur in pavements. Set tops **3 inches** (**76 mm**) above finished surface elsewhere unless otherwise indicated.
 6. Install manhole-cover inserts in frame and immediately below cover.
- E. Concrete Placement
 1. Place cast-in-place concrete according to ACI 318.
- F. Backwater Valve Installation
 1. Install horizontal-type backwater valves in piping manholes or pits.
 2. Install combination horizontal and manual gate valves in piping and in manholes.
 3. Install terminal-type backwater valves on end of piping and in manholes. Secure units to sidewalls.

G. Cleanout Installation

1. Install cleanouts and riser extensions from sewer pipes to cleanouts at grade. Use cast-iron soil pipe fittings in sewer pipes at branches for cleanouts, and use cast-iron soil pipe for riser extensions to cleanouts. Install piping so cleanouts open in direction of flow in sewer pipe.
 - a. Use Light-Duty, top-loading classification cleanouts in earth **OR** unpaved foot-traffic, **as directed**, areas.
 - b. Use Medium-Duty, top-loading classification cleanouts in paved foot-traffic areas.
 - c. Use Heavy-Duty, top-loading classification cleanouts in vehicle-traffic service areas.
 - d. Use Extra-Heavy-Duty, top-loading classification cleanouts in roads.
2. Set cleanout frames and covers in earth in cast-in-place-concrete block, **18 by 18 by 12 inches (450 by 450 by 300 mm)** deep. Set with tops **1 inch (25 mm)** above surrounding grade.
3. Set cleanout frames and covers in concrete pavement and roads with tops flush with pavement surface.

H. Connections

1. Connect nonpressure, gravity-flow drainage piping to building's sanitary building drains specified in Division 22 Section "Sanitary Waste And Vent Piping".
2. Connect force-main piping to building's sanitary force mains specified in Division 22 Section "Sanitary Waste And Vent Piping". Terminate piping where indicated.
3. Make connections to existing piping and underground manholes.
 - a. Use commercially manufactured wye fittings for piping branch connections. Remove section of existing pipe, install wye fitting into existing piping, and encase entire wye fitting plus **6-inch (150-mm)** overlap with not less than **6 inches (150 mm)** of concrete with 28-day compressive strength of **3000 psi (20.7 MPa)**.
 - b. Make branch connections from side into existing piping, **NPS 4 to NPS 20 (DN 100 to DN 500)**. Remove section of existing pipe, install wye fitting into existing piping, and encase entire wye with not less than **6 inches (150 mm)** of concrete with 28-day compressive strength of **3000 psi (20.7 MPa)**.
 - c. Make branch connections from side into existing piping, **NPS 21 (DN 525)** or larger, or to underground manholes by cutting opening into existing unit large enough to allow **3 inches (76 mm)** of concrete to be packed around entering connection. Cut end of connection pipe passing through pipe or structure wall to conform to shape of and be flush with inside wall unless otherwise indicated. On outside of pipe or manhole wall, encase entering connection in **6 inches (150 mm)** of concrete for minimum length of **12 inches (300 mm)** to provide additional support of collar from connection to undisturbed ground.
 - 1) Use concrete that will attain a minimum 28-day compressive strength of **3000 psi (20.7 MPa)** unless otherwise indicated.
 - 2) Use epoxy-bonding compound as interface between new and existing concrete and piping materials.
 - d. Protect existing piping and manholes to prevent concrete or debris from entering while making tap connections. Remove debris or other extraneous material that may accumulate.
4. Connect to grease **OR** oil **OR** sand, **as directed**, interceptors specified in Division 22 Section "Sanitary Waste Interceptors".

I. Closing Abandoned Sanitary Sewer Systems

1. Abandoned Piping: Close open ends of abandoned underground piping indicated to remain in place. Include closures strong enough to withstand hydrostatic and earth pressures that may result after ends of abandoned piping have been closed. Use either procedure below:
 - a. Close open ends of piping with at least **8-inch- (203-mm-)** thick, brick masonry bulkheads.
 - b. Close open ends of piping with threaded metal caps, plastic plugs, or other acceptable methods suitable for size and type of material being closed. Do not use wood plugs.
2. Abandoned Manholes: Excavate around manhole as required and use either procedure below:
 - a. Remove manhole and close open ends of remaining piping.

- b. Remove top of manhole down to at least **36 inches (915 mm)** below final grade. Fill to within **12 inches (300 mm)** of top with stone, rubble, gravel, or compacted dirt. Fill to top with concrete.
 3. Backfill to grade according to Division 31 Section "Earth Moving".
- J. Identification
 1. Materials and their installation are specified in Division 31 Section "Earth Moving". Arrange for installation of green warning tapes directly over piping and at outside edges of underground manholes.
 - a. Use warning tape **OR** detectable warning tape, **as directed**, over ferrous piping.
 - b. Use detectable warning tape over nonferrous piping and over edges of underground manholes.
- K. Field Quality Control
 1. Inspect interior of piping to determine whether line displacement or other damage has occurred. Inspect after approximately **24 inches (600 mm)** of backfill is in place, and again at completion of Project.
 - a. Submit separate report for each system inspection.
 - b. Defects requiring correction include the following:
 - 1) Alignment: Less than full diameter of inside of pipe is visible between structures.
 - 2) Deflection: Flexible piping with deflection that prevents passage of ball or cylinder of size not less than 92.5 percent of piping diameter.
 - 3) Damage: Crushed, broken, cracked, or otherwise damaged piping.
 - 4) Infiltration: Water leakage into piping.
 - 5) Exfiltration: Water leakage from or around piping.
 - c. Replace defective piping using new materials, and repeat inspections until defects are within allowances specified.
 - d. Reinspect and repeat procedure until results are satisfactory.
 2. Test new piping systems, and parts of existing systems that have been altered, extended, or repaired, for leaks and defects.
 - a. Do not enclose, cover, or put into service before inspection and approval.
 - b. Test completed piping systems according to requirements of authorities having jurisdiction.
 - c. Schedule tests and inspections by authorities having jurisdiction with at least 24 hours' advance notice.
 - d. Submit separate report for each test.
 - e. Hydrostatic Tests: Test sanitary sewerage according to requirements of authorities having jurisdiction and the following:
 - 1) Fill sewer piping with water. Test with pressure of at least **10-foot (3-m)** head of water, and maintain such pressure without leakage for at least 15 minutes.
 - 2) Close openings in system and fill with water.
 - 3) Purge air and refill with water.
 - 4) Disconnect water supply.
 - 5) Test and inspect joints for leaks.

OR

Air Tests: Test sanitary sewerage according to requirements of authorities having jurisdiction, UNI-B-6, and the following:

 - 6) Option: Test plastic gravity sewer piping according to ASTM F 1417.
 - 7) Option: Test concrete gravity sewer piping according to **ASTM C 924 (ASTM C 924M)**.
 - f. Force Main: Perform hydrostatic test after thrust blocks, supports, and anchors have hardened. Test at pressure not less than 1-1/2 times the maximum system operating pressure, but not less than **150 psig (1035 kPa)**.
 - 1) Ductile-Iron Piping: Test according to AWWA C600, "Hydraulic Testing" Section.
 - 2) PVC Piping: Test according to AWWA M23, "Testing and Maintenance" Chapter.
 - g. Manholes: Perform hydraulic test according to **ASTM C 969 (ASTM C 969M)**.
 3. Leaks and loss in test pressure constitute defects that must be repaired.



4. Replace leaking piping using new materials, and repeat testing until leakage is within allowances specified.

L. Cleaning

1. Clean dirt and superfluous material from interior of piping. Flush with potable water.

END OF SECTION 22 05 76 00

NOT FOR BID

SECTION 22 05 76 00a - STORM DRAINAGE PIPING SPECIALTIES

1.1 GENERAL

A. Description Of Work

1. This specification covers the furnishing and installation of materials for storm drainage piping specialties. Products shall be as follows or as directed by the Owner. Installation procedures shall be in accordance with the products manufacturer's recommendations. Demolition and removal of materials shall be as required to support the work.

B. Summary

1. Section Includes:
 - a. Roof drains.
 - b. Miscellaneous storm drainage piping specialties.
 - c. Cleanouts.
 - d. Backwater valves.
 - e. Trench drains.
 - f. Channel drainage systems.
 - g. Through-penetration firestop assemblies.
 - h. Flashing materials.

C. Submittals

1. Product Data: For each type of product indicated.

D. Quality Assurance

1. Drainage piping specialties shall bear label, stamp, or other markings of specified testing agency.

1.2 PRODUCTS

A. Metal Roof Drains

1. Cast-Iron, Large-Sump, General-Purpose Roof Drains:
 - a. Standard: ASME A112.6.4, for general-purpose roof drains.
 - b. Body Material: Cast iron.
 - c. Dimension of Body: Nominal **14-inch (357-mm)** diameter.
 - d. Combination Flashing Ring and Gravel Stop: Not required **OR** Required, **as directed**.
 - e. Flow-Control Weirs: Not required **OR** Required, **as directed**.
 - f. Outlet: Bottom **OR** Side, **as directed**.
 - g. Extension Collars: Not required **OR** Required, **as directed**.
 - h. Underdeck Clamp: Not required **OR** Required, **as directed**.
 - i. Expansion Joint: Not required **OR** Required, **as directed**.
 - j. Sump Receiver Plate: Not required **OR** Required, **as directed**.
 - k. Dome Material: Aluminum **OR** Cast iron **OR** PE **OR** Stainless steel, **as directed**.
 - l. Perforated Gravel Guard: Stainless steel **OR** Not required, **as directed**.
 - m. Vandal-Proof Dome: Not required **OR** Required, **as directed**.
 - n. Water Dam: Not required **OR** **2 inches (51 mm)** high, **as directed**.
2. Cast-Iron, Medium-Sump, General-Purpose Roof Drains:
 - a. Standard: ASME A112.6.4, for general-purpose roof drains.
 - b. Body Material: Cast iron.
 - c. Dimension of Body: **8- to 12-inch (203- to 305-mm)** diameter.
 - d. Combination Flashing Ring and Gravel Stop: Not required **OR** Required, **as directed**.
 - e. Flow-Control Weirs: Not required **OR** Required, **as directed**.
 - f. Outlet: Bottom **OR** Side, **as directed**.
 - g. Extension Collars: Not required **OR** Required, **as directed**.

- h. Underdeck Clamp: Not required **OR** Required, **as directed**.
- i. Expansion Joint: Not required **OR** Required, **as directed**.
- j. Sump Receiver Plate: Not required **OR** Required, **as directed**.
- k. Dome Material: Aluminum **OR** Cast iron **OR** Copper **OR** PE **OR** Stainless steel, **as directed**.
- l. Wire Mesh: Stainless steel or brass over dome **OR** Not required, **as directed**.
- m. Perforated Gravel Guard: Stainless steel **OR** Not required, **as directed**.
- n. Vandal-Proof Dome: Not required **OR** Required, **as directed**.
- o. Water Dam: Not required **OR 2 inches (51 mm)** high, **as directed**.
- 3. Copper, Medium-Sump, General-Purpose Roof Drains:
 - a. Standard: ASME A112.6.4, for general-purpose roof drains.
 - b. Body Material: Copper.
 - c. Dimension of Body: **8- to 12-inch (203- to 305-mm)** diameter.
 - d. Combination Flashing Ring and Gravel Stop: Not required **OR** Required, **as directed**.
 - e. Flow-Control Weirs: Not required **OR** Required, **as directed**.
 - f. Outlet: Bottom **OR** Side, **as directed**.
 - g. Extension Collars: Not required **OR** Required, **as directed**.
 - h. Underdeck Clamp: Not required **OR** Required, **as directed**.
 - i. Expansion Joint: Not required **OR** Required, **as directed**.
 - j. Sump Receiver Plate: Not required **OR** Required, **as directed**.
 - k. Dome Material: Aluminum **OR** Cast iron **OR** Copper **OR** PE **OR** Stainless steel, **as directed**.
 - l. Wire Mesh: Stainless steel or brass over dome **OR** Not required, **as directed**.
 - m. Perforated Gravel Guard: Stainless steel **OR** Not required, **as directed**.
 - n. Vandal-Proof Dome: Not required **OR** Required, **as directed**.
 - o. Water Dam: Not required **OR 2 inches (51 mm)** high, **as directed**.
- 4. Cast-Iron, Small-Sump, General-Purpose Roof Drains:
 - a. Standard: ASME A112.6.4, for general-purpose roof drains.
 - b. Body Material: Cast iron.
 - c. Dimension of Body: Nominal **8-inch (203-mm)** diameter.
 - d. Combination Flashing Ring and Gravel Stop: Not required **OR** Required, **as directed**.
 - e. Outlet: Bottom **OR** Side, **as directed**.
 - f. Extension Collars: Not required **OR** Required, **as directed**.
 - g. Underdeck Clamp: Not required **OR** Required, **as directed**.
 - h. Expansion Joint: Not required **OR** Required, **as directed**.
 - i. Sump Receiver Plate: Not required **OR** Required, **as directed**.
 - j. Dome Material: Cast iron.
 - k. Wire Mesh: Stainless steel or brass over dome **OR** Not required, **as directed**.
 - l. Vandal-Proof Dome: Not required **OR** Required, **as directed**.
- 5. Copper, Small-Sump, General-Purpose Roof Drains:
 - a. Standard: ASME A112.6.4, for general-purpose roof drains.
 - b. Body Material: Copper.
 - c. Dimension of Body: Nominal **8-inch (203-mm)** diameter.
 - d. Combination Flashing Ring and Gravel Stop: Not required **OR** Required, **as directed**.
 - e. Outlet: Bottom **OR** Side, **as directed**.
 - f. Extension Collars: Not required **OR** Required, **as directed**.
 - g. Underdeck Clamp: Not required **OR** Required, **as directed**.
 - h. Expansion Joint: Not required **OR** Required, **as directed**.
 - i. Sump Receiver Plate: Not required **OR** Required, **as directed**.
 - j. Dome Material: Cast iron.
 - k. Wire Mesh: Stainless steel or brass over dome **OR** Not required, **as directed**.
 - l. Vandal-Proof Dome: Not required **OR** Required, **as directed**.
- 6. Metal, Cornice and Gutter Roof Drains:
 - a. Standard: ASME A112.6.4, for cornice and gutter roof drains.
 - b. Body Material: Metal.

- c. Dimension of Body: Nominal **6-inch (152-mm)** diameter.
 - d. Outlet: Bottom **OR** Side **OR** 45-degree angle, **as directed**.
 - e. Dome Material: Bronze.
 - f. Vandal-Proof Dome: Not required **OR** Required, **as directed**.
7. Metal, Parapet Roof Drains:
 - a. Standard: ASME A112.6.4, for parapet roof drains.
 - b. Body Material: Cast iron.
 - c. Outlet: Back **OR** Angle, **as directed**.
 - d. Grate Material: Bronze **OR** Cast iron **OR** Nickel-bronze alloy, **as directed**.
 - e. Vandal-Proof Grate: Not required **OR** Required, **as directed**.
8. Metal, Large-Sump, Promenade Roof Drains:
 - a. Standard: ASME A112.6.4, for promenade roof drains.
 - b. Body Material: Cast iron.
 - c. Dimension of Body: Nominal **14-inch (357-mm)** diameter.
 - d. Dimension of Frame and Grate: Nominal **14 inches (357 mm)** square.
 - e. Outlet: Bottom.
 - f. Grate Material: Bronze **OR** Cast iron **OR** Nickel-bronze alloy, **as directed**.
 - g. Vandal-Proof Grate: Not required **OR** Required, **as directed**.
 - h. Extension Collars: Not required **OR** Required, **as directed**.
 - i. Underdeck Clamp: Not required **OR** Required, **as directed**.
 - j. Expansion Joint: Not required **OR** Required, **as directed**.
 - k. Sump Receiver Plate: Not required **OR** Required, **as directed**.
9. Metal, Medium-Sump, Promenade Roof Drains:
 - a. Standard: ASME A112.6.4, for promenade roof drains.
 - b. Body Material: Cast iron.
 - c. Dimension of Body: **11- to 12-inch (280- to 305-mm)** diameter.
 - d. Dimension of Frame and Grate: Nominal **12 inches (305 mm)** square.
 - e. Outlet: Bottom.
 - f. Grate Material: Bronze **OR** Cast iron **OR** Nickel-bronze alloy, **as directed**.
 - g. Vandal-Proof Grate: Not required **OR** Required, **as directed**.
 - h. Extension Collars: Not required **OR** Required, **as directed**.
 - i. Underdeck Clamp: Not required **OR** Required, **as directed**.
 - j. Expansion Joint: Not required **OR** Required, **as directed**.
 - k. Sump Receiver Plate: Not required **OR** Required, **as directed**.
10. Metal, Small-Sump, Promenade Roof Drains:
 - a. Standard: ASME A112.6.4, for promenade roof drains.
 - b. Body Material: Cast iron.
 - c. Dimension of Body: Nominal **8-inch (203-mm)** diameter.
 - d. Dimension of Frame and Grate: Nominal **8 inches (203 mm)** square.
 - e. Outlet: Bottom.
 - f. Grate Material: Bronze **OR** Cast iron **OR** Nickel-bronze alloy, **as directed**.
 - g. Vandal-Proof Grate: Not required **OR** Required, **as directed**.
 - h. Extension Collars: Not required **OR** Required, **as directed**.
 - i. Underdeck Clamp: Not required **OR** Required, **as directed**.
 - j. Expansion Joint: Not required **OR** Required, **as directed**.
 - k. Sump Receiver Plate: Not required **OR** Required, **as directed**.
11. Metal, Medium-Sump, Deck Roof Drains:
 - a. Standard: ASME A112.6.4, for deck roof drains; ASME A112.6.3, for floor drains.
 - b. Body Material: Metal.
 - c. Flange: Anchor **OR** Anchor with weep holes **OR** Not required, **as directed**.
 - d. Clamping Device: Not required **OR** Required, **as directed**.
 - e. Integral Backwater Valve: Not required **OR** Required, **as directed**.
 - f. Outlet: Bottom **OR** End **OR** Side, **as directed**.
 - g. Grate Material: Cast iron.
 - h. Grate Finish: Painted **OR** Not required, **as directed**.



- i. Overall Dimension of Frame and Grate: Nominal **14 inches (357 mm)** round **OR** square, **as directed**.
 - j. Top-Loading Classification: Extra-Heavy Duty **OR** Heavy Duty, **as directed**.
 - k. Vandal-Proof Frame and Grate: Not required **OR** Required, **as directed**.
- 12. Metal, Small-Sump, Deck Roof Drains:
 - a. Standard: ASME A112.6.4, for deck roof drains; ASME A112.6.3, for floor drains.
 - b. Body Material: Metal.
 - c. Flange: Anchor **OR** Anchor with weep holes **OR** Not required, **as directed**.
 - d. Clamping Device: Not required **OR** Required, **as directed**.
 - e. Integral Backwater Valve: Not required **OR** Required, **as directed**.
 - f. Outlet: Bottom **OR** End **OR** Side, **as directed**.
 - g. Grate Material: Cast iron.
 - h. Grate Finish: Painted **OR** Not required, **as directed**.
 - i. Overall Dimension of Frame and Grate: Nominal **8 inches (203 mm)** round **OR** square, **as directed**.
 - j. Top-Loading Classification: Extra-Heavy Duty **OR** Heavy Duty **OR** Light Duty **OR** Medium Duty, **as directed**.
 - k. Vandal-Proof Frame and Grate: Not required **OR** Required, **as directed**.
- B. Plastic Roof Drains
 - 1. Plastic Roof Drains:
 - a. Standard: ASME A112.6.4, for plastic roof drains.
 - b. Body Material: ABS or PVC.
 - c. Sump Diameter: **<Insert nominal dimension>**.
 - d. Combination Flashing Ring and Gravel Stop: Not required **OR** Required, **as directed**.
 - e. Outlet: Bottom.
 - f. Extension Collars: Not required **OR** Required, **as directed**.
 - g. Underdeck Clamp: Not required **OR** Required, **as directed**.
 - h. Expansion Joint: Not required **OR** Required, **as directed**.
 - i. Sump Receiver Plate: Not required **OR** Required, **as directed**.
 - j. Dome Material: Aluminum **OR** Cast iron **OR** PE **OR** Stainless steel, **as directed**.
 - k. Vandal-Proof Dome: Not required **OR** Required, **as directed**.
- C. Miscellaneous Storm Drainage Piping Specialties
 - 1. Downspout Adaptors:
 - a. Description: Manufactured, gray-iron casting, for attaching to horizontal-outlet, parapet roof drain and to exterior, sheet metal downspout.
 - b. Size: Inlet size to match parapet drain outlet.
 - 2. Downspout Boots:
 - a. Description: Manufactured, ASTM A 48/A 48M, gray-iron casting, with strap or ears for attaching to building; **NPS 4 (DN 100)** outlet; and shop-applied bituminous coating.
 - b. Size: Inlet size to match downspout and **NPS 4 (DN 100)** outlet.
 - 3. Conductor Nozzles:
 - a. Description: Bronze body with threaded inlet and bronze wall flange with mounting holes.
 - b. Size: Same as connected conductor.
- D. Cleanouts
 - 1. Floor Cleanouts:
 - a. Standard: ASME A112.36.2M, for adjustable housing **OR** cast-iron soil pipe with cast-iron ferrule **OR** heavy-duty, adjustable housing **OR** threaded, adjustable housing, **as directed**, cleanouts.
 - b. Size: Same as connected branch.
 - c. Type: Adjustable housing **OR** Cast-iron soil pipe with cast-iron ferrule **OR** Heavy-duty, adjustable housing **OR** Threaded, adjustable housing, **as directed**.
 - d. Body or Ferrule Material: Cast iron **OR** Stainless steel, **as directed**.

- e. Clamping Device: Not required **OR** Required, **as directed**.
 - f. Outlet Connection: Inside cask **OR** Spigot **OR** Threaded, **as directed**.
 - g. Closure: Brass plug with straight threads and gasket **OR** Brass plug with tapered threads **OR** Cast-iron plug **OR** Plastic plug, **as directed**.
 - h. Adjustable Housing Material: Cast iron **OR** Plastic, **as directed**, with threads **OR** set-screws or other device, **as directed**.
 - i. Frame and Cover Material and Finish: Nickel-bronze, copper alloy **OR** Painted cast iron **OR** Polished bronze **OR** Rough bronze **OR** Stainless steel, **as directed**.
 - j. Frame and Cover Shape: Round **OR** Square, **as directed**.
 - k. Top-Loading Classification: Extra-Heavy Duty **OR** Heavy Duty **OR** Light Duty **OR** Medium Duty, **as directed**.
 - l. Riser: ASTM A 74, Extra-Heavy **OR** Service, **as directed**, class, cast-iron drainage pipe fitting and riser to cleanout.
2. Test Tees:
- a. Standard: ASME A112.36.2M and ASTM A 74, ASTM A 888, or CISPI 301, for cleanout test tees.
 - b. Size: Same as connected drainage piping.
 - c. Body Material: Hub-and-spigot, cast-iron soil-pipe T-branch or hubless, cast-iron soil-pipe test tee as required to match connected piping.
 - d. Closure Plug: Countersunk or raised head, brass.
 - e. Closure Plug Size: Same as or not more than one size smaller than cleanout size.
3. Wall Cleanouts:
- a. Standard: ASME A112.36.2M, for cleanouts. Include wall access.
 - b. Size: Same as connected drainage piping.
 - c. Body Material: Hub-and-spigot, cast-iron soil-pipe T-branch **OR** Hubless, cast-iron soil-pipe test tee, **as directed**, as required to match connected piping.
 - d. Closure: Countersunk **OR** Countersunk or raised-head **OR** Raised-head, **as directed**, drilled-and-threaded **OR** brass **OR** cast-iron, **as directed**, plug.
 - e. Closure Plug Size: Same as or not more than one size smaller than cleanout size.
 - f. Wall Access: Round, deep, chrome-plated bronze **OR** flat, chrome-plated brass or stainless-steel, **as directed**, cover plate with screw.
 - g. Wall Access: Round **OR** Square, **as directed**, nickel-bronze, copper-alloy, or stainless-steel wall-installation frame and cover.
4. Plastic Floor Cleanouts:
- a. Size: Same as connected branch.
 - b. Body Material: PVC.
 - c. Closure Plug: PVC.
 - d. Riser: Drainage pipe fitting and riser to cleanout of same material as drainage piping.
- E. Backwater Valves
1. Cast-Iron, Horizontal Backwater Valves:
- a. Standard: ASME A112.14.1, for backwater valves.
 - b. Size: Same as connected piping.
 - c. Body Material: Cast iron.
 - d. Cover: Cast iron with bolted or threaded access check valve.
 - e. End Connections: Hub and spigot or hubless.
 - f. Check Valve: Removable, bronze, swing check, factory assembled or field modified to hang closed **OR** open for airflow unless subject to backflow condition, **as directed**.
 - g. Extension: ASTM A 74, Service class; full-size, cast-iron soil-pipe extension to field-installed cleanout at floor; replaces backwater valve cover.
2. Cast-Iron, Drain-Outlet Backwater Valves:
- a. Size: Same as floor drain outlet.
 - b. Body Material: Cast iron or bronze made for vertical installation in bottom outlet of floor drain.
 - c. Check Valve: Removable ball float.
 - d. Inlet: Threaded.

- e. Outlet: Threaded or spigot.
- 3. Plastic, Horizontal Backwater Valves:
 - a. Standard: ASME A112.14.1, for backwater valves.
 - b. Size: Same as connected piping.
 - c. Body Material: ABS **OR** PVC, **as directed**.
 - d. Cover: Same material as body with threaded access to check valve.
 - e. Check Valve: Removable swing check.
 - f. End Connections: Socket type.

F. Trench Drains

- 1. Trench Drains:
 - a. Standard: ASME A112.6.3, for trench drains.
 - b. Body Material: Cast iron.
 - c. Flange: Anchor **OR** Anchor with weep holes **OR** Not required, **as directed**.
 - d. Clamping Device: Not required **OR** Required, **as directed**.
 - e. Outlet: Bottom **OR** End **OR** Side, **as directed**.
 - f. Grate Material: Ductile iron or gray iron **OR** stainless steel, **as directed**.
 - g. Grate Finish: Painted **OR** Not required, **as directed**.
 - h. Dimensions of Frame and Grate: **<Insert dimensions>**.
 - i. Top-Loading Classification: Extra-Heavy Duty **OR** Heavy Duty **OR** Light Duty **OR** Medium Duty, **as directed**.

G. Channel Drainage Systems

- 1. Narrow, Sloped-Invert, Polymer-Concrete, Channel Drainage Systems:
 - a. Type: Modular system of channel sections, grates, and appurtenances; designed so grates fit into channel recesses without rocking or rattling.
 - 1) Channel Sections: Narrow, interlocking-joint, sloped-invert, polymer-concrete modular units with end caps. Include rounded bottom, with built-in invert slope of 0.6 percent and with outlets in number, sizes, and locations indicated. Include extension sections necessary for required depth.
 - a) Dimensions: **4-inch (102-mm)** inside width. Include number of units required to form total lengths indicated.
 - b) Frame: Galvanized steel or gray iron for grates **OR** Not required, **as directed**.
 - 2) Grates: Manufacturer's designation "heavy duty" **OR** "medium duty", **as directed**, with slots or perforations, and of width and thickness that fit recesses in channel sections.
 - a) Material: Ductile iron **OR** Fiberglass **OR** Galvanized steel **OR** Gray iron **OR** Stainless steel, **as directed**.
 - b) Locking Mechanism: Manufacturer's standard device for securing grates to channel sections **OR** Not required, **as directed**.
 - 3) Covers: Solid ductile or gray iron, of width and thickness that fit recesses in channel sections, and of lengths indicated.
 - 4) Supports, Anchors, and Setting Devices: Manufacturer's standard unless otherwise indicated.
 - 5) Channel-Section Joining and Fastening Materials: As recommended by system manufacturer.
- 2. Narrow, Level-Invert, Polymer-Concrete, Channel Drainage Systems:
 - a. Type: Modular system of channel sections, grates, and appurtenances; designed so grates fit into channel recesses without rocking or rattling.
 - 1) Channel Sections: Narrow, interlocking-joint, precast, polymer-concrete modular units with end caps. Include rounded bottom, with level invert and with **NPS 4 (DN 100)** outlets in number and locations indicated.
 - a) Dimensions: **5-inch (127-mm)** inside width and **9-3/4-inch (248-mm)** depth. Include number of units required to form total lengths indicated.

- b) Frame: Galvanized steel or gray iron for grates **OR** Not required, **as directed**.
 - 2) Grates: Manufacturer's designation "heavy duty" **OR** "medium duty", **as directed**, with slots or perforations, and of width and thickness that fit recesses in channel sections.
 - a) Material: Ductile iron **OR** Fiberglass **OR** Galvanized steel **OR** Gray iron **OR** Stainless steel, **as directed**.
 - b) Locking Mechanism: Manufacturer's standard device for securing grates to channel sections **OR** Not required, **as directed**.
 - 3) Covers: Solid ductile or gray iron, of width and thickness that fit recesses in channel sections, and of lengths indicated.
 - 4) Supports, Anchors, and Setting Devices: Manufacturer's standard unless otherwise indicated.
 - 5) Channel-Section Joining and Fastening Materials: As recommended by system manufacturer.
 3. Wide, Level-Invert, Polymer-Concrete, Channel Drainage Systems:
 - a. Type: Modular system of channel sections, grates, and appurtenances; designed so grates fit into channel recesses without rocking or rattling.
 - 1) Channel Sections: Wide, interlocking-joint, precast, polymer-concrete modular units with end caps. Include flat or rounded bottom, with level invert and with outlets in number, sizes, and locations indicated.
 - a) Dimensions: 8-inch (203-mm) inside width and 13-3/4-inch (350-mm) depth. Include number of units required to form total lengths indicated.
 - b) Frame: Galvanized steel or gray iron for grates **OR** Not required, **as directed**.
 - 2) Grates: Manufacturer's designation "heavy duty" **OR** "medium duty", **as directed**, with slots or perforations, and of width and thickness that fit recesses in channel sections.
 - a) Material: Ductile iron **OR** Fiberglass **OR** Galvanized steel **OR** Gray iron **OR** Stainless steel, **as directed**.
 - b) Locking Mechanism: Manufacturer's standard device for securing grates to channel sections **OR** Not required, **as directed**.
 - 3) Covers: Solid ductile or gray iron, of width and thickness that fit recesses in channel sections, and of lengths indicated.
 - 4) Supports, Anchors, and Setting Devices: Manufacturer's standard unless otherwise indicated.
 - 5) Channel-Section Joining and Fastening Materials: As recommended by system manufacturer.
- H. Through-Penetration Firestop Assemblies
 1. Through-Penetration Firestop Assemblies:
 - a. Standard: ASTM E 814, for through-penetration firestop assemblies.
 - b. Certification and Listing: Intertek Testing Service NA for through-penetration firestop assemblies.
 - c. Size: Same as connected pipe.
 - d. Sleeve: Molded PVC plastic, of length to match slab thickness and with integral nailing flange on one end for installation in cast-in-place concrete slabs.
 - e. Stack Fitting: ASTM A 48/A 48M, gray-iron, hubless-pattern, wye branch with neoprene O-ring at base and gray-iron plug in thermal-release harness. Include PVC protective cap for plug.
 - f. Special Coating: Corrosion resistant on interior of fittings.
- I. Flashing Materials
 1. Copper Sheet: ASTM B 152/B 152M, 12 oz./sq. ft. (3.7 kg/sq. m or 0.41-mm thickness).

2. Zinc-Coated Steel Sheet: ASTM A 653/A 653M, with 0.20 percent copper content and **0.04-inch (1.01-mm)** minimum thickness unless otherwise indicated. Include **G90 (Z275)** hot-dip galvanized, mill-phosphatized finish for painting if indicated.
3. Elastic Membrane Sheet: ASTM D 4068, flexible, chlorinated polyethylene, **40-mil (1.01-mm)** minimum thickness.
4. Fasteners: Metal compatible with material and substrate being fastened.
5. Metal Accessories: Sheet metal strips, clamps, anchoring devices, and similar accessory units required for installation; matching or compatible with material being installed.
6. Solder: ASTM B 32, lead-free alloy.

1.3 EXECUTION

A. Installation

1. Install roof drains at low points of roof areas according to roof membrane manufacturer's written installation instructions. Roofing materials are specified in Division 7 Sections.
 - a. Install flashing collar or flange of roof drain to prevent leakage between drain and adjoining roofing. Maintain integrity of waterproof membranes where penetrated.
 - b. Install expansion joints, if indicated, in roof drain outlets.
 - c. Position roof drains for easy access and maintenance.
2. Install downspout adapters on outlet of back-outlet parapet roof drains and connect to sheet metal downspouts.
3. Install downspout boots at grade with top **6 inches (152 mm) OR 12 inches (305 mm) OR 18 inches (457 mm)**, **as directed**, above grade. Secure to building wall.
4. Install conductor nozzles at exposed bottom of conductors where they spill onto grade.
5. Install cleanouts in aboveground piping and building drain piping according to the following instructions unless otherwise indicated:
 - a. Use cleanouts the same size as drainage piping up to **NPS 4 (DN 100)**. Use **NPS 4 (DN 100)** for larger drainage piping unless larger cleanout is indicated.
 - b. Locate cleanouts at each change in direction of piping greater than 45 degrees.
 - c. Locate cleanouts at minimum intervals of **50 feet (15 m)** for piping **NPS 4 (DN 100)** and smaller and **100 feet (30 m)** for larger piping.
 - d. Locate cleanouts at base of each vertical soil and waste stack.
6. For floor cleanouts for piping below floors, install cleanout deck plates with top flush with finished floor.
7. For cleanouts located in concealed piping, install cleanout wall access covers, of types indicated, with frame and cover flush with finished wall.
8. Install horizontal backwater valves in floor with cover flush with floor.
9. Install drain-outlet backwater valves in outlet of drains.
10. Install test tees in vertical conductors and near floor.
11. Install wall cleanouts in vertical conductors. Install access door in wall if indicated.
12. Install trench drains at low points of surface areas to be drained. Set grates of drains flush with finished surface unless otherwise indicated.
13. Assemble channel drainage system components according to manufacturer's written instructions. Install on support devices so that top will be flush with adjacent surface.
14. Install through-penetration firestop assemblies in plastic conductors at concrete floor penetrations.
15. Install sleeve flashing device with each conductor passing through floors with waterproof membrane.

B. Connections

1. Comply with requirements for piping specified in Division 15 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

C. Flashing Installation

1. Fabricate flashing from single piece of metal unless large pans, sumps, or other drainage shapes are required. Join flashing according to the following if required:
 - a. Lead Sheets: Burn joints of 6.0-lb/sq. ft. (30-kg/sq. m) lead sheets, 0.0938-inch (2.4-mm) thickness or thicker. Solder joints of 4.0-lb/sq. ft. (20-kg/sq. m) lead sheets, 0.0625-inch (1.6-mm) thickness or thinner.
 - b. Copper Sheets: Solder joints of copper sheets.
 2. Install sheet flashing on pipes, sleeves, and specialties passing through or embedded in floors and roofs with waterproof membrane.
 - a. Pipe Flashing: Sleeve type, matching the pipe size, with a minimum length of 10 inches (250 mm) and with skirt or flange extending at least 8 inches (200 mm) around pipe.
 - b. Sleeve Flashing: Flat sheet, with skirt or flange extending at least 8 inches (200 mm) around sleeve.
 - c. Embedded Specialty Flashing: Flat sheet, with skirt or flange extending at least 8 inches (200 mm) around specialty.
 3. Set flashing on floors and roofs in solid coating of bituminous cement.
 4. Secure flashing into sleeve and specialty clamping ring or device.
 5. Fabricate and install flashing and pans, sumps, and other drainage shapes.
- D. Protection
1. Protect drains during remainder of construction period to avoid clogging with dirt or debris and to prevent damage from traffic or construction work.
 2. Place plugs in ends of uncompleted piping at end of each day or when work stops.

END OF SECTION 22 05 76 00a

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SECTION 22 07 19 00 - PLUMBING INSULATION

1.1 GENERAL

A. Description Of Work

1. This specification covers the furnishing and installation of materials for plumbing insulation. Products shall be as follows or as directed by the Owner. Installation procedures shall be in accordance with the products manufacturer's recommendations. Demolition and removal of materials shall be as required to support the work.

B. Summary

1. Section Includes:
 - a. Insulation Materials:
 - 1) Calcium silicate.
 - 2) Cellular glass.
 - 3) Flexible elastomeric.
 - 4) Mineral fiber.
 - 5) Phenolic.
 - 6) Polyisocyanurate.
 - 7) Polyolefin.
 - 8) Polystyrene.
 - b. Insulating cements.
 - c. Adhesives.
 - d. Mastics.
 - e. Lagging adhesives.
 - f. Sealants.
 - g. Factory-applied jackets.
 - h. Field-applied fabric-reinforcing mesh.
 - i. Field-applied cloths.
 - j. Field-applied jackets.
 - k. Tapes.
 - l. Securements.
 - m. Corner angles.

C. Submittals

1. Product Data: For each type of product indicated.
2. LEED Submittal:
 - a. Product Data for Credit EQ 4.1: For adhesives and sealants, including printed statement of VOC content.
3. Shop Drawings:
 - a. Detail application of protective shields, saddles, and inserts at hangers for each type of insulation and hanger.
 - b. Detail attachment and covering of heat tracing inside insulation.
 - c. Detail insulation application at pipe expansion joints for each type of insulation.
 - d. Detail insulation application at elbows, fittings, flanges, valves, and specialties for each type of insulation.
 - e. Detail removable insulation at piping specialties, equipment connections, and access panels.
 - f. Detail application of field-applied jackets.
 - g. Detail application at linkages of control devices.
 - h. Detail field application for each equipment type.
4. Field quality-control reports.

D. Quality Assurance

1. Fire-Test-Response Characteristics: Insulation and related materials shall have fire-test-response characteristics indicated, as determined by testing identical products per ASTM E 84, by a testing and inspecting agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing and inspecting agency.
 - a. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.
 - b. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 or less.

E. Delivery, Storage, And Handling

1. Packaging: Insulation material containers shall be marked by manufacturer with appropriate ASTM standard designation, type and grade, and maximum use temperature.

1.2 PRODUCTS

A. Insulation Materials

1. Comply with requirements in Part 1.3 schedule articles for where insulating materials shall be applied.
2. Products shall not contain asbestos, lead, mercury, or mercury compounds.
3. Products that come in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C 871.
4. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.
5. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.
6. Calcium Silicate:
 - a. Preformed Pipe Sections: Flat-, curved-, and grooved-block sections of noncombustible, inorganic, hydrous calcium silicate with a non-asbestos fibrous reinforcement. Comply with ASTM C 533, Type I.
 - b. Flat-, curved-, and grooved-block sections of noncombustible, inorganic, hydrous calcium silicate with a non-asbestos fibrous reinforcement. Comply with ASTM C 533, Type I.
 - c. Prefabricated Fitting Covers: Comply with ASTM C 450 and ASTM C 585 for dimensions used in preforming insulation to cover valves, elbows, tees, and flanges.
7. Cellular Glass: Inorganic, incombustible, foamed or cellulated glass with annealed, rigid, hermetically sealed cells. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
 - a. Block Insulation: ASTM C 552, Type I.
 - b. Special-Shaped Insulation: ASTM C 552, Type III.
 - c. Board Insulation: ASTM C 552, Type IV.
 - d. Preformed Pipe Insulation without Jacket: Comply with ASTM C 552, Type II, Class 1.
 - e. Preformed Pipe Insulation with Factory-Applied ASJ **OR** ASJ-SSL, **as directed**: Comply with ASTM C 552, Type II, Class 2.
 - f. Factory fabricate shapes according to ASTM C 450 and ASTM C 585.
8. Flexible Elastomeric: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C 534, Type I for tubular materials and Type II for sheet materials.
9. Mineral-Fiber Blanket Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 553, Type II and ASTM C 1290, Type I. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
10. High-Temperature, Mineral-Fiber Blanket Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 553, Type V, without factory-applied jacket.
11. Mineral-Fiber Board Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 612, Type IA or Type IB. For equipment applications, provide insulation

- without factory-applied jacket **OR** with factory-applied ASJ **OR** with factory-applied FSK jacket, **as directed**. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
12. High-Temperature, Mineral-Fiber Board Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 612, Type III, without factory-applied jacket.
 13. Mineral-Fiber, Preformed Pipe Insulation:
 - a. Type I, **850 deg F (454 deg C)** Materials: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 547, Type I, Grade A, without factory-applied jacket **OR** with factory-applied ASJ **OR** with factory-applied ASJ-SSL, **as directed**. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
 14. Mineral-Fiber, Pipe and Tank Insulation: Mineral or glass fibers bonded with a thermosetting resin. Semirigid board material with factory-applied ASJ **OR** FSK jacket, **as directed**, complying with ASTM C 1393, Type II or Type IIIA Category 2, or with properties similar to ASTM C 612, Type IB. Nominal density is **2.5 lb/cu. ft. (40 kg/cu. m)** or more. Thermal conductivity (k-value) at **100 deg F (55 deg C)** is **0.29 Btu x in./h x sq. ft. x deg F (0.042 W/m x K)** or less. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
 15. Phenolic:
 - a. Preformed pipe insulation of rigid, expanded, closed-cell structure. Comply with ASTM C 1126, Type III, Grade 1.
 - b. Block insulation of rigid, expanded, closed-cell structure. Comply with ASTM C 1126, Type II, Grade 1.
 - c. Factory fabricate shapes according to ASTM C 450 and ASTM C 585.
 - d. Factory-Applied Jacket: Requirements are specified in "Factory-Applied Jackets" Article.
 - 1) Preformed Pipe Insulation: None **OR** ASJ, **as directed**.
 - 2) Board for Equipment Applications: None **OR** ASJ, **as directed**.
 16. Polyisocyanurate: Unfaced, preformed, rigid cellular polyisocyanurate material intended for use as thermal insulation.
 - a. Comply with ASTM C 591, Type I or Type IV, except thermal conductivity (k-value) shall not exceed **0.19 Btu x in./h x sq. ft. x deg F (0.027 W/m x K)** at **75 deg F (24 deg C)** after 180 days of aging.
 - b. Flame-spread index shall be 25 or less and smoke-developed index shall be 50 or less for thickness up to **1-1/2 inches (38 mm)** as tested by ASTM E 84.
 - c. Fabricate shapes according to ASTM C 450 and ASTM C 585.
 - d. Factory-Applied Jacket: Requirements are specified in "Factory-Applied Jackets" Article.
 - 1) Pipe Applications: None **OR** ASJ **OR** ASJ-SSL **OR** PVDC **OR** PVDC-SSL, **as directed**.
 - 2) Equipment Applications: None **OR** ASJ **OR** ASJ-SSL **OR** PVDC **OR** PVDC-SSL, **as directed**.
 17. Polyolefin: Unicellular, polyethylene thermal plastic insulation. Comply with ASTM C 534 or ASTM C 1427, Type I, Grade 1 for tubular materials and Type II, Grade 1 for sheet materials.
 18. Polystyrene: Rigid, extruded cellular polystyrene intended for use as thermal insulation. Comply with ASTM C 578, Type IV or Type XIII, except thermal conductivity (k-value) shall not exceed **0.26 Btu x in./h x sq. ft. x deg F (0.038 W/m x K)** after 180 days of aging. Fabricate shapes according to ASTM C 450 and ASTM C 585.
- B. Insulating Cements
1. Mineral-Fiber Insulating Cement: Comply with ASTM C 195.
 2. Expanded or Exfoliated Vermiculite Insulating Cement: Comply with ASTM C 196.
 3. Mineral-Fiber, Hydraulic-Setting Insulating and Finishing Cement: Comply with ASTM C 449/C 449M.
- C. Adhesives
1. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated, unless otherwise indicated.
 2. Calcium Silicate Adhesive: Fibrous, sodium-silicate-based adhesive with a service temperature range of **50 to 800 deg F (10 to 427 deg C)**.

- a. For indoor applications, use adhesive that has a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
3. Cellular-Glass, Phenolic, Polyisocyanurate, and Polystyrene Adhesive: Solvent-based resin adhesive, with a service temperature range of **minus 75 to plus 300 deg F** (**minus 59 to plus 149 deg C**).
 - a. For indoor applications, use adhesive that has a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
4. Flexible Elastomeric and Polyolefin Adhesive: Comply with MIL-A-24179A, Type II, Class I.
 - a. For indoor applications, use adhesive that has a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
5. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.
 - a. For indoor applications, use adhesive that has a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
6. Polystyrene Adhesive: Solvent- or water-based, synthetic resin adhesive with a service temperature range of **minus 20 to plus 140 deg F** (**29 to plus 60 deg C**).
7. ASJ Adhesive, and FSK and PVDC Jacket Adhesive: Comply with MIL-A-3316C, Class 2, Grade A for bonding insulation jacket lap seams and joints.
 - a. For indoor applications, use adhesive that has a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
8. PVC Jacket Adhesive: Compatible with PVC jacket.
 - a. For indoor applications, use adhesive that has a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

D. Mastics

1. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL-C-19565C, Type II.
 - a. For indoor applications, use mastics that have a VOC content of **<Insert value> g/L** or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
2. Vapor-Barrier Mastic: Water based; suitable for indoor and outdoor use on below ambient services.
 - a. Water-Vapor Permeance: ASTM E 96, Procedure B, **0.013 perm** (**0.009 metric perm**) at **43-mil (1.09-mm)** dry film thickness.
 - b. Service Temperature Range: **Minus 20 to plus 180 deg F** (**Minus 29 to plus 82 deg C**).
 - c. Solids Content: ASTM D 1644, 59 percent by volume and 71 percent by weight.
 - d. Color: White.
3. Vapor-Barrier Mastic: Solvent based; suitable for indoor use on below ambient services.
 - a. Water-Vapor Permeance: ASTM F 1249, **0.05 perm** (**0.03 metric perm**) at **35-mil (0.9-mm)** dry film thickness.
 - b. Service Temperature Range: **0 to 180 deg F** (**Minus 18 to plus 82 deg C**).
 - c. Solids Content: ASTM D 1644, 44 percent by volume and 62 percent by weight.
 - d. Color: White.
4. Vapor-Barrier Mastic: Solvent based; suitable for outdoor use on below ambient services.
 - a. Water-Vapor Permeance: ASTM F 1249, **0.05 perm** (**0.033 metric perm**) at **30-mil (0.8-mm)** dry film thickness.
 - b. Service Temperature Range: **Minus 50 to plus 220 deg F** (**Minus 46 to plus 104 deg C**).
 - c. Solids Content: ASTM D 1644, 33 percent by volume and 46 percent by weight.
 - d. Color: White.
5. Breather Mastic: Water based; suitable for indoor and outdoor use on above ambient services.
 - a. Water-Vapor Permeance: ASTM F 1249, **3 perms** (**2 metric perms**) at **0.0625-inch (1.6-mm)** dry film thickness.
 - b. Service Temperature Range: **Minus 20 to plus 200 deg F** (**Minus 29 to plus 93 deg C**).
 - c. Solids Content: 63 percent by volume and 73 percent by weight.
 - d. Color: White.

E. Lagging Adhesives

1. Description: Comply with MIL-A-3316C, Class I, Grade A, and shall be compatible with insulation materials, jackets, and substrates.
 - a. For indoor applications, use lagging adhesives that have a VOC content of <Insert value> g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 - b. Fire-resistant, water-based lagging adhesive and coating for use indoors to adhere fire-resistant lagging cloths over equipment and pipe insulation.
 - c. Service Temperature Range: **Minus 50 to plus 180 deg F** (Minus 46 to plus 82 deg C).
 - d. Color: White.
- F. Sealants
1. Joint Sealants:
 - a. Materials shall be compatible with insulation materials, jackets, and substrates.
 - b. Permanently flexible, elastomeric sealant.
 - c. Service Temperature Range: **Minus 100 to plus 300 deg F** (Minus 73 to plus 149 deg C).
 - d. Color: White or gray.
 - e. For indoor applications, use sealants that have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 2. FSK and Metal Jacket Flashing Sealants:
 - a. Materials shall be compatible with insulation materials, jackets, and substrates.
 - b. Fire- and water-resistant, flexible, elastomeric sealant.
 - c. Service Temperature Range: **Minus 40 to plus 250 deg F** (Minus 40 to plus 121 deg C).
 - d. Color: Aluminum.
 - e. For indoor applications, use sealants that have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 3. ASJ Flashing Sealants, and Vinyl, PVDC, and PVC Jacket Flashing Sealants:
 - a. Materials shall be compatible with insulation materials, jackets, and substrates.
 - b. Fire- and water-resistant, flexible, elastomeric sealant.
 - c. Service Temperature Range: **Minus 40 to plus 250 deg F** (Minus 40 to plus 121 deg C).
 - d. Color: White.
 - e. For indoor applications, use sealants that have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- G. Factory-Applied Jackets
1. Insulation system schedules indicate factory-applied jackets on various applications. When factory-applied jackets are indicated, comply with the following:
 - a. ASJ: White, kraft-paper, fiberglass-reinforced scrim with aluminum-foil backing; complying with ASTM C 1136, Type I.
 - b. ASJ-SSL: ASJ with self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip; complying with ASTM C 1136, Type I.
 - c. FSK Jacket: Aluminum-foil, fiberglass-reinforced scrim with kraft-paper backing; complying with ASTM C 1136, Type II.
 - d. PVDC Jacket for Indoor Applications: **4-mil- (0.10-mm-)** thick, white PVDC biaxially oriented barrier film with a permeance at **0.02 perms (0.013 metric perms)** when tested according to ASTM E 96 and with a flame-spread index of 5 and a smoke-developed index of 20 when tested according to ASTM E 84.
 - e. PVDC Jacket for Outdoor Applications: **6-mil- (0.15-mm-)** thick, white PVDC biaxially oriented barrier film with a permeance at **0.01 perms (0.007 metric perms)** when tested according to ASTM E 96 and with a flame-spread index of 5 and a smoke-developed index of 25 when tested according to ASTM E 84.
 - f. PVDC-SSL Jacket: PVDC jacket with a self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip.
- H. Field-Applied Fabric-Reinforcing Mesh
1. Woven Glass-Fiber Fabric for Pipe Insulation: Approximately **2 oz./sq. yd. (68 g/sq. m)** with a thread count of **10 strands by 10 strands/sq. inch (4 strands by 4 strands/sq. mm)** for covering pipe and pipe fittings.

2. Woven Glass-Fiber Fabric for Equipment Insulation: Approximately **6 oz./sq. yd.** (203 g/sq. m) with a thread count of **5 strands by 5 strands/sq. inch** (2 strands by 2 strands/sq. mm) for covering equipment.
3. Woven Polyester Fabric: Approximately **1 oz./sq. yd.** (34 g/sq. m) with a thread count of **10 strands by 10 strands/sq. inch** (4 strands by 4 strands/sq. mm), in a Leno weave, for equipment and pipe.

I. Field-Applied Cloths

1. Woven Glass-Fiber Fabric: Comply with MIL-C-20079H, Type I, plain weave, and presized a minimum of **8 oz./sq. yd.** (271 g/sq. m).

J. Field-Applied Jackets

1. Field-applied jackets shall comply with ASTM C 921, Type I, unless otherwise indicated.
2. PVC Jacket: High-impact-resistant, UV-resistant PVC complying with ASTM D 1784, Class 16354-C; thickness as scheduled; roll stock ready for shop or field cutting and forming. Thickness is indicated in field-applied jacket schedules.
 - a. Adhesive: As recommended by jacket material manufacturer.
 - b. Color: White **OR** Color-code jackets based on system. Color as selected by the Owner, **as directed**.
 - c. Factory-fabricated fitting covers to match jacket if available; otherwise, field fabricate.
 - 1) Shapes: 45- and 90-degree, short- and long-radius elbows, tees, valves, flanges, unions, reducers, end caps, soil-pipe hubs, traps, mechanical joints, and P-trap and supply covers for lavatories.
 - d. Factory-fabricated tank heads and tank side panels.
3. Metal Jacket:
 - a. Aluminum Jacket: Comply with **ASTM B 209** (ASTM B 209M), Alloy 3003, 3005, 3105 or 5005, Temper H-14.
 - 1) Sheet and roll stock ready for shop or field sizing **OR** Factory cut and rolled to size, **as directed**.
 - 2) Finish and thickness are indicated in field-applied jacket schedules.
 - 3) Moisture Barrier for Indoor Applications: **1-mil-** (0.025-mm-) thick, heat-bonded polyethylene and kraft paper **OR 3-mil-** (0.075-mm-) thick, heat-bonded polyethylene and kraft paper **OR 2.5-mil-** (0.063-mm-) thick Polysurlyn, **as directed**.
 - 4) Moisture Barrier for Outdoor Applications: **3-mil-** (0.075-mm-) thick, heat-bonded polyethylene and kraft paper **OR 2.5-mil-** (0.063-mm-) thick Polysurlyn, **as directed**.
 - 5) Factory-Fabricated Fitting Covers:
 - a) Same material, finish, and thickness as jacket.
 - b) Preformed 2-piece or gore, 45- and 90-degree, short- and long-radius elbows.
 - c) Tee covers.
 - d) Flange and union covers.
 - e) End caps.
 - f) Beveled collars.
 - g) Valve covers.
 - h) Field fabricate fitting covers only if factory-fabricated fitting covers are not available.
 - b. Stainless-Steel Jacket: ASTM A 167 or ASTM A 240/A 240M.
 - 1) Sheet and roll stock ready for shop or field sizing **OR** Factory cut and rolled to size, **as directed**.
 - 2) Material, finish, and thickness are indicated in field-applied jacket schedules.
 - 3) Moisture Barrier for Indoor Applications: **1-mil-** (0.025-mm-) thick, heat-bonded polyethylene and kraft paper **OR 3-mil-** (0.075-mm-) thick, heat-bonded polyethylene and kraft paper **OR 2.5-mil-** (0.063-mm-) thick Polysurlyn, **as directed**.
 - 4) Moisture Barrier for Outdoor Applications: **3-mil-** (0.075-mm-) thick, heat-bonded polyethylene and kraft paper **OR 2.5-mil-** (0.063-mm-) thick Polysurlyn, **as directed**.
 - 5) Factory-Fabricated Fitting Covers:

- a) Same material, finish, and thickness as jacket.
 - b) Preformed 2-piece or gore, 45- and 90-degree, short- and long-radius elbows.
 - c) Tee covers.
 - d) Flange and union covers.
 - e) End caps.
 - f) Beveled collars.
 - g) Valve covers.
 - h) Field fabricate fitting covers only if factory-fabricated fitting covers are not available.
4. Underground Direct-Buried Jacket: **125-mil- (3.2-mm-)** thick vapor barrier and waterproofing membrane consisting of a rubberized bituminous resin reinforced with a woven-glass fiber or polyester scrim and laminated aluminum foil.

K. Tapes

1. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C 1136.
 - a. Width: **3 inches (75 mm)**.
 - b. Thickness: **11.5 mils (0.29 mm)**.
 - c. Adhesion: **90 ounces force/inch (1.0 N/mm)** in width.
 - d. Elongation: 2 percent.
 - e. Tensile Strength: **40 lbf/inch (7.2 N/mm)** in width.
 - f. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.
2. FSK Tape: Foil-face, vapor-retarder tape matching factory-applied jacket with acrylic adhesive; complying with ASTM C 1136.
 - a. Width: **3 inches (75 mm)**.
 - b. Thickness: **6.5 mils (0.16 mm)**.
 - c. Adhesion: **90 ounces force/inch (1.0 N/mm)** in width.
 - d. Elongation: 2 percent.
 - e. Tensile Strength: **40 lbf/inch (7.2 N/mm)** in width.
 - f. FSK Tape Disks and Squares: Precut disks or squares of FSK tape.
3. PVC Tape: White vapor-retarder tape matching field-applied PVC jacket with acrylic adhesive. Suitable for indoor and outdoor applications.
 - a. Width: **2 inches (50 mm)**.
 - b. Thickness: **6 mils (0.15 mm)**.
 - c. Adhesion: **64 ounces force/inch (0.7 N/mm)** in width.
 - d. Elongation: 500 percent.
 - e. Tensile Strength: **18 lbf/inch (3.3 N/mm)** in width.
4. Aluminum-Foil Tape: Vapor-retarder tape with acrylic adhesive.
 - a. Width: **2 inches (50 mm)**.
 - b. Thickness: **3.7 mils (0.093 mm)**.
 - c. Adhesion: **100 ounces force/inch (1.1 N/mm)** in width.
 - d. Elongation: 5 percent.
 - e. Tensile Strength: **34 lbf/inch (6.2 N/mm)** in width.
5. PVDC Tape: White vapor-retarder PVDC tape with acrylic adhesive.
 - a. Width: **3 inches (75 mm)**.
 - b. Film Thickness: **4 mils (0.10 mm) OR 6 mils (0.15 mm), as directed**.
 - c. Adhesive Thickness: **1.5 mils (0.04 mm)**.
 - d. Elongation at Break: 145 percent.
 - e. Tensile Strength: **55 lbf/inch (10.1 N/mm)** in width.

L. Securements

1. Bands:
 - a. Stainless Steel: ASTM A 167 or ASTM A 240/A 240M, Type 304 **OR** Type 316, **as directed**; **0.015 inch (0.38 mm)** thick, **1/2 inch (13 mm) OR 3/4 inch (19 mm), as directed**, wide with wing seal **OR** closed seal, **as directed**.

- b. Aluminum: **ASTM B 209 (ASTM B 209M)**, Alloy 3003, 3005, 3105, or 5005; Temper H-14, **0.020 inch (0.51 mm)** thick, **1/2 inch (13 mm) OR 3/4 inch (19 mm)**, **as directed**, wide with wing seal **OR** closed seal, **as directed**.
- c. Springs: Twin spring set constructed of stainless steel with ends flat and slotted to accept metal bands. Spring size determined by manufacturer for application.
- 2. Insulation Pins and Hangers:
 - a. Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, **0.106-inch- (2.6-mm-) OR 0.135-inch- (3.5-mm-)**, **as directed**, diameter shank, length to suit depth of insulation indicated.
 - b. Cupped-Head, Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, **0.106-inch- (2.6-mm-) OR 0.135-inch- (3.5-mm-)**, **as directed**, diameter shank, length to suit depth of insulation indicated with integral **1-1/2-inch (38-mm)** galvanized carbon-steel washer.
 - c. Metal, Adhesively Attached, Perforated-Base Insulation Hangers: Baseplate welded to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place. Comply with the following requirements:
 - 1) Baseplate: Perforated, galvanized carbon-steel sheet, **0.030 inch (0.76 mm)** thick by **2 inches (50 mm)** square.
 - 2) Spindle: Copper- or zinc-coated, low carbon steel **OR** Aluminum **OR** Stainless steel, **as directed**, fully annealed, **0.106-inch- (2.6-mm-)** diameter shank, length to suit depth of insulation indicated.
 - 3) Adhesive: Recommended by hanger manufacturer. Product with demonstrated capability to bond insulation hanger securely to substrates indicated without damaging insulation, hangers, and substrates.
 - d. Nonmetal, Adhesively Attached, Perforated-Base Insulation Hangers: Baseplate fastened to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place. Comply with the following requirements:
 - 1) Baseplate: Perforated, nylon sheet, **0.030 inch (0.76 mm)** thick by **1-1/2 inches (38 mm)** in diameter.
 - 2) Spindle: Nylon, **0.106-inch- (2.6-mm-)** diameter shank, length to suit depth of insulation indicated, up to **2-1/2 inches (63 mm)**.
 - 3) Adhesive: Recommended by hanger manufacturer. Product with demonstrated capability to bond insulation hanger securely to substrates indicated without damaging insulation, hangers, and substrates.
 - e. Self-Sticking-Base Insulation Hangers: Baseplate welded to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place. Comply with the following requirements:
 - 1) Baseplate: Galvanized carbon-steel sheet, **0.030 inch (0.76 mm)** thick by **2 inches (50 mm)** square.
 - 2) Spindle: Copper- or zinc-coated, low carbon steel **OR** Aluminum **OR** Stainless steel, **as directed**, fully annealed, **0.106-inch- (2.6-mm-)** diameter shank, length to suit depth of insulation indicated.
 - 3) Adhesive-backed base with a peel-off protective cover.
 - f. Insulation-Retaining Washers: Self-locking washers formed from **0.016-inch- (0.41-mm-)** thick, galvanized-steel **OR** aluminum **OR** stainless-steel, **as directed**, sheet, with beveled edge sized as required to hold insulation securely in place but not less than **1-1/2 inches (38 mm)** in diameter.
 - 1) Protect ends with capped self-locking washers incorporating a spring steel insert to ensure permanent retention of cap in exposed locations.
 - g. Nonmetal Insulation-Retaining Washers: Self-locking washers formed from **0.016-inch- (0.41-mm-)** thick nylon sheet, with beveled edge sized as required to hold insulation securely in place but not less than **1-1/2 inches (38 mm)** in diameter.

3. Staples: Outward-clinching insulation staples, nominal **3/4-inch- (19-mm-)** wide, stainless steel or Monel.
4. Wire: **0.080-inch (2.0-mm)** nickel-copper alloy **OR 0.062-inch (1.6-mm)** soft-annealed, stainless steel **OR 0.062-inch (1.6-mm)** soft-annealed, galvanized steel, **as directed**.

M. Corner Angles

1. PVC Corner Angles: **30 mils (0.8 mm)** thick, minimum **1 by 1 inch (25 by 25 mm)**, PVC according to ASTM D 1784, Class 16354-C. White or color-coded to match adjacent surface.
2. Aluminum Corner Angles: **0.040 inch (1.0 mm)** thick, minimum **1 by 1 inch (25 by 25 mm)**, aluminum according to **ASTM B 209 (ASTM B 209M)**, Alloy 3003, 3005, 3105 or 5005; Temper H-14.
3. Stainless-Steel Corner Angles: **0.024 inch (0.61 mm)** thick, minimum **1 by 1 inch (25 by 25 mm)**, stainless steel according to ASTM A 167 or ASTM A 240/A 240M, Type 304 **OR** Type 316, **as directed**.

1.3 EXECUTION

A. Preparation

1. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.
OR
Surface Preparation: Clean and prepare surfaces to be insulated. Before insulating, apply a corrosion coating to insulated surfaces as follows:
 - a. Stainless Steel: Coat 300 series stainless steel with an epoxy primer **5 mils (0.127 mm)** thick and an epoxy finish **5 mils (0.127 mm)** thick if operating in a temperature range between **140 and 300 deg F (60 and 149 deg C)**. Consult coating manufacturer for appropriate coating materials and application methods for operating temperature range.
 - b. Carbon Steel: Coat carbon steel operating at a service temperature between **32 and 300 deg F (0 and 149 deg C)** with an epoxy coating. Consult coating manufacturer for appropriate coating materials and application methods for operating temperature range.
2. Coordinate insulation installation with the trade installing heat tracing. Comply with requirements for heat tracing that apply to insulation.
3. Mix insulating cements with clean potable water; if insulating cements are to be in contact with stainless-steel surfaces, use demineralized water.

B. General Installation Requirements

1. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of equipment and piping including fittings, valves, and specialties.
2. Install insulation materials, forms, vapor barriers or retarders, jackets, and thicknesses required for each item of equipment and pipe system as specified in insulation system schedules.
3. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.
4. Install insulation with longitudinal seams at top and bottom of horizontal runs.
5. Install multiple layers of insulation with longitudinal and end seams staggered.
6. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.
7. Keep insulation materials dry during application and finishing.
8. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.
9. Install insulation with least number of joints practical.
10. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.
 - a. Install insulation continuously through hangers and around anchor attachments.

- b. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends at attachment to structure with vapor-barrier mastic.
- c. Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.
- d. Cover inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect jacket from tear or puncture by hanger, support, and shield.
- 11. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.
- 12. Install insulation with factory-applied jackets as follows:
 - a. Draw jacket tight and smooth.
 - b. Cover circumferential joints with **3-inch- (75-mm-)** wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced **4 inches (100 mm)** o.c.
 - c. Overlap jacket longitudinal seams at least **1-1/2 inches (38 mm)**. Install insulation with longitudinal seams at bottom of pipe. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at **2 inches (50 mm) OR 4 inches (100 mm), as directed**, o.c.
 - 1) For below ambient services, apply vapor-barrier mastic over staples.
 - d. Cover joints and seams with tape as recommended by insulation material manufacturer to maintain vapor seal.
 - e. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to pipe flanges and fittings.
- 13. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.
- 14. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.
- 15. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least **4 inches (100 mm)** beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.
- 16. For above ambient services, do not install insulation to the following:
 - a. Vibration-control devices.
 - b. Testing agency labels and stamps.
 - c. Nameplates and data plates.
 - d. Manholes.
 - e. Handholes.
 - f. Cleanouts.

C. Penetrations

- 1. Insulation Installation at Roof Penetrations: Install insulation continuously through roof penetrations.
 - a. Seal penetrations with flashing sealant.
 - b. For applications requiring only indoor insulation, terminate insulation above roof surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
 - c. Extend jacket of outdoor insulation outside roof flashing at least **2 inches (50 mm)** below top of roof flashing.
 - d. Seal jacket to roof flashing with flashing sealant.
- 2. Insulation Installation at Underground Exterior Wall Penetrations: Terminate insulation flush with sleeve seal. Seal terminations with flashing sealant.
- 3. Insulation Installation at Aboveground Exterior Wall Penetrations: Install insulation continuously through wall penetrations.
 - a. Seal penetrations with flashing sealant.

- b. For applications requiring only indoor insulation, terminate insulation inside wall surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
 - c. Extend jacket of outdoor insulation outside wall flashing and overlap wall flashing at least **2 inches (50 mm)**.
 - d. Seal jacket to wall flashing with flashing sealant.
 4. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.
 5. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Install insulation continuously through penetrations of fire-rated walls and partitions.
 - a. Comply with requirements in Division 07 Section "Penetration Firestopping" for firestopping and fire-resistive joint sealers.
 6. Insulation Installation at Floor Penetrations:
 - a. Pipe: Install insulation continuously through floor penetrations.
 - b. Seal penetrations through fire-rated assemblies. Comply with requirements in Division 07 Section "Penetration Firestopping".
- D. Equipment, Tank, And Vessel Insulation Installation
 1. Mineral Fiber, Pipe and Tank Insulation Installation for Tanks and Vessels: Secure insulation with adhesive and anchor pins and speed washers.
 - a. Apply adhesives according to manufacturer's recommended coverage rates per unit area, for 100 **OR** 50, **as directed**, percent coverage of tank and vessel surfaces.
 - b. Groove and score insulation materials to fit as closely as possible to equipment, including contours. Bevel insulation edges for cylindrical surfaces for tight joints. Stagger end joints.
 - c. Protect exposed corners with secured corner angles.
 - d. Install adhesively attached or self-sticking insulation hangers and speed washers on sides of tanks and vessels as follows:
 - 1) Do not weld anchor pins to ASME-labeled pressure vessels.
 - 2) Select insulation hangers and adhesive that are compatible with service temperature and with substrate.
 - 3) On tanks and vessels, maximum anchor-pin spacing is **3 inches (75 mm)** from insulation end joints, and **16 inches (400 mm)** o.c. in both directions.
 - 4) Do not overcompress insulation during installation.
 - 5) Cut and miter insulation segments to fit curved sides and domed heads of tanks and vessels.
 - 6) Impale insulation over anchor pins and attach speed washers.
 - 7) Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.
 - e. Secure each layer of insulation with stainless-steel or aluminum bands. Select band material compatible with insulation materials.
 - f. Where insulation hangers on equipment and vessels are not permitted or practical and where insulation support rings are not provided, install a girdle network for securing insulation. Stretch prestressed aircraft cable around the diameter of vessel and make taut with clamps, turnbuckles, or breather springs. Place one circumferential girdle around equipment approximately **6 inches (150 mm)** from each end. Install wire or cable between two circumferential girdles **12 inches (300 mm)** o.c. Install a wire ring around each end and around outer periphery of center openings, and stretch prestressed aircraft cable radially from the wire ring to nearest circumferential girdle. Install additional circumferential girdles along the body of equipment or tank at a minimum spacing of **48 inches (1200 mm)** o.c. Use this network for securing insulation with tie wire or bands.
 - g. Stagger joints between insulation layers at least **3 inches (75 mm)**.
 - h. Install insulation in removable segments on equipment access doors, manholes, handholes, and other elements that require frequent removal for service and inspection.

- i. Bevel and seal insulation ends around manholes, handholes, ASME stamps, and nameplates.
 - j. For equipment with surface temperatures below ambient, apply mastic to open ends, joints, seams, breaks, and punctures in insulation.
 2. Flexible Elastomeric Thermal Insulation Installation for Tanks and Vessels: Install insulation over entire surface of tanks and vessels.
 - a. Apply 100 percent coverage of adhesive to surface with manufacturer's recommended adhesive.
 - b. Seal longitudinal seams and end joints.
 3. Insulation Installation on Pumps:
 - a. Fabricate metal boxes lined with insulation. Fit boxes around pumps and coincide box joints with splits in pump casings. Fabricate joints with outward bolted flanges. Bolt flanges on **6-inch (150-mm)** centers, starting at corners. Install **3/8-inch- (10-mm-)** diameter fasteners with wing nuts. Alternatively, secure the box sections together using a latching mechanism.
 - b. Fabricate boxes from galvanized steel **OR** aluminum **OR** stainless steel, **as directed**, at least **0.040 inch (1.0 mm) OR 0.050 inch (1.3 mm) OR 0.060 inch (1.6 mm)**, **as directed**, thick.
 - c. For below ambient services, install a vapor barrier at seams, joints, and penetrations. Seal between flanges with replaceable gasket material to form a vapor barrier.

E. General Pipe Insulation Installation

1. Requirements in this article generally apply to all insulation materials except where more specific requirements are specified in various pipe insulation material installation articles.
2. Insulation Installation on Fittings, Valves, Strainers, Flanges, and Unions:
 - a. Install insulation over fittings, valves, strainers, flanges, unions, and other specialties with continuous thermal and vapor-retarder integrity, unless otherwise indicated.
 - b. Insulate pipe elbows using preformed fitting insulation or mitered fittings made from same material and density as adjacent pipe insulation. Each piece shall be butted tightly against adjoining piece and bonded with adhesive. Fill joints, seams, voids, and irregular surfaces with insulating cement finished to a smooth, hard, and uniform contour that is uniform with adjoining pipe insulation.
 - c. Insulate tee fittings with preformed fitting insulation or sectional pipe insulation of same material and thickness as used for adjacent pipe. Cut sectional pipe insulation to fit. Butt each section closely to the next and hold in place with tie wire. Bond pieces with adhesive.
 - d. Insulate valves using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. For valves, insulate up to and including the bonnets, valve stuffing-box studs, bolts, and nuts. Fill joints, seams, and irregular surfaces with insulating cement.
 - e. Insulate strainers using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. Fill joints, seams, and irregular surfaces with insulating cement. Insulate strainers so strainer basket flange or plug can be easily removed and replaced without damaging the insulation and jacket. Provide a removable reusable insulation cover. For below ambient services, provide a design that maintains vapor barrier.
 - f. Insulate flanges and unions using a section of oversized preformed pipe insulation. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker.
 - g. Cover segmented insulated surfaces with a layer of finishing cement and coat with a mastic. Install vapor-barrier mastic for below ambient services and a breather mastic for above ambient services. Reinforce the mastic with fabric-reinforcing mesh. Trowel the mastic to a smooth and well-shaped contour.

- h. For services not specified to receive a field-applied jacket except for flexible elastomeric and polyolefin, install fitted PVC cover over elbows, tees, strainers, valves, flanges, and unions. Terminate ends with PVC end caps. Tape PVC covers to adjoining insulation facing using PVC tape.
- i. Stencil or label the outside insulation jacket of each union with the word "UNION." Match size and color of pipe labels.
3. Insulate instrument connections for thermometers, pressure gages, pressure temperature taps, test connections, flow meters, sensors, switches, and transmitters on insulated pipes, vessels, and equipment. Shape insulation at these connections by tapering it to and around the connection with insulating cement and finish with finishing cement, mastic, and flashing sealant.
4. Install removable insulation covers at locations indicated. Installation shall conform to the following:
 - a. Make removable flange and union insulation from sectional pipe insulation of same thickness as that on adjoining pipe. Install same insulation jacket as adjoining pipe insulation.
 - b. When flange and union covers are made from sectional pipe insulation, extend insulation from flanges or union long at least two times the insulation thickness over adjacent pipe insulation on each side of flange or union. Secure flange cover in place with stainless-steel or aluminum bands. Select band material compatible with insulation and jacket.
 - c. Construct removable valve insulation covers in same manner as for flanges except divide the two-part section on the vertical center line of valve body.
 - d. When covers are made from block insulation, make two halves, each consisting of mitered blocks wired to stainless-steel fabric. Secure this wire frame, with its attached insulation, to flanges with tie wire. Extend insulation at least **2 inches (50 mm)** over adjacent pipe insulation on each side of valve. Fill space between flange or union cover and pipe insulation with insulating cement. Finish cover assembly with insulating cement applied in two coats. After first coat is dry, apply and trowel second coat to a smooth finish.
 - e. Unless a PVC jacket is indicated in field-applied jacket schedules, finish exposed surfaces with a metal jacket.
- F. Calcium Silicate Insulation Installation
 1. Insulation Installation on Domestic Water Boiler Breechings:
 - a. Secure single-layer insulation with stainless-steel bands at **12-inch (300-mm)** intervals and tighten bands without deforming insulation material.
 - b. Install 2-layer insulation with joints tightly butted and staggered at least **3 inches (75 mm)**. Secure inner layer with wire spaced at **12-inch (300-mm)** intervals. Secure outer layer with stainless-steel bands at **12-inch (300-mm)** intervals.
 - c. On exposed applications without metal jacket, finish insulation surface with a skim coat of mineral-fiber, hydraulic-setting cement. When cement is dry, apply flood coat of lagging adhesive and press on one layer of glass cloth. Overlap edges at least **1 inch (25 mm)**. Apply finish coat of lagging adhesive over glass cloth. Thin finish coat to achieve smooth, uniform finish.
 2. Insulation Installation on Straight Pipes and Tubes:
 - a. Secure single-layer insulation with stainless-steel bands at **12-inch (300-mm)** intervals and tighten bands without deforming insulation materials.
 - b. Install 2-layer insulation with joints tightly butted and staggered at least **3 inches (75 mm)**. Secure inner layer with wire spaced at **12-inch (300-mm)** intervals. Secure outer layer with stainless-steel bands at **12-inch (300-mm)** intervals.
 - c. Apply a skim coat of mineral-fiber, hydraulic-setting cement to insulation surface. When cement is dry, apply flood coat of lagging adhesive and press on one layer of glass cloth or tape. Overlap edges at least **1 inch (25 mm)**. Apply finish coat of lagging adhesive over glass cloth or tape. Thin finish coat to achieve smooth, uniform finish.
 3. Insulation Installation on Pipe Flanges:
 - a. Install preformed pipe insulation to outer diameter of pipe flange.
 - b. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.

- c. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of block insulation of same material and thickness as pipe insulation.
- d. Finish flange insulation same as pipe insulation.
- 4. Insulation Installation on Pipe Fittings and Elbows:
 - a. Install preformed sections of same material as straight segments of pipe insulation when available. Secure according to manufacturer's written instructions.
 - b. When preformed insulation sections of insulation are not available, install mitered sections of calcium silicate insulation. Secure insulation materials with wire or bands.
 - c. Finish fittings insulation same as pipe insulation.
- 5. Insulation Installation on Valves and Pipe Specialties:
 - a. Install mitered segments of calcium silicate insulation to valve body. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
 - b. Install insulation to flanges as specified for flange insulation application.
 - c. Finish valve and specialty insulation same as pipe insulation.

G. Cellular-Glass Insulation Installation

- 1. Insulation Installation on Straight Pipes and Tubes:
 - a. Secure each layer of insulation to pipe with wire or bands and tighten bands without deforming insulation materials.
 - b. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
 - c. For insulation with factory-applied jackets on above ambient services, secure laps with outward clinched staples at **6 inches (150 mm)** o.c.
 - d. For insulation with factory-applied jackets on below ambient services, do not staple longitudinal tabs but secure tabs with additional adhesive as recommended by insulation material manufacturer and seal with vapor-barrier mastic and flashing sealant.
- 2. Insulation Installation on Pipe Flanges:
 - a. Install preformed pipe insulation to outer diameter of pipe flange.
 - b. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
 - c. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of cellular-glass block insulation of same thickness as pipe insulation.
 - d. Install jacket material with manufacturer's recommended adhesive, overlap seams at least **1 inch (25 mm)**, and seal joints with flashing sealant.
- 3. Insulation Installation on Pipe Fittings and Elbows:
 - a. Install preformed sections of same material as straight segments of pipe insulation when available. Secure according to manufacturer's written instructions.
 - b. When preformed sections of insulation are not available, install mitered sections of cellular-glass insulation. Secure insulation materials with wire or bands.
- 4. Insulation Installation on Valves and Pipe Specialties:
 - a. Install preformed sections of cellular-glass insulation to valve body.
 - b. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
 - c. Install insulation to flanges as specified for flange insulation application.

H. Flexible Elastomeric Insulation Installation

- 1. Seal longitudinal seams and end joints with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.
- 2. Insulation Installation on Pipe Flanges:
 - a. Install pipe insulation to outer diameter of pipe flange.
 - b. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.

- c. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of sheet insulation of same thickness as pipe insulation.
 - d. Secure insulation to flanges and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.
 - 3. Insulation Installation on Pipe Fittings and Elbows:
 - a. Install mitered sections of pipe insulation.
 - b. Secure insulation materials and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.
 - 4. Insulation Installation on Valves and Pipe Specialties:
 - a. Install preformed valve covers manufactured of same material as pipe insulation when available.
 - b. When preformed valve covers are not available, install cut sections of pipe and sheet insulation to valve body. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
 - c. Install insulation to flanges as specified for flange insulation application.
 - d. Secure insulation to valves and specialties and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.
- I. Mineral-Fiber Insulation Installation
 - 1. Insulation Installation on Straight Pipes and Tubes:
 - a. Secure each layer of preformed pipe insulation to pipe with wire or bands and tighten bands without deforming insulation materials.
 - b. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
 - c. For insulation with factory-applied jackets on above ambient surfaces, secure laps with outward clinched staples at **6 inches (150 mm)** o.c.
 - d. For insulation with factory-applied jackets on below ambient surfaces, do not staple longitudinal tabs but secure tabs with additional adhesive as recommended by insulation material manufacturer and seal with vapor-barrier mastic and flashing sealant.
 - 2. Insulation Installation on Pipe Flanges:
 - a. Install preformed pipe insulation to outer diameter of pipe flange.
 - b. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
 - c. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with mineral-fiber blanket insulation.
 - d. Install jacket material with manufacturer's recommended adhesive, overlap seams at least **1 inch (25 mm)**, and seal joints with flashing sealant.
 - 3. Insulation Installation on Pipe Fittings and Elbows:
 - a. Install preformed sections of same material as straight segments of pipe insulation when available.
 - b. When preformed insulation elbows and fittings are not available, install mitered sections of pipe insulation, to a thickness equal to adjoining pipe insulation. Secure insulation materials with wire or bands.
 - 4. Insulation Installation on Valves and Pipe Specialties:
 - a. Install preformed sections of same material as straight segments of pipe insulation when available.
 - b. When preformed sections are not available, install mitered sections of pipe insulation to valve body.
 - c. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
 - d. Install insulation to flanges as specified for flange insulation application.
- J. Phenolic Insulation Installation
 - 1. General Installation Requirements:

- a. Secure single-layer insulation with stainless-steel bands at **12-inch (300-mm)** intervals and tighten bands without deforming insulation materials.
 - b. Install 2-layer insulation with joints tightly butted and staggered at least **3 inches (75 mm)**. Secure inner layer with **0.062-inch (1.6-mm)** wire spaced at **12-inch (300-mm)** intervals. Secure outer layer with stainless-steel bands at **12-inch (300-mm)** intervals.
 2. Insulation Installation on Straight Pipes and Tubes:
 - a. Secure each layer of insulation to pipe with wire or bands and tighten bands without deforming insulation materials.
 - b. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
 - c. For insulation with factory-applied jackets on above ambient services, secure laps with outward clinched staples at **6 inches (150 mm)** o.c.
 - d. For insulation with factory-applied jackets with vapor retarders on below ambient services, do not staple longitudinal tabs but secure tabs with additional adhesive as recommended by insulation material manufacturer and seal with vapor-barrier mastic and flashing sealant.
 3. Insulation Installation on Pipe Flanges:
 - a. Install preformed pipe insulation to outer diameter of pipe flange.
 - b. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
 - c. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of block insulation of same material and thickness as pipe insulation.
 4. Insulation Installation on Pipe Fittings and Elbows:
 - a. Install preformed insulation sections of same material as straight segments of pipe insulation. Secure according to manufacturer's written instructions.
 5. Insulation Installation on Valves and Pipe Specialties:
 - a. Install preformed insulation sections of same material as straight segments of pipe insulation. Secure according to manufacturer's written instructions.
 - b. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
 - c. Install insulation to flanges as specified for flange insulation application.
- K. Polyisocyanurate Insulation Installation
 1. Insulation Installation on Straight Pipes and Tubes:
 - a. Secure each layer of insulation to pipe with tape or bands and tighten without deforming insulation materials. Orient longitudinal joints between half sections in 3 and 9 o'clock positions on the pipe.
 - b. For insulation with factory-applied jackets with vapor barriers, do not staple longitudinal tabs but secure tabs with additional adhesive or tape as recommended by insulation material manufacturer and seal with vapor-barrier mastic.
 - c. All insulation shall be tightly butted and free of voids and gaps at all joints. Vapor barrier must be continuous. Before installing jacket material, install vapor-barrier system.
 2. Insulation Installation on Pipe Flanges:
 - a. Install preformed pipe insulation to outer diameter of pipe flange.
 - b. Make width of insulation section same as overall width of flange and bolts, same thickness of adjacent pipe insulation, not to exceed **1-1/2-inch (38-mm)** thickness.
 - c. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of polyisocyanurate block insulation of same thickness as pipe insulation.
 3. Insulation Installation on Fittings and Elbows:
 - a. Install preformed sections of same material as straight segments of pipe insulation. Secure according to manufacturer's written instructions.
 4. Insulation Installation on Valves and Pipe Specialties:
 - a. Install preformed sections of polyisocyanurate insulation to valve body.

- b. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
- c. Install insulation to flanges as specified for flange insulation application.

L. Polyolefin Insulation Installation

- 1. Insulation Installation on Straight Pipes and Tubes:
 - a. Seal split-tube longitudinal seams and end joints with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.
- 2. Insulation Installation on Pipe Flanges:
 - a. Install pipe insulation to outer diameter of pipe flange.
 - b. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
 - c. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of polyolefin sheet insulation of same thickness as pipe insulation.
 - d. Secure insulation to flanges and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.
- 3. Insulation Installation on Pipe Fittings and Elbows:
 - a. Install mitered sections of polyolefin pipe insulation.
 - b. Secure insulation materials and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.
- 4. Insulation Installation on Valves and Pipe Specialties:
 - a. Install cut sections of polyolefin pipe and sheet insulation to valve body.
 - b. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
 - c. Install insulation to flanges as specified for flange insulation application.
 - d. Secure insulation to valves and specialties, and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

M. Polystyrene Insulation Installation

- 1. Insulation Installation on Straight Pipes and Tubes:
 - a. Secure each layer of insulation with tape or bands and tighten bands without deforming insulation materials. Orient longitudinal joints between half sections in 3 and 9 o'clock positions on the pipe.
 - b. For insulation with factory-applied jackets with vapor barriers, do not staple longitudinal tabs but secure tabs with additional adhesive or tape as recommended by insulation material manufacturer and seal with vapor-barrier mastic.
 - c. All insulation shall be tightly butted and free of voids and gaps at all joints. Vapor barrier must be continuous. Before installing jacket material, install vapor-barrier system.
- 2. Insulation Installation on Pipe Flanges:
 - a. Install preformed pipe insulation to outer diameter of pipe flange.
 - b. Make width of insulation section same as overall width of flange and bolts, same thickness of adjacent pipe insulation, not to exceed 1-1/2-inch (38-mm) thickness.
 - c. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of polystyrene block insulation of same thickness as pipe insulation.
- 3. Insulation Installation on Pipe Fittings and Elbows:
 - a. Install preformed insulation sections of same material as straight segments of pipe insulation. Secure according to manufacturer's written instructions.
- 4. Insulation Installation on Valves and Pipe Specialties:
 - a. Install preformed section of polystyrene insulation to valve body.
 - b. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
 - c. Install insulation to flanges as specified for flange insulation application.

N. Field-Applied Jacket Installation

1. Where glass-cloth jackets are indicated, install directly over bare insulation or insulation with factory-applied jackets.
 - a. Draw jacket smooth and tight to surface with **2-inch (50-mm)** overlap at seams and joints.
 - b. Embed glass cloth between two **0.062-inch- (1.6-mm-)** thick coats of lagging adhesive.
 - c. Completely encapsulate insulation with coating, leaving no exposed insulation.
2. Where FSK jackets are indicated, install as follows:
 - a. Draw jacket material smooth and tight.
 - b. Install lap or joint strips with same material as jacket.
 - c. Secure jacket to insulation with manufacturer's recommended adhesive.
 - d. Install jacket with **1-1/2-inch (38-mm)** laps at longitudinal seams and **3-inch- (75-mm-)** wide joint strips at end joints.
 - e. Seal openings, punctures, and breaks in vapor-retarder jackets and exposed insulation with vapor-barrier mastic.
3. Where PVC jackets are indicated, install with **1-inch (25-mm)** overlap at longitudinal seams and end joints; for horizontal applications, install with longitudinal seams along top and bottom of tanks and vessels. Seal with manufacturer's recommended adhesive.
 - a. Apply two continuous beads of adhesive to seams and joints, one bead under lap and the finish bead along seam and joint edge.
4. Where metal jackets are indicated, install with **2-inch (50-mm)** overlap at longitudinal seams and end joints. Overlap longitudinal seams arranged to shed water. Seal end joints with weatherproof sealant recommended by insulation manufacturer. Secure jacket with stainless-steel bands **12 inches (300 mm)** o.c. and at end joints.
5. Where PVDC jackets are indicated, install as follows:
 - a. Apply three separate wraps of filament tape per insulation section to secure pipe insulation to pipe prior to installation of PVDC jacket.
 - b. Wrap factory-presizes jackets around individual pipe insulation sections with one end overlapping the previously installed sheet. Install presized jacket with an approximate overlap at butt joint of **2 inches (50 mm)** over the previous section. Adhere lap seal using adhesive or SSL, and then apply 1-1/4 circumferences of appropriate PVDC tape around overlapped butt joint.
 - c. Continuous jacket can be spiral wrapped around a length of pipe insulation. Apply adhesive or PVDC tape at overlapped spiral edge. When electing to use adhesives, refer to manufacturer's written instructions for application of adhesives along this spiral edge to maintain a permanent bond.
 - d. Jacket can be wrapped in cigarette fashion along length of roll for insulation systems with an outer circumference of **33-1/2 inches (850 mm)** or less. The **33-1/2-inch- (850-mm-)** circumference limit allows for **2-inch- (50-mm-)** overlap seal. Using the length of roll allows for longer sections of jacket to be installed at one time. Use adhesive on the lap seal. Visually inspect lap seal for "fishmouthing," and use PVDC tape along lap seal to secure joint.
 - e. Repair holes or tears in PVDC jacket by placing PVDC tape over the hole or tear and wrapping a minimum of 1-1/4 circumferences to avoid damage to tape edges.

O. Finishes

1. Equipment and Pipe Insulation with ASJ, Glass-Cloth, or Other Paintable Jacket Material: Paint jacket with paint system identified below and as specified in Division 07.
 - a. Flat Acrylic Finish: Two finish coats over a primer that is compatible with jacket material and finish coat paint. Add fungicidal agent to render fabric mildew proof.
 - 1) Finish Coat Material: Interior, flat, latex-emulsion size.
2. Flexible Elastomeric Thermal Insulation: After adhesive has fully cured, apply two coats of insulation manufacturer's recommended protective coating.
3. Color: Final color as selected by the Owner. Vary first and second coats to allow visual inspection of the completed Work.
4. Do not field paint aluminum or stainless-steel jackets.

P. Field Quality Control

1. Perform tests and inspections.
2. Tests and Inspections:
 - a. Inspect field-insulated equipment, randomly selected by the Owner, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to one location(s) for each type of equipment defined in the "Equipment Insulation Schedule" Article. For large equipment, remove only a portion adequate to determine compliance.
 - b. Inspect pipe, fittings, strainers, and valves, randomly selected by the Owner, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to three locations of straight pipe, three locations of threaded fittings, three locations of welded fittings, two locations of threaded strainers, two locations of welded strainers, three locations of threaded valves, and three locations of flanged valves for each pipe service defined in the "Piping Insulation Schedule, General" Article.
3. All insulation applications will be considered defective Work if sample inspection reveals noncompliance with requirements.

Q. Domestic Water Boiler Breeching Insulation Schedule

1. Round, exposed breeching and connector insulation shall be one of the following:
 - a. Calcium Silicate: **4 inches (100 mm)** thick.
 - b. High-Temperature Mineral-Fiber Blanket: **3 inches (75 mm)** thick and **3-lb/cu. ft. (48-kg/cu. m)** nominal density.
 - c. High-Temperature Mineral-Fiber Board: **3 inches (75 mm)** thick and **3-lb/cu. ft. (48-kg/cu. m) OR 6-lb/cu. ft. (96-kg/cu. m), as directed**, nominal density.
2. Round, concealed breeching and connector insulation shall be one of the following:
 - a. Calcium Silicate: **4 inches (100 mm)** thick.
 - b. High-Temperature Mineral-Fiber Blanket: **3 inches (75 mm)** thick and **3-lb/cu. ft. (48-kg/cu. m)** nominal density.
 - c. High-Temperature Mineral-Fiber Board: **3 inches (75 mm)** thick and **3-lb/cu. ft. (48-kg/cu. m) OR 6-lb/cu. ft. (96-kg/cu. m), as directed**, nominal density.
3. Rectangular, exposed breeching and connector insulation shall be one of the following:
 - a. Calcium Silicate: **4 inches (100 mm)** thick.
 - b. High-Temperature Mineral-Fiber Blanket: **3 inches (75 mm)** thick and **3-lb/cu. ft. (48-kg/cu. m)** nominal density.
 - c. High-Temperature Mineral-Fiber Board: **3 inches (75 mm)** thick and **3-lb/cu. ft. (48-kg/cu. m) OR 6-lb/cu. ft. (96-kg/cu. m), as directed**, nominal density.
4. Rectangular, concealed breeching and connector insulation shall be one of the following:
 - a. Calcium Silicate: **4 inches (100 mm)** thick.
 - b. High-Temperature Mineral-Fiber Blanket: **3 inches (75 mm)** thick and **3-lb/cu. ft. (48-kg/cu. m)** nominal density.
 - c. High-Temperature Mineral-Fiber Board: **3 inches (75 mm)** thick and **3-lb/cu. ft. (48-kg/cu. m) OR 6-lb/cu. ft. (96-kg/cu. m), as directed**, nominal density.

R. Equipment Insulation Schedule

1. Insulation materials and thicknesses are identified below. If more than one material is listed for a type of equipment, selection from materials listed is Contractor's option.
2. Insulate indoor and outdoor equipment in paragraphs below that is not factory insulated.
3. Heat-exchanger (water-to-water for domestic water heating service) insulation shall be one of the following:
 - a. Calcium Silicate: **3 inches (75 mm)** thick.
 - b. Cellular Glass: **3 inches (75 mm)** thick.
 - c. Mineral-Fiber Board: **2 inches (50 mm)** thick and **2-lb/cu. ft. (32-kg/cu. m) OR 3-lb/cu. ft. (48-kg/cu. m) OR 6-lb/cu. ft. (96-kg/cu. m), as directed**, nominal density.
 - d. Mineral-Fiber Pipe and Tank: **2 inches (50 mm)** thick.
4. Steam-to-hot-water converter insulation shall be one of the following:
 - a. Calcium Silicate: **3 inches (75 mm)** thick.

- b. Cellular Glass: 3 inches (75 mm) thick.
- c. Mineral-Fiber Board: 2 inches (50 mm) thick and 2-lb/cu. ft. (32-kg/cu. m) OR 3-lb/cu. ft. (48-kg/cu. m) OR 6-lb/cu. ft. (96-kg/cu. m), as directed, nominal density.
- d. Mineral-Fiber Pipe and Tank: 2 inches (50 mm) thick.
- 5. Domestic water pump insulation shall be one of the following:
 - a. Cellular Glass: 2 inches (50 mm) thick.
 - b. Mineral-Fiber Board: 1 inch (25 mm) thick and 2-lb/cu. ft. (32-kg/cu. m) OR 3-lb/cu. ft. (48-kg/cu. m) OR 6-lb/cu. ft. (96-kg/cu. m), as directed, nominal density.
 - c. Phenolic: 1 inch (25 mm) thick.
 - d. Polyisocyanurate: 1 inch (25 mm) thick.
- 6. Domestic chilled-water (potable) pump insulation shall be one of the following:
 - a. Cellular Glass: 3 inches (75 mm) thick.
 - b. Mineral-Fiber Board: 2 inches (50 mm) thick and 2-lb/cu. ft. (32-kg/cu. m) OR 3-lb/cu. ft. (48-kg/cu. m) OR 6-lb/cu. ft. (96-kg/cu. m), as directed, nominal density.
 - c. Phenolic: 1 inch (25 mm) thick.
 - d. Polyisocyanurate: 1-1/2 inches (38 mm) thick.
- 7. Domestic hot-water pump insulation shall be one of the following:
 - a. Cellular Glass: 2 inches (50 mm) thick.
 - b. Mineral-Fiber Board: 1 inch (25 mm) thick and 2-lb/cu. ft. (32-kg/cu. m) OR 3-lb/cu. ft. (48-kg/cu. m) OR 6-lb/cu. ft. (96-kg/cu. m), as directed, nominal density.
 - c. Phenolic: 1 inch (25 mm) thick.
 - d. Polyisocyanurate: 1 inch (25 mm) thick.
- 8. Domestic water, domestic chilled-water (potable), and domestic hot-water hydropneumatic tank insulation shall be one of the following:
 - a. Cellular Glass: 1-1/2 inches (38 mm) thick.
 - b. Flexible Elastomeric: 1 inch (25 mm) thick.
 - c. Mineral-Fiber Board: 1 inch (25 mm) thick and 2-lb/cu. ft. (32-kg/cu. m) OR 3-lb/cu. ft. (48-kg/cu. m) OR 6-lb/cu. ft. (96-kg/cu. m), as directed, nominal density.
 - d. Mineral-Fiber Pipe and Tank: 1 inch (25 mm) thick.
 - e. Phenolic: 1 inch (25 mm) thick.
 - f. Polyisocyanurate: 1 inch (25 mm) thick.
 - g. Polyolefin: 1 inch (25 mm) thick.
- 9. Domestic hot-water storage tank insulation shall be one of the following, of thickness to provide an R-value of 12.5:
 - a. Cellular glass.
 - b. Mineral-Fiber Board: 2-lb/cu. ft. (32-kg/cu. m) OR 3-lb/cu. ft. (48-kg/cu. m) OR 6-lb/cu. ft. (96-kg/cu. m), as directed, nominal density.
 - c. Mineral-fiber pipe and tank.
 - d. Phenolic.
- 10. Domestic water storage tank insulation shall be one of the following:
 - a. Cellular Glass: 2 inches (50 mm) thick.
 - b. Flexible Elastomeric: 1 inch (25 mm) thick.
 - c. Mineral-Fiber Board: 1 inch (25 mm) thick and 2-lb/cu. ft. (32-kg/cu. m) OR 3-lb/cu. ft. (48-kg/cu. m) OR 6-lb/cu. ft. (96-kg/cu. m), as directed, nominal density.
 - d. Mineral-Fiber Pipe and Tank: 1 inch (25 mm) thick.
 - e. Phenolic: 1 inch (25 mm) thick.
 - f. Polyisocyanurate: 1 inch (25 mm) thick.
 - g. Polyolefin: 1 inch (25 mm) thick.
- 11. Domestic chilled-water (potable) storage tank insulation shall be one of the following:
 - a. Cellular Glass: 2 inches (50 mm) thick.
 - b. Flexible Elastomeric: 1 inch (25 mm) thick.
 - c. Mineral-Fiber Board: 1 inch (25 mm) thick and 2-lb/cu. ft. (32-kg/cu. m) OR 3-lb/cu. ft. (48-kg/cu. m) OR 6-lb/cu. ft. (96-kg/cu. m), as directed, nominal density.
 - d. Mineral-Fiber Pipe and Tank: 1 inch (25 mm) thick.
 - e. Phenolic: 1 inch (25 mm) thick.

- f. Polyisocyanurate: **1 inch (25 mm)** thick.
- g. Polyolefin: **1 inch (25 mm)** thick.
12. Piping system filter-housing insulation shall be one of the following:
 - a. Cellular Glass: **3 inches (75 mm)** thick.
 - b. Mineral-Fiber Board: **2 inches (50 mm)** thick and **2-lb/cu. ft. (32-kg/cu. m) OR 3-lb/cu. ft. (48-kg/cu. m) OR 6-lb/cu. ft. (96-kg/cu. m)**, **as directed**, nominal density.
 - c. Mineral-Fiber Pipe and Tank: **2 inches (50 mm)** thick.
- S. Piping Insulation Schedule, General
 1. Acceptable preformed pipe and tubular insulation materials and thicknesses are identified for each piping system and pipe size range. If more than one material is listed for a piping system, selection from materials listed is Contractor's option.
 2. Items Not Insulated: Unless otherwise indicated, do not install insulation on the following:
 - a. Drainage piping located in crawl spaces.
 - b. Underground piping.
 - c. Chrome-plated pipes and fittings unless there is a potential for personnel injury.
- T. Indoor Piping Insulation Schedule
 1. Domestic Cold Water:
 - a. **NPS 1 (DN 25)** and Smaller: Insulation shall be one of the following:
 - 1) Cellular Glass: **1-1/2 inches (38 mm)** thick.
 - 2) Flexible Elastomeric: **1/2 inch (13 mm) OR 3/4 inch (19 mm) OR 1 inch (25 mm)**, **as directed**, thick.
 - 3) Mineral-Fiber, Preformed Pipe Insulation, Type I: **1/2 inch (13 mm) OR 1 inch (25 mm)**, **as directed**, thick.
 - 4) Phenolic: **1 inch (25 mm)** thick.
 - 5) Polyisocyanurate: **1 inch (25 mm)** thick.
 - 6) Polyolefin: **1/2 inch (13 mm) OR 3/4 inch (19 mm) OR 1 inch (25 mm)**, **as directed**, thick.
 - b. **NPS 1-1/4 (DN 32)** and Larger: Insulation shall be one of the following:
 - 1) Cellular Glass: **1-1/2 inches (38 mm)** thick.
 - 2) Flexible Elastomeric: **1 inch (25 mm)** thick.
 - 3) Mineral-Fiber, Preformed Pipe Insulation, Type I: **1 inch (25 mm)** thick.
 - 4) Phenolic: **1 inch (25 mm)** thick.
 - 5) Polyisocyanurate: **1 inch (25 mm)** thick.
 - 6) Polyolefin: **1 inch (25 mm)** thick.
 2. Domestic Hot and Recirculated Hot Water:
 - a. **NPS 1-1/4 (DN 32)** and Smaller: Insulation shall be one of the following:
 - 1) Cellular Glass: **1-1/2 inches (38 mm)** thick.
 - 2) Flexible Elastomeric: **3/4 inch (19 mm) OR 1 inch (25 mm)**, **as directed**, thick.
 - 3) Mineral-Fiber, Preformed Pipe Insulation, Type I: **1/2 inch (13 mm) OR 1 inch (25 mm)**, **as directed**, thick.
 - 4) Phenolic: **1 inch (25 mm)** thick.
 - 5) Polyisocyanurate: **1 inch (25 mm)** thick.
 - 6) Polyolefin: **3/4 inch (19 mm) OR 1 inch (25 mm)**, **as directed**, thick.
 - b. **NPS 1-1/2 (DN 40)** and Larger: Insulation shall be one of the following:
 - 1) Cellular Glass: **1-1/2 inches (38 mm)** thick.
 - 2) Flexible Elastomeric: **1 inch (25 mm)** thick.
 - 3) Mineral-Fiber, Preformed Pipe Insulation, Type I: **1 inch (25 mm)** thick.
 - 4) Phenolic: **1 inch (25 mm)** thick.
 - 5) Polyisocyanurate: **1 inch (25 mm)** thick.
 - 6) Polyolefin: **1 inch (25 mm)** thick.
 3. Domestic Chilled Water (Potable):
 - a. All Pipe Sizes: Insulation shall be one of the following:
 - 1) Cellular Glass: **1-1/2 inches (38 mm)** thick.
 - 2) Flexible Elastomeric: **1 inch (25 mm)** thick.

- 3) Mineral-Fiber, Preformed Pipe Insulation, Type I: **1 inch (25 mm)** thick.
- 4) Phenolic: **1 inch (25 mm)** thick.
- 5) Polyisocyanurate: **1 inch (25 mm)** thick.
- 6) Polyolefin: **1 inch (25 mm)** thick.
4. Stormwater and Overflow:
 - a. All Pipe Sizes: Insulation shall be one of the following:
 - 1) Cellular Glass: **1-1/2 inches (38 mm)** thick.
 - 2) Flexible Elastomeric: **1 inch (25 mm)** thick.
 - 3) Mineral-Fiber, Preformed Pipe Insulation, Type I: **1 inch (25 mm)** thick.
 - 4) Phenolic: **1 inch (25 mm)** thick.
 - 5) Polyisocyanurate: **1 inch (25 mm)** thick.
 - 6) Polyolefin: **1 inch (25 mm)** thick.
5. Roof Drain and Overflow Drain Bodies:
 - a. All Pipe Sizes: Insulation shall be one of the following:
 - 1) Cellular Glass: **1-1/2 inches (38 mm)** thick.
 - 2) Flexible Elastomeric: **1 inch (25 mm)** thick.
 - 3) Mineral-Fiber, Preformed Pipe Insulation, Type I: **1 inch (25 mm)** thick.
 - 4) Phenolic: **1 inch (25 mm)** thick.
 - 5) Polyisocyanurate: **1 inch (25 mm)** thick.
 - 6) Polyolefin: **1 inch (25 mm)** thick.
6. Exposed Sanitary Drains, Domestic Water, Domestic Hot Water, and Stops for Plumbing Fixtures for People with Disabilities:
 - a. All Pipe Sizes: Insulation shall be one of the following:
 - 1) Flexible Elastomeric: **1/2 inch (13 mm) OR 3/4 inch (19 mm) OR 1 inch (25 mm), as directed**, thick.
 - 2) Mineral-Fiber, Preformed Pipe Insulation, Type I: **1/2 inch (13 mm) OR 1 inch (25 mm)** thick.
 - 3) Polyolefin: **1/2 inch (13 mm) OR 3/4 inch (19 mm) OR 1 inch (25 mm)** thick.
7. Sanitary Waste Piping Where Heat Tracing Is Installed:
 - a. All Pipe Sizes: Insulation shall be one of the following:
 - 1) Cellular Glass: **2 inches (50 mm)** thick.
 - 2) Mineral-Fiber, Preformed Pipe Insulation, Type I: **1-1/2 inches (38 mm)** thick.
 - 3) Phenolic: **1-1/2 inches (38 mm)** thick.
 - 4) Polyisocyanurate: **1-1/2 inches (38 mm)** thick.
8. Condensate and Equipment Drain Water below **60 Deg F (16 Deg C)**:
 - a. All Pipe Sizes: Insulation shall be one of the following:
 - 1) Cellular Glass: **1-1/2 inches (38 mm)** thick.
 - 2) Flexible Elastomeric: **3/4 inch (19 mm) OR 1 inch (25 mm), as directed**, thick.
 - 3) Mineral-Fiber, Preformed Pipe Insulation, Type I: **1/2 inch (13 mm) OR 1 inch (25 mm), as directed**, thick.
 - 4) Phenolic: **1 inch (25 mm)** thick.
 - 5) Polyisocyanurate: **1 inch (25 mm)** thick.
 - 6) Polyolefin: **3/4 inch (19 mm) OR 1 inch (25 mm), as directed**, thick.
9. Floor Drains, Traps, and Sanitary Drain Piping within **10 Feet (3 m)** of Drain Receiving Condensate and Equipment Drain Water below **60 Deg F (16 Deg C)**:
 - a. All Pipe Sizes: Insulation shall be one of the following:
 - 1) Cellular Glass: **1-1/2 inches (38 mm)** thick.
 - 2) Flexible Elastomeric: **3/4 inch (19 mm) OR 1 inch (25 mm), as directed**, thick.
 - 3) Mineral-Fiber, Preformed Pipe Insulation, Type I: **1/2 inch (13 mm) OR 1 inch (25 mm), as directed**, thick.
 - 4) Phenolic: **1 inch (25 mm)** thick.
 - 5) Polyisocyanurate: **1 inch (25 mm)** thick.
 - 6) Polyolefin: **3/4 inch (19 mm) OR 1 inch (25 mm), as directed**, thick.
10. Hot Service Drains:
 - a. All Pipe Sizes: Insulation shall be one of the following:

- 1) Calcium Silicate: 1-1/2 inches (38 mm) thick.
 - 2) Cellular Glass: 1-1/2 inches (38 mm) thick.
 - 3) Mineral-Fiber, Preformed Pipe, Type I or II: 1 inch (25 mm) thick.
11. Hot Service Vents:
- a. All Pipe Sizes: Insulation shall be one of the following:
 - 1) Calcium Silicate: 1-1/2 inches (38 mm) thick.
 - 2) Cellular Glass: 1-1/2 inches (38 mm) thick.
 - 3) Mineral-Fiber, Preformed Pipe, Type I or II: 1 inch (25 mm) thick.
- U. Outdoor, Aboveground Piping Insulation Schedule
1. Domestic Water Piping:
 - a. All Pipe Sizes: Insulation shall be one of the following:
 - 1) Cellular Glass: 2 inches (50 mm) thick.
 - 2) Flexible Elastomeric: 2 inches (50 mm) thick.
 - 3) Mineral-Fiber, Preformed Pipe Insulation, Type I: 2 inches (50 mm) thick.
 - 4) Phenolic: 2 inches (50 mm) thick.
 - 5) Polyisocyanurate: 2 inches (50 mm) thick.
 - 6) Polyolefin: 2 inches (50 mm) thick.
 - 7) Polystyrene: 2 inches (50 mm) thick.
 2. Domestic Hot and Recirculated Hot Water:
 - a. All Pipe Sizes: Insulation shall be one of the following:
 - 1) Cellular Glass: 2 inches (50 mm) thick.
 - 2) Flexible Elastomeric: 2 inches (50 mm) thick.
 - 3) Mineral-Fiber, Preformed Pipe Insulation, Type I: 2 inches (50 mm) thick.
 - 4) Phenolic: 2 inches (50 mm) thick.
 - 5) Polyisocyanurate: 2 inches (50 mm) thick.
 - 6) Polyolefin: 2 inches (50 mm) thick.
 3. Sanitary Waste Piping Where Heat Tracing Is Installed:
 - a. All Pipe Sizes: Insulation shall be one of the following:
 - 1) Cellular Glass: 2 inches (50 mm) thick.
 - 2) Mineral-Fiber, Preformed Pipe Insulation, Type I: 2 inches (50 mm) thick.
 - 3) Phenolic: 2 inches (50 mm) thick.
 - 4) Polyisocyanurate: 2 inches (50 mm) thick.
 4. Hot Service Drains:
 - a. All Pipe Sizes: Insulation shall be one of the following:
 - 1) Calcium Silicate: 1-1/2 inches (38 mm) thick.
 - 2) Cellular Glass: 1-1/2 inches (38 mm) thick.
 - 3) Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch (25 mm) thick.
 5. Hot Service Vents:
 - a. All Pipe Sizes: Insulation shall be one of the following:
 - 1) Calcium Silicate: 1-1/2 inches (38 mm) thick.
 - 2) Cellular Glass: 1-1/2 inches (38 mm) thick.
 - 3) Mineral-Fiber, Preformed Pipe Insulation, Type II: 1 inch (25 mm) thick.
- V. Outdoor, Underground Piping Insulation Schedule
1. Loose-fill insulation, for belowground piping, is specified in Division 28.
 2. Sanitary Waste Piping, All Sizes, Where Heat Tracing Is Installed: Cellular glass, 2 inches (50 mm) thick.
 3. Chilled Water, All Sizes: Cellular glass, 2 inches (50 mm) thick.
- W. Indoor, Field-Applied Jacket Schedule
1. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.
 2. If more than one material is listed, selection from materials listed is Contractor's option.
 3. Equipment, Concealed:
 - a. None.

- b. PVC **OR** PVC, Color-Coded by System, **as directed**: 20 mils (0.5 mm) **OR** 30 mils (0.8 mm), **as directed**, thick.
 - c. Aluminum, Smooth **OR** Corrugated **OR** Stucco Embossed, **as directed**: 0.016 inch (0.41 mm) **OR** 0.020 inch (0.51 mm) **OR** 0.024 inch (0.61 mm) **OR** 0.032 inch (0.81 mm) **OR** 0.040 inch (1.0 mm), **as directed**, thick.
 - d. Painted Aluminum, Smooth **OR** Corrugated **OR** Stucco Embossed, **as directed**: 0.016 inch (0.41 mm) **OR** 0.020 inch (0.51 mm) **OR** 0.024 inch (0.61 mm) **OR** 0.032 inch (0.81 mm), **as directed**, thick.
 - e. Stainless Steel, Type 304 **OR** Type 316, **as directed**, Smooth 2B Finish **OR** Corrugated **OR** Stucco Embossed, **as directed**: 0.010 inch (0.25 mm) **OR** 0.016 inch (0.41 mm) **OR** 0.020 inch (0.51 mm) **OR** 0.024 inch (0.61 mm), **as directed**, thick.
4. Equipment, Exposed, up to 48 Inches (1200 mm) in Diameter or with Flat Surfaces up to 72 Inches (1800 mm):
 - a. None.
 - b. PVC **OR** PVC, Color-Coded by System, **as directed**: 20 mils (0.5 mm) **OR** 30 mils (0.8 mm), **as directed**, thick.
 - c. Aluminum, Smooth **OR** Corrugated **OR** Stucco Embossed, **as directed**: 0.016 inch (0.41 mm) **OR** 0.020 inch (0.51 mm) **OR** 0.024 inch (0.61 mm) **OR** 0.032 inch (0.81 mm) **OR** 0.040 inch (1.0 mm), **as directed**, thick.
 - d. Painted Aluminum, Smooth **OR** Corrugated **OR** Stucco Embossed, **as directed**: 0.016 inch (0.41 mm) **OR** 0.020 inch (0.51 mm) **OR** 0.024 inch (0.61 mm) **OR** 0.032 inch (0.81 mm), **as directed**, thick.
 - e. Stainless Steel, Type 304 **OR** Type 316, **as directed**, Smooth 2B Finish **OR** Corrugated **OR** Stucco Embossed, **as directed**: 0.010 inch (0.25 mm) **OR** 0.016 inch (0.41 mm) **OR** 0.020 inch (0.51 mm) **OR** 0.024 inch (0.61 mm), **as directed**, thick.
5. Equipment, Exposed, Larger Than 48 Inches (1200 mm) in Diameter or with Flat Surfaces Larger Than 72 Inches (1800 mm):
 - a. None.
 - b. Aluminum **OR** Painted Aluminum, **as directed**, Smooth **OR** Stucco Embossed, **as directed**, with 1-1/4-Inch- (32-mm-) Deep Corrugations **OR** 2-1/2-Inch- (65-mm-) Deep Corrugations **OR** 4-by-1-Inch (100-by-25-mm) Box Ribs, **as directed**: 0.032 inch (0.81 mm) **OR** 0.040 inch (1.0 mm), **as directed**, thick.
 - c. Stainless Steel, Type 304 **OR** Type 316, **as directed**, Smooth **OR** Stucco Embossed, **as directed**, with 1-1/4-Inch- (32-mm-) Deep Corrugations **OR** 2-1/2-Inch- (65-mm-) Deep Corrugations **OR** 4-by-1-Inch (100-by-25-mm) Box Ribs, **as directed**: 0.020 inch (0.51 mm) **OR** 0.024 inch (0.61 mm), **as directed**, thick.
6. Piping, Concealed:
 - a. None.
 - b. PVC **OR** PVC, Color-Coded by System, **as directed**: 20 mils (0.5 mm) **OR** 30 mils (0.8 mm), **as directed**, thick.
 - c. Aluminum, Smooth **OR** Corrugated **OR** Stucco Embossed, **as directed**: 0.016 inch (0.41 mm) **OR** 0.020 inch (0.51 mm) **OR** 0.024 inch (0.61 mm) **OR** 0.032 inch (0.81 mm) **OR** 0.040 inch (1.0 mm), **as directed**, thick.
 - d. Painted Aluminum, Smooth **OR** Corrugated **OR** Stucco Embossed, **as directed**: 0.016 inch (0.41 mm) **OR** 0.020 inch (0.51 mm) **OR** 0.024 inch (0.61 mm) **OR** 0.032 inch (0.81 mm), **as directed**, thick.
 - e. Stainless Steel, Type 304 **OR** Type 316, **as directed**, Smooth 2B Finish **OR** Corrugated **OR** Stucco Embossed, **as directed**: 0.010 inch (0.25 mm) **OR** 0.016 inch (0.41 mm) **OR** 0.020 inch (0.51 mm) **OR** 0.024 inch (0.61 mm), **as directed**, thick.
7. Piping, Exposed:
 - a. None.
 - b. PVC **OR** PVC, Color-Coded by System, **as directed**: 20 mils (0.5 mm) **OR** 30 mils (0.8 mm), **as directed**, thick.

- c. Aluminum, Smooth **OR** Corrugated **OR** Stucco Embossed, **as directed**: 0.016 inch (0.41 mm) **OR** 0.020 inch (0.51 mm) **OR** 0.024 inch (0.61 mm) **OR** 0.032 inch (0.81 mm) **OR** 0.040 inch (1.0 mm), **as directed**, thick.
 - d. Aluminum **OR** Painted Aluminum, **as directed**, Smooth **OR** Corrugated **OR** Stucco Embossed, **as directed**: 0.016 inch (0.41 mm) **OR** 0.020 inch (0.51 mm) **OR** 0.024 inch (0.61 mm) **OR** 0.032 inch (0.81 mm), **as directed**, thick.
 - e. Stainless Steel, Type 304 **OR** Type 316, **as directed**, Smooth 2B Finish **OR** Corrugated **OR** Stucco Embossed, **as directed**: 0.010 inch (0.25 mm) **OR** 0.016 inch (0.41 mm) **OR** 0.020 inch (0.51 mm) **OR** 0.024 inch (0.61 mm), **as directed**, thick.
- X. Outdoor, Field-Applied Jacket Schedule
- 1. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.
 - 2. If more than one material is listed, selection from materials listed is Contractor's option.
 - 3. Equipment, Concealed:
 - a. None.
 - b. PVC **OR** PVC, Color-Coded by System, **as directed**: 20 mils (0.5 mm) **OR** 30 mils (0.8 mm), **as directed**, thick.
 - c. Aluminum, Smooth **OR** Corrugated **OR** Stucco Embossed, **as directed**: 0.016 inch (0.41 mm) **OR** 0.020 inch (0.51 mm) **OR** 0.024 inch (0.61 mm) **OR** 0.032 inch (0.81 mm) **OR** 0.040 inch (1.0 mm), **as directed**, thick.
 - d. Aluminum **OR** Painted Aluminum, **as directed**, Smooth **OR** Corrugated **OR** Stucco Embossed, **as directed**: 0.016 inch (0.41 mm) **OR** 0.020 inch (0.51 mm) **OR** 0.024 inch (0.61 mm) **OR** 0.032 inch (0.81 mm), **as directed**, thick.
 - e. Stainless Steel, Type 304 **OR** Type 316, **as directed**, Smooth 2B Finish **OR** Corrugated **OR** Stucco Embossed, **as directed**: 0.010 inch (0.25 mm) **OR** 0.016 inch (0.41 mm) **OR** 0.020 inch (0.51 mm) **OR** 0.024 inch (0.61 mm), **as directed**, thick.
 - 4. Equipment, Exposed, up to 48 Inches (1200 mm) in Diameter or with Flat Surfaces up to 72 Inches (1800 mm):
 - a. Aluminum **OR** Painted Aluminum, **as directed**, Smooth **OR** Corrugated **OR** Stucco Embossed, **as directed**, with Z-Shaped Locking Seam, **as directed**: 0.016 inch (0.41 mm) **OR** 0.020 inch (0.51 mm) **OR** 0.024 inch (0.61 mm) **OR** 0.032 inch (0.81 mm) **OR** 0.040 inch (1.0 mm), **as directed**, thick.
 - b. Stainless Steel, Type 304 **OR** Type 316, **as directed**, Smooth 2B Finish **OR** Corrugated **OR** Stucco Embossed, **as directed**, with Z-Shaped Locking Seam, **as directed**: 0.010 inch (0.25 mm) **OR** 0.016 inch (0.41 mm) **OR** 0.020 inch (0.51 mm) **OR** 0.024 inch (0.61 mm), **as directed**, thick.
 - 5. Equipment, Exposed, Larger Than 48 Inches (1200 mm) in Diameter or with Flat Surfaces Larger Than 72 Inches (1800 mm):
 - a. Aluminum **OR** Painted Aluminum, **as directed**, Smooth **OR** Stucco Embossed, **as directed** with 1-1/4-Inch- (32-mm-) Deep Corrugations **OR** 2-1/2-Inch- (65-mm-) Deep Corrugations **OR** 4-by-1-Inch (100-by-25-mm) Box Ribs, **as directed**: 0.032 inch (0.81 mm) **OR** 0.040 inch (1.0 mm), **as directed**, thick.
 - b. Stainless Steel, Type 304 **OR** Type 316, **as directed**, Smooth **OR** Stucco Embossed, **as directed**, with 1-1/4-Inch- (32-mm-) Deep Corrugations **OR** 2-1/2-Inch- (65-mm-) Deep Corrugations **OR** 4-by-1-Inch (100-by-25-mm) Box Ribs, **as directed**: 0.020 inch (0.51 mm) **OR** 0.024 inch (0.61 mm), **as directed**, thick.
 - 6. Piping, Concealed:
 - a. None.
 - b. PVC **OR** PVC, Color-Coded by System, **as directed**: 20 mils (0.5 mm) **OR** 30 mils (0.8 mm), **as directed**, thick.
 - c. Aluminum, Smooth **OR** Corrugated **OR** Stucco Embossed, **as directed**: 0.016 inch (0.41 mm) **OR** 0.020 inch (0.51 mm) **OR** 0.024 inch (0.61 mm) **OR** 0.032 inch (0.81 mm) **OR** 0.040 inch (1.0 mm), **as directed**, thick.

- d. Aluminum **OR** Painted Aluminum, **as directed**, Smooth **OR** Corrugated **OR** Stucco Embossed, **as directed**: 0.016 inch (0.41 mm) **OR** 0.020 inch (0.51 mm) **OR** 0.024 inch (0.61 mm) **OR** 0.032 inch (0.81 mm), **as directed**, thick.
 - e. Stainless Steel, Type 304 **OR** Type 316, **as directed**, Smooth 2B Finish **OR** Corrugated **OR** Stucco Embossed, **as directed**: 0.010 inch (0.25 mm) **OR** 0.016 inch (0.41 mm) **OR** 0.020 inch (0.51 mm) **OR** 0.024 inch (0.61 mm), **as directed**, thick.
7. Piping, Exposed:
- a. PVC: 20 mils (0.5 mm) **OR** 30 mils (0.8 mm) **OR** 40 mils (1.0 mm), **as directed**, thick.
 - b. Aluminum **OR** Painted Aluminum, **as directed**, Smooth **OR** Corrugated **OR** Stucco Embossed, **as directed**, with Z-Shaped Locking Seam, **as directed**: 0.016 inch (0.41 mm) **OR** 0.020 inch (0.51 mm) **OR** 0.024 inch (0.61 mm) **OR** 0.032 inch (0.81 mm) **OR** 0.040 inch (1.0 mm), **as directed**, thick.
 - c. Stainless Steel, Type 304 **OR** Type 316, **as directed**, Smooth 2B Finish **OR** Corrugated **OR** Stucco Embossed, **as directed**, with Z-Shaped Locking Seam, **as directed**: 0.010 inch (0.25 mm) **OR** 0.016 inch (0.41 mm) **OR** 0.020 inch (0.51 mm) **OR** 0.024 inch (0.61 mm), **as directed**, thick.
- Y. Underground, Field-Installed Insulation Jacket
- 1. For underground direct-buried piping applications, install underground direct-buried jacket over insulation material.

END OF SECTION 22 07 19 00



Task	Specification	Specification Description
22 07 19 00	21 07 00 00	Fire-Suppression Systems Insulation

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SECTION 22 11 16 00 - DOMESTIC WATER PIPING

1.1 GENERAL

A. Description Of Work

1. This specification covers the furnishing and installation of materials for domestic water piping. Products shall be as follows or as directed by the Owner. Installation procedures shall be in accordance with the products manufacturer's recommendations. Demolition and removal of materials shall be as required to support the work.

B. Summary

1. Section Includes:
 - a. Under-building slab and aboveground domestic water pipes, tubes, fittings, and specialties inside the building.
 - b. Encasement for piping.
 - c. Specialty valves.
 - d. Flexible connectors.
 - e. Water meters furnished by utility company for installation by Contractor.
OR
Water meters.
 - f. Escutcheons.
 - g. Sleeves and sleeve seals.
 - h. Wall penetration systems.

C. Performance Requirements

1. Seismic Performance: Domestic water piping and support and installation shall withstand effects of earthquake motions determined according to ASCE/SEI 7.

D. Submittals

1. Product Data: For each type of product indicated.
2. LEED Submittal:
 - a. Product Data for Credit EQ 4.1: For solvent cements and adhesive primers, including printed statement of VOC content.
3. Field quality-control reports.

E. Quality Assurance

1. Piping materials shall bear label, stamp, or other markings of specified testing agency.
2. Comply with NSF 14 for plastic, potable domestic water piping and components. Include marking "NSF-pw" on piping, **as directed**.
3. Comply with NSF 61 for potable domestic water piping and components.

F. Project Conditions

1. Interruption of Existing Water Service: Do not interrupt water service to facilities occupied by the Owner or others unless permitted under the following conditions and then only after arranging to provide temporary water service according to requirements indicated:
 - a. Notify the Owner no fewer than two days in advance of proposed interruption of water service.
 - b. Do not proceed with interruption of water service without the Owner's written permission.

1.2 PRODUCTS

A. Piping Materials

1. Comply with requirements in "Piping Schedule" Article for applications of pipe, tube, fitting materials, and joining methods for specific services, service locations, and pipe sizes.

B. Copper Tube And Fittings

1. Hard Copper Tube: **ASTM B 88, Type L (ASTM B 88M, Type B)** water tube, drawn temper.
 - a. Cast-Copper Solder-Joint Fittings: ASME B16.18, pressure fittings.
 - b. Wrought-Copper Solder-Joint Fittings: ASME B16.22, wrought-copper pressure fittings.
 - c. Bronze Flanges: ASME B16.24, Class 150, with solder-joint ends.
 - d. Copper Unions: MSS SP-123, cast-copper-alloy, hexagonal-stock body, with ball-and-socket, metal-to-metal seating surfaces, and solder-joint or threaded ends.
 - e. Copper Pressure-Seal-Joint Fittings:
 - 1) **NPS 2 (DN 50)** and Smaller: Wrought-copper fitting with EPDM-rubber O-ring seal in each end.
 - 2) **NPS 2-1/2 to NPS 4 (DN 65 to DN 100)**: Cast-bronze or wrought-copper fitting with EPDM-rubber O-ring seal in each end.
 - f. Copper Push-on-Joint Fittings:
 - 1) Description: Cast-copper fitting complying with ASME B16.18 or wrought-copper fitting complying with ASME B 16.22; with stainless-steel teeth and EPDM-rubber O-ring seal in each end instead of solder-joint ends.
 - g. Copper-Tube Extruded-Tee Connections:
 - 1) Description: Tee formed in copper tube according to ASTM F 2014.
 - h. Grooved-Joint Copper-Tube Appurtenances:
 - 1) Copper Grooved-End Fittings: **ASTM B 75 (ASTM B 75M)** copper tube or ASTM B 584 bronze castings.
 - 2) Grooved-End-Tube Couplings: Copper-tube dimensions and design similar to AWWA C606. Include ferrous housing sections, EPDM-rubber gaskets suitable for hot and cold water, and bolts and nuts.
2. Soft Copper Tube: **ASTM B 88, Type K (ASTM B 88M, Type A)** and **ASTM B 88, Type L (ASTM B 88M, Type B)** water tube, annealed temper.
 - a. Copper Solder-Joint Fittings: ASME B16.22, wrought-copper pressure fittings.
 - b. Copper Pressure-Seal-Joint Fittings:
 - 1) **NPS 2 (DN 50)** and Smaller: Wrought-copper fitting with EPDM-rubber O-ring seal in each end.
 - 2) **NPS 3 and NPS 4 (DN 80 and DN 100)**: Cast-bronze or wrought-copper fitting with EPDM-rubber O-ring seal in each end.

C. Ductile-Iron Pipe And Fittings

1. Mechanical-Joint, Ductile-Iron Pipe: AWWA C151, with mechanical-joint bell and plain spigot end unless grooved or flanged ends are indicated.
 - a. Standard-Pattern, Mechanical-Joint Fittings: AWWA C110, ductile or gray iron.
 - b. Compact-Pattern, Mechanical-Joint Fittings: AWWA C153, ductile iron.
 - 1) Glands, Gaskets, and Bolts: AWWA C111, ductile- or gray-iron glands, rubber gaskets, and steel bolts.
2. Push-on-Joint, Ductile-Iron Pipe: AWWA C151, with push-on-joint bell and plain spigot end unless grooved or flanged ends are indicated.
 - a. Standard-Pattern, Push-on-Joint Fittings: AWWA C110, ductile or gray iron.
 - 1) Gaskets: AWWA C111, rubber.
 - b. Compact-Pattern, Push-on-Joint Fittings: AWWA C153, ductile iron.
 - 1) Gaskets: AWWA C111, rubber.
3. Plain-End, Ductile-Iron Pipe: AWWA C151.
 - a. Grooved-Joint, Ductile-Iron-Pipe Appurtenances:
 - 1) Grooved-End, Ductile-Iron Fittings: ASTM A 47/A 47M, malleable-iron castings or ASTM A 536, ductile-iron castings with dimensions matching pipe.

- 2) Grooved-End, Ductile-Iron-Pipe Couplings: AWWA C606 for ductile-iron-pipe dimensions. Include ferrous housing sections, EPDM-rubber gaskets suitable for hot and cold water, and bolts and nuts.
- D. Galvanized-Steel Pipe And Fittings
1. Galvanized-Steel Pipe: ASTM A 53/A 53M, Type E, Grade B, Standard Weight. Include ends matching joining method.
 - a. Galvanized-Steel Pipe Nipples: ASTM A 733, made of ASTM A 53/A 53M or ASTM A 106/A 106M, Standard Weight, seamless steel pipe with threaded ends.
 - b. Galvanized, Gray-Iron Threaded Fittings: ASME B16.4, Class 125, standard pattern.
 - c. Malleable-Iron Unions: ASME B16.39, Class 150, hexagonal-stock body with ball-and-socket, metal-to-metal, bronze seating surface, and female threaded ends.
 - d. Flanges: ASME B16.1, Class 125, cast iron.
 - e. Grooved-Joint, Galvanized-Steel-Pipe Appurtenances:
 - 1) Galvanized, Grooved-End Fittings for Galvanized-Steel Piping: ASTM A 47/A 47M, malleable-iron casting; ASTM A 106/A 106M, steel pipe; or ASTM A 536, ductile-iron casting; with dimensions matching steel pipe.
 - 2) Grooved-End-Pipe Couplings for Galvanized-Steel Piping: AWWA C606 for steel-pipe dimensions. Include ferrous housing sections, EPDM-rubber gaskets suitable for hot and cold water, and bolts and nuts.
- E. CPVC Piping
1. CPVC Pipe: ASTM F 441/F 441M, Schedule 40 and Schedule 80.
 - a. CPVC Socket Fittings: ASTM F 438 for Schedule 40 and ASTM F 439 for Schedule 80.
 - b. CPVC Threaded Fittings: ASTM F 437, Schedule 80.
 2. CPVC Piping System: ASTM D 2846/D 2846M, SDR 11, pipe and socket fittings.
 3. CPVC Tubing System: ASTM D 2846/D 2846M, SDR 11, tube and socket fittings.
- F. PEX Tube And Fittings
1. PEX Distribution System: ASTM F 877, SDR 9 tubing.
 - a. Fittings for PEX Tube: ASTM F 1807, metal-insert type with copper or stainless-steel crimp rings and matching PEX tube dimensions.
 - b. Manifold: Multiple-outlet, plastic or corrosion-resistant-metal assembly complying with ASTM F 877; with plastic or corrosion-resistant-metal valve for each outlet.
- G. PVC Pipe And Fittings
1. PVC Pipe: ASTM D 1785, Schedule 40 and Schedule 80.
 - a. PVC Socket Fittings: ASTM D 2466 for Schedule 40 and ASTM D 2467 for Schedule 80.
 - b. PVC Schedule 80 Threaded Fittings: ASTM D 2464.
- H. Piping Joining Materials
1. Pipe-Flange Gasket Materials: AWWA C110, rubber, flat face, **1/8 inch (3.2 mm)** thick or ASME B16.21, nonmetallic and asbestos free, unless otherwise indicated; full-face or ring type unless otherwise indicated.
 2. Metal, Pipe-Flange Bolts and Nuts: ASME B18.2.1, carbon steel unless otherwise indicated.
 3. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.
 4. Brazing Filler Metals: AWS A5.8/A5.8M, BCuP Series, copper-phosphorus alloys for general-duty brazing unless otherwise indicated.
 5. Solvent Cements for Joining CPVC Piping and Tubing: ASTM F 493.
 - a. Use CPVC solvent cement that has a VOC content of 490 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 - b. Use adhesive primer that has a VOC content of 550 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 6. Solvent Cements for Joining PVC Piping: ASTM D 2564. Include primer according to ASTM F 656.

- a. Use PVC solvent cement that has a VOC content of 510 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- b. Use adhesive primer that has a VOC content of 550 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
7. Plastic, Pipe-Flange Gaskets, Bolts, and Nuts: Type and material recommended by piping system manufacturer unless otherwise indicated.

I. Encasement For Piping

1. Standard: ASTM A 674 or AWWA C105.
2. Form: Sheet **OR** Tube, **as directed**.
3. Material: LLDPE film of **0.008-inch (0.20-mm)** **OR** LLDPE film of **0.008-inch (0.20-mm)** minimum thickness or high-density, cross-laminated PE film of **0.004-inch (0.10-mm)** **OR** High-density, cross-laminated PE film of **0.004-inch (0.10-mm)**, **as directed**, minimum thickness.
4. Color: Black **OR** Natural, **as directed**.

J. Specialty Valves

1. Comply with requirements in Division 22 Section "General-duty Valves For Plumbing Piping" for general-duty metal valves.
2. Comply with requirements in Division 22 Section "Domestic Water Piping Specialties" for balancing valves, drain valves, backflow preventers, and vacuum breakers.
3. CPVC Union Ball Valves:
 - a. Description:
 - 1) Standard: MSS SP-122.
 - 2) Pressure Rating: **125 psig (860 kPa)** **OR** **150 psig (1035 kPa)**, **as directed**, at **73 deg F (23 deg C)**.
 - 3) Body Material: CPVC.
 - 4) Body Design: Union type.
 - 5) End Connections for Valves **NPS 2 (DN 50)** and Smaller: Detachable, socket **OR** threaded, **as directed**.
 - 6) End Connections for Valves **NPS 2-1/2 to NPS 4 (DN 65 to DN 100)**: Detachable, socket **OR** threaded **OR** flanged, **as directed**.
 - 7) Ball: CPVC; full port.
 - 8) Seals: PTFE or EPDM-rubber O-rings.
 - 9) Handle: Tee shaped.
4. PVC Union Ball Valves:
 - a. Description:
 - 1) Standard: MSS SP-122.
 - 2) Pressure Rating: **125 psig (860 kPa)** **OR** **150 psig (1035 kPa)**, **as directed**, at **73 deg F (23 deg C)**.
 - 3) Body Material: PVC.
 - 4) Body Design: Union type.
 - 5) End Connections for Valves **NPS 2 (DN 50)** and Smaller: Detachable, socket **OR** threaded, **as directed**.
 - 6) End Connections for Valves **NPS 2-1/2 to NPS 4 (DN 65 to DN 100)**: Detachable, socket **OR** threaded **OR** flanged, **as directed**.
 - 7) Ball: PVC; full port.
 - 8) Seals: PTFE or EPDM-rubber O-rings.
 - 9) Handle: Tee shaped.
5. CPVC Non-Union Ball Valves:
 - a. Description:
 - 1) Standard: MSS SP-122.
 - 2) Pressure Rating: **125 psig (860 kPa)** **OR** **150 psig (1035 kPa)**, **as directed**, at **73 deg F (23 deg C)**.
 - 3) Body Material: CPVC.
 - 4) Body Design: Non-union type.

- 5) End Connections: Socket or threaded.
- 6) Ball: CPVC; full or reduced port.
- 7) Seals: PTFE or EPDM-rubber O-rings.
- 8) Handle: Tee shaped.
6. PVC Non-Union Ball Valves:
 - a. Description:
 - 1) Standard: MSS SP-122.
 - 2) Pressure Rating: 125 psig (860 kPa) OR 150 psig (1035 kPa), as directed, at 73 deg F (23 deg C).
 - 3) Body Material: PVC.
 - 4) Body Design: Non-union type.
 - 5) End Connections: Socket or threaded.
 - 6) Ball: PVC; full or reduced port.
 - 7) Seals: PTFE or EPDM-rubber O-rings.
 - 8) Handle: Tee shaped.
7. CPVC Butterfly Valves:
 - a. Description:
 - 1) Pressure Rating: 125 psig (860 kPa) OR 150 psig (1035 kPa), as directed, at 73 deg F (23 deg C).
 - 2) Body Material: CPVC.
 - 3) Body Design: Lug or wafer type.
 - 4) Seat: EPDM rubber.
 - 5) Seals: PTFE or EPDM-rubber O-rings.
 - 6) Disc: CPVC.
 - 7) Stem: Stainless steel.
 - 8) Handle: Lever.
8. PVC Butterfly Valves:
 - a. Description:
 - 1) Pressure Rating: 125 psig (860 kPa) OR 150 psig (1035 kPa), as directed, at 73 deg F (23 deg C).
 - 2) Body Material: PVC.
 - 3) Body Design: Lug or wafer type.
 - 4) Seat: EPDM rubber.
 - 5) Seals: PTFE or EPDM-rubber O-rings.
 - 6) Disc: PVC.
 - 7) Stem: Stainless steel.
 - 8) Handle: Lever.
9. CPVC Ball Check Valves:
 - a. Description:
 - 1) Pressure Rating: 125 psig (860 kPa) OR 150 psig (1035 kPa), as directed, at 73 deg F (23 deg C).
 - 2) Body Material: CPVC.
 - 3) Body Design: Union-type ball check.
 - 4) End Connections for Valves NPS 2 (DN 50) and Smaller: Detachable, socket OR threaded, as directed.
 - 5) End Connections for Valves NPS 2-1/2 to NPS 4 (DN 65 to DN 100): Detachable, socket OR threaded OR flanged, as directed.
 - 6) Ball: CPVC.
 - 7) Seals: EPDM- or FKM-rubber O-rings.
10. PVC Ball Check Valves:
 - a. Description:
 - 1) Pressure Rating: 125 psig (860 kPa) OR 150 psig (1035 kPa), as directed, at 73 deg F (23 deg C).
 - 2) Body Material: PVC.
 - 3) Body Design: Union-type ball check.

- 4) End Connections for Valves **NPS 2 (DN 50)** and Smaller: Detachable, socket **OR** threaded, **as directed**.
 - 5) End Connections for Valves **NPS 2-1/2 to NPS 4 (DN 65 to DN 100)**: Detachable, socket **OR** threaded **OR** flanged, **as directed**.
 - 6) Ball: PVC.
 - 7) Seals: EPDM- or FKM-rubber O-rings.
11. CPVC Gate Valves:
- a. Description:
 - 1) Pressure Rating: **125 psig (860 kPa) OR 150 psig (1035 kPa), as directed**, at **73 deg F (23 deg C)**.
 - 2) Body Material: CPVC.
 - 3) Body Design: Nonrising stem.
 - 4) End Connections for Valves **NPS 2 (DN 50)** and Smaller: Socket **OR** Threaded, **as directed**.
 - 5) End Connections for Valves **NPS 2-1/2 to NPS 4 (DN 65 to DN 100)**: Socket **OR** Threaded **OR** Flanged, **as directed**.
 - 6) Gate and Stem: Plastic.
 - 7) Seals: EPDM rubber.
 - 8) Handle: Wheel.
12. PVC Gate Valves:
- a. Description:
 - 1) Pressure Rating: **125 psig (860 kPa) OR 150 psig (1035 kPa), as directed**, at **73 deg F (23 deg C)**.
 - 2) Body Material: PVC.
 - 3) Body Design: Nonrising stem.
 - 4) End Connections for Valves **NPS 2 (DN 50)** and Smaller: Socket **OR** Threaded, **as directed**.
 - 5) End Connections for Valves **NPS 2-1/2 to NPS 4 (DN 65 to DN 100)**: Socket **OR** Threaded **OR** Flanged, **as directed**.
 - 6) Gate and Stem: Plastic.
 - 7) Seals: EPDM rubber.
 - 8) Handle: Wheel.
- K. Transition Fittings
1. General Requirements:
 - a. Same size as pipes to be joined.
 - b. Pressure rating at least equal to pipes to be joined.
 - c. End connections compatible with pipes to be joined.
 2. Fitting-Type Transition Couplings: Manufactured piping coupling or specified piping system fitting.
 3. Sleeve-Type Transition Coupling: AWWA C219.
 4. Plastic-to-Metal Transition Fittings:
 - a. Description: CPVC **OR** PVC, **as directed**, one-piece fitting with manufacturer's Schedule 80 equivalent dimensions; one end with threaded brass insert and one solvent-cement-socket threaded, **as directed**, end.
 5. Plastic-to-Metal Transition Unions:
 - a. Description: CPVC **OR** PVC, **as directed**, four-part union. Include brass or stainless-steel, **as directed**, threaded end, solvent-cement-joint or threaded, **as directed**, plastic end, rubber O-ring, and union nut.
- L. Dielectric Fittings
1. General Requirements: Assembly of copper alloy and ferrous materials or ferrous material body with separating nonconductive insulating material suitable for system fluid, pressure, and temperature.
 2. Dielectric Unions:

- a. Description:
 - 1) Pressure Rating: **150 psig (1035 kPa) OR 250 psig (1725 kPa), as directed**, at **180 deg F (82 deg C)**.
 - 2) End Connections: Solder-joint copper alloy and threaded ferrous.
3. Dielectric Flanges:
 - a. Description:
 - 1) Factory-fabricated, bolted, companion-flange assembly.
 - 2) Pressure Rating: **150 psig (1035 kPa) OR 175 psig (1200 kPa) minimum OR 300 psig (2070 kPa), as directed**.
 - 3) End Connections: Solder-joint copper alloy and threaded ferrous; threaded solder-joint copper alloy and threaded ferrous.
4. Dielectric-Flange Kits:
 - a. Description:
 - 1) Nonconducting materials for field assembly of companion flanges.
 - 2) Pressure Rating: **150 psig (1035 kPa)**.
 - 3) Gasket: Neoprene or phenolic.
 - 4) Bolt Sleeves: Phenolic or polyethylene.
 - 5) Washers: Phenolic with steel backing washers.
5. Dielectric Couplings:
 - a. Description:
 - 1) Galvanized-steel coupling.
 - 2) Pressure Rating: **300 psig (2070 kPa) at 225 deg F (107 deg C)**.
 - 3) End Connections: Female threaded.
 - 4) Lining: Inert and noncorrosive, thermoplastic.
6. Dielectric Nipples:
 - a. Description:
 - 1) Electroplated steel nipple complying with ASTM F 1545.
 - 2) Pressure Rating: **300 psig (2070 kPa) at 225 deg F (107 deg C)**.
 - 3) End Connections: Male threaded or grooved.
 - 4) Lining: Inert and noncorrosive, propylene.
- M. Flexible Connectors
 1. Bronze-Hose Flexible Connectors: Corrugated-bronze tubing with bronze wire-braid covering and ends brazed to inner tubing.
 - a. Working-Pressure Rating: Minimum **200 psig (1380 kPa) OR 250 psig (1725 kPa), as directed**.
 - b. End Connections **NPS 2 (DN 50)** and Smaller: Threaded copper pipe or plain-end copper tube.
 - c. End Connections **NPS 2-1/2 (DN 65)** and Larger: Flanged copper alloy.
 2. Stainless-Steel-Hose Flexible Connectors: Corrugated-stainless-steel tubing with stainless-steel wire-braid covering and ends welded to inner tubing.
 - a. Working-Pressure Rating: Minimum **200 psig (1380 kPa) OR 250 psig (1725 kPa), as directed**.
 - b. End Connections **NPS 2 (DN 50)** and Smaller: Threaded steel-pipe nipple.
 - c. End Connections **NPS 2-1/2 (DN 65)** and Larger: Flanged steel nipple.
- N. Water Meters
 1. Displacement-Type Water Meters:
 - a. Description:
 - 1) Standard: AWWA C700.
 - 2) Pressure Rating: **150-psig (1035-kPa)** working pressure.
 - 3) Body Design: Nutating disc; totalization meter.
 - 4) Registration: In **gallons (liters)** or **cubic feet (cubic meters)** as required by utility.
 - 5) Case: Bronze.
 - 6) End Connections: Threaded.
 2. Turbine-Type Water Meters:

- a. Description:
 - 1) Standard: AWWA C701.
 - 2) Pressure Rating: 150-psig (1035-kPa) working pressure.
 - 3) Body Design: Turbine; totalization meter.
 - 4) Registration: In gallons (liters) or cubic feet (cubic meters) as required by utility company.
 - 5) Case: Bronze.
 - 6) End Connections for Meters NPS 2 (DN 50) and Smaller: Threaded.
 - 7) End Connections for Meters NPS 2-1/2 (DN 65) and Larger: Flanged.
3. Compound-Type Water Meters:
 - a. Description:
 - 1) Standard: AWWA C702.
 - 2) Pressure Rating: 150-psig (1035-kPa) working pressure.
 - 3) Body Design: With integral mainline and bypass meters; totalization meter.
 - 4) Registration: In gallons (liters) or cubic feet (cubic meters) as required by utility company.
 - 5) Case: Bronze.
 - 6) Pipe Connections: Flanged.
4. Fire-Service-Type Water Meters:
 - a. Description:
 - 1) Standard: AWWA C703 and UL listing.
 - 2) Pressure Rating: 175-psig (1200-kPa) working pressure.
 - 3) Body Design:
 - a) Proportional, Detector-Type Water Meters: With meter on bypass.
 - i. Bypass Meter: AWWA C701, turbine **OR** AWWA C702, compound, **as directed**, type with bronze case; size not less than one-half nominal size of main-line meter.
 - b) Turbine-Type Water Meters: With strainer, and with meter on bypass.
 - i. Strainer: Full size, matching water meter.
 - ii. Bypass Meter: AWWA C701, turbine type with bronze case; not less than NPS 2 (DN 50).
 - 4) Registration: In gallons (liters) or cubic feet (cubic meters) as required by utility company.
 - 5) Case: Bronze.
 - 6) Pipe Connections for Meters NPS 2 (DN 50) and Smaller: Threaded.
 - 7) Pipe Connections for Meters NPS 2-1/2 (DN 65) and Larger: Flanged.
 5. Remote Registration System: Direct-reading type complying with AWWA C706; modified with signal transmitting assembly, low-voltage connecting wiring, and remote register assembly as required by utility company.
OR
Remote Registration System: Encoder type complying with AWWA C707; modified with signal transmitting assembly, low-voltage connecting wiring, and remote register assembly as required by utility company.
 - O. Escutcheons
 1. General: Manufactured ceiling, floor, and wall escutcheons and floor plates.
 2. One Piece, Cast Brass: Polished, chrome-plated **OR** rough-brass, **as directed**, finish with setscrews.
 3. One Piece, Deep Pattern: Deep-drawn, box-shaped brass with chrome-plated finish.
 4. One Piece, Stamped Steel: Chrome-plated finish with setscrew **OR** spring clips, **as directed**.
 5. Split Casting, Cast Brass: Polished, chrome-plated **OR** rough-brass, **as directed**, finish with concealed hinge and setscrew.
 6. Split Plate, Stamped Steel: Chrome-plated finish with concealed **OR** exposed-rivet, **as directed**, hinge, setscrew **OR** spring clips, **as directed**.
 7. One-Piece Floor Plates: Cast-iron flange with holes for fasteners, **as directed**.

8. Split-Casting Floor Plates: Cast brass with concealed hinge.

P. Sleeves

1. Cast-Iron Wall Pipes: Fabricated of cast iron, and equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop unless otherwise indicated.
2. Galvanized-Steel-Sheet Sleeves: 0.0239-inch (0.6-mm) minimum thickness; round tube closed with welded longitudinal joint.
3. Molded-PE Sleeves: Reusable, PE, tapered-cup shaped, and smooth outer surface with nailing flange for attaching to wooden forms.
4. Molded-PVC Sleeves: Permanent, with nailing flange for attaching to wooden forms.
5. PVC-Pipe Sleeves: ASTM D 1785, Schedule 40.
6. Galvanized-Steel-Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, zinc-coated, with plain ends.
7. Stack Sleeve Fittings: Manufactured, cast-iron sleeve with integral clamping flange. Include clamping ring and bolts and nuts for membrane flashing.
 - a. Underdeck Clamp: Clamping ring with setscrews.

Q. Sleeve Seals

1. Description: Modular sealing element unit, designed for field assembly, used to fill annular space between pipe and sleeve.
 - a. Sealing Elements: EPDM-rubber **OR** NBR, **as directed**, interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
 - b. Pressure Plates: Carbon steel **OR** Plastic **OR** Stainless steel, **as directed**.
 - c. Connecting Bolts and Nuts: Carbon steel, with corrosion-resistant coating, **OR** Stainless steel, **as directed**, of length required to secure pressure plates to sealing elements.

R. Wall Penetration Systems

1. Description: Wall-sleeve assembly, consisting of housing and gland, gaskets, and pipe sleeve.
 - a. Carrier-Pipe Deflection: Up to 5 percent without leakage.
 - b. Housing: Ductile-iron casting with hub, waterstop, anchor ring, and locking devices. Include gland, bolts, and nuts.
 - c. Housing-to-Sleeve Gasket: EPDM rubber **OR** NBR, **as directed**.
 - d. Housing-to-Carrier-Pipe Gasket: AWWA C111, EPDM rubber **OR** NBR, **as directed**.
 - e. Pipe Sleeve: AWWA C151, ductile-iron pipe **OR** ASTM A 53/A 53M, Schedule 40, zinc-coated steel pipe, **as directed**.

S. Grout

1. Standard: ASTM C 1107, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.
2. Characteristics: Nonshrink; recommended for interior and exterior applications.
3. Design Mix: 5000-psi (34.5-MPa), 28-day compressive strength.
4. Packaging: Premixed and factory packaged.

1.3 EXECUTION

A. Earthwork

1. Comply with requirements in Division 31 Section "Earth Moving" for excavating, trenching, and backfilling.

B. Piping Installation

1. Drawing plans, schematics, and diagrams indicate general location and arrangement of domestic water piping. Indicated locations and arrangements are used to size pipe and calculate friction loss, expansion, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.
2. Install copper tubing under building slab according to CDA's "Copper Tube Handbook."

3. Install ductile-iron piping under building slab with restrained joints according to AWWA C600 and AWWA M41.
4. Install underground copper tube and ductile-iron pipe in PE encasement according to ASTM A 674 or AWWA C105.
5. Install shutoff valve, hose-end drain valve, strainer, pressure gage, and test tee with valve, inside the building at each domestic water service entrance. Comply with requirements in Division 22 Section "Meters And Gages For Plumbing Piping" for pressure gages and Division 22 Section "Domestic Water Piping Specialties" for drain valves and strainers.
6. Install shutoff valve immediately upstream of each dielectric fitting.
7. Install water-pressure-reducing valves downstream from shutoff valves. Comply with requirements in Division 22 Section "Domestic Water Piping Specialties" for pressure-reducing valves.
8. Install domestic water piping level with 0.25 percent slope downward toward drain **OR** without pitch, **as directed**, and plumb.
9. Rough-in domestic water piping for water-meter installation according to utility company's requirements.
10. Install seismic restraints on piping. Comply with requirements in Division 22 Section "Vibration And Seismic Controls For Plumbing Piping And Equipment" for seismic-restraint devices.
11. Install piping concealed from view and protected from physical contact by building occupants unless otherwise indicated and except in equipment rooms and service areas.
12. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
13. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal, and coordinate with other services occupying that space.
14. Install piping adjacent to equipment and specialties to allow service and maintenance.
15. Install piping to permit valve servicing.
16. Install nipples, unions, special fittings, and valves with pressure ratings the same as or higher than system pressure rating used in applications below unless otherwise indicated.
17. Install piping free of sags and bends.
18. Install fittings for changes in direction and branch connections.
19. Install PEX piping with loop at each change of direction of more than 90 degrees.
20. Install unions in copper tubing at final connection to each piece of equipment, machine, and specialty.
21. Install pressure gages on suction and discharge piping from each plumbing pump and packaged booster pump. Comply with requirements in Division 22 Section "Meters And Gages For Plumbing Piping" for pressure gages.
22. Install thermostats in hot-water circulation piping. Comply with requirements in Division 22 Section "Domestic Water Pumps" for thermostats.
23. Install thermometers on inlet **OR** inlet and outlet, **as directed**, piping from each water heater. Comply with requirements in Division 22 Section "Meters And Gages For Plumbing Piping" for thermometers.

C. Joint Construction

1. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
2. Remove scale, slag, dirt, and debris from inside and outside of pipes, tubes, and fittings before assembly.
3. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
 - a. Apply appropriate tape or thread compound to external pipe threads.
 - b. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged.
4. Brazed Joints: Join copper tube and fittings according to CDA's "Copper Tube Handbook," "Brazed Joints" Chapter.

5. Soldered Joints: Apply ASTM B 813, water-flushable flux to end of tube. Join copper tube and fittings according to ASTM B 828 or CDA's "Copper Tube Handbook."
 6. Pressure-Sealed Joints: Join copper tube and pressure-seal fittings with tools recommended by fitting manufacturer.
 7. Copper-Tubing, Push-on Joints: Clean end of tube. Measure insertion depth with manufacturer's depth gage. Join copper tube and push-on-joint fittings by inserting tube to measured depth.
 8. Extruded-Tee Connections: Form tee in copper tube according to ASTM F 2104. Use tool designed for copper tube; drill pilot hole, form collar for outlet, dimple tube to form seating stop, and braze branch tube into collar.
 9. Copper-Tubing Grooved Joints: Roll groove end of tube. Assemble coupling with housing, gasket, lubricant, and bolts. Join copper tube and grooved-end fittings according to AWWA C606 for roll-grooved joints.
 10. Ductile-Iron-Piping Grooved Joints: Cut groove end of pipe. Assemble coupling with housing, gasket, lubricant, and bolts. Join ductile-iron pipe and grooved-end fittings according to AWWA C606 for ductile-iron-pipe, cut-grooved joints.
 11. Steel-Piping Grooved Joints: Cut **OR** Roll, **as directed**, groove end of pipe. Assemble coupling with housing, gasket, lubricant, and bolts. Join steel pipe and grooved-end fittings according to AWWA C606 for steel-pipe grooved joints.
 12. Flanged Joints: Select appropriate asbestos-free, nonmetallic gasket material in size, type, and thickness suitable for domestic water service. Join flanges with gasket and bolts according to ASME B31.9.
 13. Plastic Piping Solvent-Cement Joints: Clean and dry joining surfaces. Join pipe and fittings according to the following:
 - a. Comply with ASTM F 402 for safe-handling practice of cleaners, primers, and solvent cements. Apply primer.
 - b. CPVC Piping: Join according to ASTM D 2846/D 2846M Appendix.
 - c. PVC Piping: Join according to ASTM D 2855.
 14. PEX Piping Joints: Join according to ASTM F 1807.
 15. Dissimilar-Material Piping Joints: Make joints using adapters compatible with materials of both piping systems.
- D. Valve Installation
1. General-Duty Valves: Comply with requirements in Division 22 Section "General-duty Valves For Plumbing Piping" for valve installations.
 2. Install shutoff valve close to water main on each branch and riser serving plumbing fixtures or equipment, on each water supply to equipment, and on each water supply to plumbing fixtures that do not have supply stops. Use ball or gate valves for piping **NPS 2 (DN 50)** and smaller. Use butterfly or gate valves for piping **NPS 2-1/2 (DN 65)** and larger.
 3. Install drain valves for equipment at base of each water riser, at low points in horizontal piping, and where required to drain water piping. Drain valves are specified in Division 22 Section "Domestic Water Piping Specialties".
 - a. Hose-End Drain Valves: At low points in water mains, risers, and branches.
 - b. Stop-and-Waste Drain Valves: Instead of hose-end drain valves where indicated.
 4. Install balancing valve in each hot-water circulation return branch and discharge side of each pump and circulator. Set balancing valves partly open to restrict but not stop flow. Use ball valves for piping **NPS 2 (DN 50)** and smaller and butterfly valves for piping **NPS 2-1/2 (DN 65)** and larger. Comply with requirements in Division 22 Section "Domestic Water Piping Specialties" for balancing valves.
 5. Install calibrated balancing valves in each hot-water circulation return branch and discharge side of each pump and circulator. Set calibrated balancing valves partly open to restrict but not stop flow. Comply with requirements in Division 22 Section "Domestic Water Piping Specialties" for calibrated balancing valves.
- E. Transition Fitting Installation
1. Install transition couplings at joints of dissimilar piping.
 2. Transition Fittings in Underground Domestic Water Piping:

- a. **NPS 1-1/2 (DN 40)** and Smaller: Fitting-type coupling.
- b. **NPS 2 (DN 50)** and Larger: Sleeve-type coupling.
3. Transition Fittings in Aboveground Domestic Water Piping **NPS 2 (DN 50)** and Smaller: Plastic-to-metal transition fittings **OR** unions, **as directed**.

F. Dielectric Fitting Installation

1. Install dielectric fittings in piping at connections of dissimilar metal piping and tubing.
2. Dielectric Fittings for **NPS 2 (DN 50)** and Smaller: Use dielectric couplings **OR** nipples **OR** unions, **as directed**.
3. Dielectric Fittings for **NPS 2-1/2 to NPS 4 (DN 65 to DN 100)**: Use dielectric flanges **OR** flange kits **OR** nipples, **as directed**.
4. Dielectric Fittings for **NPS 5 (DN 125)** and Larger: Use dielectric flange kits.

G. Flexible Connector Installation

1. Install flexible connectors in suction and discharge piping connections to each domestic water pump and in suction and discharge manifold connections to each domestic water booster pump, **as directed**.
2. Install bronze-hose flexible connectors in copper domestic water tubing.
3. Install stainless-steel-hose flexible connectors in steel domestic water piping.

H. Water Meter Installation

1. Rough-in domestic water piping for water meter installation, and install water meters, **as directed**, according to utility company's requirements.
2. Water meters will be furnished and installed by utility company.
OR
Install water meters according to AWWA M6 and utility company's requirements.
3. Install displacement-type water meters with shutoff valve on water-meter inlet. Install valve on water-meter outlet and valved bypass around meter unless prohibited by authorities having jurisdiction.
OR
Install turbine-type water meters with shutoff valve on water-meter inlet. Install valve on water-meter outlet and valved bypass around meter unless prohibited by authorities having jurisdiction.
OR
Install compound-type water meters with shutoff valves on water-meter inlet and outlet and on valved bypass around meter. Support meters, valves, and piping on brick or concrete piers.
OR
Install fire-service water meters with shutoff valves on water-meter inlet and outlet and on full-size valved bypass around meter. Support meter, valves, and piping on brick or concrete piers.
4. Install remote registration system according to standards of utility company and of authorities having jurisdiction.

I. Hanger And Support Installation

1. Comply with requirements in Division 22 Section "Vibration And Seismic Controls For Plumbing Piping And Equipment" for seismic-restraint devices.
2. Comply with requirements in Division 22 Section "Hangers And Supports For Plumbing Piping And Equipment" for pipe hanger and support products and installation.
 - a. Vertical Piping: MSS Type 8 or 42, clamps.
 - b. Individual, Straight, Horizontal Piping Runs:
 - 1) **100 Feet (30 m)** and Less: MSS Type 1, adjustable, steel clevis hangers.
 - 2) Longer Than **100 Feet (30 m)**: MSS Type 43, adjustable roller hangers.
 - 3) Longer Than **100 Feet (30 m)** If Indicated: MSS Type 49, spring cushion rolls.
 - c. Multiple, Straight, Horizontal Piping Runs **100 Feet (30 m)** or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
 - d. Base of Vertical Piping: MSS Type 52, spring hangers.
3. Support vertical piping and tubing at base and at each floor.

4. Rod diameter may be reduced one size for double-rod hangers, to a minimum of **3/8 inch (10 mm)**.
 5. Install hangers for copper tubing with the following maximum horizontal spacing and minimum rod diameters:
 - a. **NPS 3/4 (DN 20) and Smaller: 60 inches (1500 mm) with 3/8-inch (10-mm) rod.**
 - b. **NPS 1 and NPS 1-1/4 (DN 25 and DN 32): 72 inches (1800 mm) with 3/8-inch (10-mm) rod.**
 - c. **NPS 1-1/2 and NPS 2 (DN 40 and DN 50): 96 inches (2400 mm) with 3/8-inch (10-mm) rod.**
 - d. **NPS 2-1/2 (DN 65): 108 inches (2700 mm) with 1/2-inch (13-mm) rod.**
 - e. **NPS 3 to NPS 5 (DN 80 to DN 125): 10 feet (3 m) with 1/2-inch (13-mm) rod.**
 - f. **NPS 6 (DN 150): 10 feet (3 m) with 5/8-inch (16-mm) rod.**
 - g. **NPS 8 (DN 200): 10 feet (3 m) with 3/4-inch (19-mm) rod.**
 6. Install supports for vertical copper tubing every **10 feet (3 m)**.
 7. Install hangers for steel piping with the following maximum horizontal spacing and minimum rod diameters:
 - a. **NPS 1-1/4 (DN 32) and Smaller: 84 inches (2100 mm) with 3/8-inch (10-mm) rod.**
 - b. **NPS 1-1/2 (DN 40): 108 inches (2700 mm) with 3/8-inch (10-mm) rod.**
 - c. **NPS 2 (DN 50): 10 feet (3 m) with 3/8-inch (10-mm) rod.**
 - d. **NPS 2-1/2 (DN 65): 11 feet (3.4 m) with 1/2-inch (13-mm) rod.**
 - e. **NPS 3 and NPS 3-1/2 (DN 80 and DN 90): 12 feet (3.7 m) with 1/2-inch (13-mm) rod.**
 - f. **NPS 4 and NPS 5 (DN 100 and DN 125): 12 feet (3.7 m) with 5/8-inch (16-mm) rod.**
 - g. **NPS 6 (DN 150): 12 feet (3.7 m) with 3/4-inch (19-mm) rod.**
 - h. **NPS 8 to NPS 12 (DN 200 to DN 300): 12 feet (3.7 m) with 7/8-inch (22-mm) rod.**
 8. Install supports for vertical steel piping every **15 feet (4.5 m)**.
 9. Install vinyl-coated hangers for CPVC piping with the following maximum horizontal spacing and minimum rod diameters:
 - a. **NPS 1 (DN 25) and Smaller: 36 inches (900 mm) with 3/8-inch (10-mm) rod.**
 - b. **NPS 1-1/4 to NPS 2 (DN 32 to DN 50): 48 inches (1200 mm) with 3/8-inch (10-mm) rod.**
 - c. **NPS 2-1/2 to NPS 3-1/2 (DN 65 to DN 90): 48 inches (1200 mm) with 1/2-inch (13-mm) rod.**
 - d. **NPS 4 and NPS 5 (DN 100 and DN 125): 48 inches (1200 mm) with 5/8-inch (16-mm) rod.**
 - e. **NPS 6 (DN 150): 48 inches (1200 mm) with 3/4-inch (19-mm) rod.**
 - f. **NPS 8 (DN 200): 48 inches (1200 mm) with 7/8-inch (22-mm) rod.**
 10. Install supports for vertical CPVC piping every **60 inches (1500 mm)** for **NPS 1 (DN 25)** and smaller, and every **72 inches (1800 mm)** for **NPS 1-1/4 (DN 32)** and larger.
 11. Install vinyl-coated hangers for PEX piping with the following maximum horizontal spacing and minimum rod diameters:
 - a. **NPS 1 (DN 25) and Smaller: 32 inches (815 mm) with 3/8-inch (10-mm) rod.**
 12. Install hangers for vertical PEX piping every **48 inches (1200 mm)**.
 13. Install vinyl-coated hangers for PVC piping with the following maximum horizontal spacing and minimum rod diameters:
 - a. **NPS 2 (DN 50) and Smaller: 48 inches (1200 mm) with 3/8-inch (10-mm) rod.**
 - b. **NPS 2-1/2 to NPS 3-1/2 (DN 65 to DN 90): 48 inches (1200 mm) with 1/2-inch (13-mm) rod.**
 - c. **NPS 4 and NPS 5 (DN 100 and DN 125): 48 inches (1200 mm) with 5/8-inch (16-mm) rod.**
 - d. **NPS 6 (DN 150): 48 inches (1200 mm) with 3/4-inch (19-mm) rod.**
 - e. **NPS 8 (DN 200): 48 inches (1200 mm) with 7/8-inch (22-mm) rod.**
 14. Install supports for vertical PVC piping every **48 inches (1200 mm)**.
 15. Support piping and tubing not listed in this article according to MSS SP-69 and manufacturer's written instructions.
- J. Connections
1. Drawings indicate general arrangement of piping, fittings, and specialties.
 2. Install piping adjacent to equipment and machines to allow service and maintenance.



3. Connect domestic water piping to exterior water-service piping. Use transition fitting to join dissimilar piping materials.
4. Connect domestic water piping to water-service piping with shutoff valve; extend and connect to the following:
 - a. Domestic Water Booster Pumps: Cold-water suction and discharge piping.
 - b. Water Heaters: Cold-water inlet and hot-water outlet piping in sizes indicated, but not smaller than sizes of water heater connections.
 - c. Plumbing Fixtures: Cold- and hot-water supply piping in sizes indicated, but not smaller than required by plumbing code. Comply with requirements in Division 22 Section(s) "Plumbing Fixtures" OR "Healthcare Plumbing Fixtures" OR "Emergency Plumbing Fixtures" OR "Security Plumbing Fixtures", **as directed**, for connection sizes.
 - d. Equipment: Cold- and hot-water supply piping as indicated, but not smaller than equipment connections. Provide shutoff valve and union for each connection. Use flanges instead of unions for **NPS 2-1/2 (DN 65)** and larger.

K. Escutcheon Installation

1. Install escutcheons for penetrations of walls, ceilings, and floors.
2. Escutcheons for New Piping:
 - a. Piping with Fitting or Sleeve Protruding from Wall: One piece, deep pattern.
 - b. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One piece, cast brass with polished chrome-plated finish **OR** stamped steel with set screw **OR** stamped steel with set screw or spring clips **OR** stamped steel with spring clips, **as directed**.
 - c. Bare Piping at Ceiling Penetrations in Finished Spaces: One piece, cast brass with polished chrome-plated finish **OR** One piece or split casting, cast brass with polished chrome-plated finish **OR** Split casting, cast brass with polished chrome-plated finish **OR** One piece, stamped steel with set screw **OR** One piece or split plate, stamped steel with set screw **OR** Split plate, stamped steel with set screw, **as directed**.
 - d. Bare Piping in Unfinished Service Spaces: One piece, cast brass with polished chrome-plated finish **OR** cast brass with rough-brass finish **OR** stamped steel with set screw **OR** stamped steel with spring clips **OR** stamped steel with set screw or spring clips, **as directed**.
 - e. Bare Piping in Equipment Rooms: One piece, cast brass **OR** stamped steel with set screw **OR** stamped steel with spring clips **OR** stamped steel with set screw or spring clips, **as directed**.
 - f. Bare Piping at Floor Penetrations in Equipment Rooms: One-piece floor plate.
3. Escutcheons for Existing Piping:
 - a. Chrome-Plated Piping: Split casting, cast brass with chrome-plated finish.
 - b. Insulated Piping: Split plate, stamped steel with concealed **OR** exposed-rivet, **as directed**, hinge and spring clips.
 - c. Bare Piping at Wall and Floor Penetrations in Finished Spaces: Split casting, cast brass with chrome-plated finish **OR** plate, stamped steel with concealed hinge and spring clips, **as directed**.
 - d. Bare Piping at Ceiling Penetrations in Finished Spaces: Split casting, cast brass with chrome-plated finish **OR** plate, stamped steel with concealed hinge and set screw, **as directed**.
 - e. Bare Piping in Unfinished Service Spaces: Split casting, cast brass with polished chrome-plated finish **OR** casting, cast brass with rough-brass finish **OR** plate, stamped steel with concealed hinge and set screw or spring clips **OR** plate, stamped steel with concealed or exposed-rivet hinge and set screw or spring clips **OR** plate, stamped steel with exposed-rivet hinge and set screw or spring clips, **as directed**.
 - f. Bare Piping in Equipment Rooms: Split casting, cast brass **OR** plate, stamped steel with set screw or spring clips, **as directed**.
 - g. Bare Piping at Floor Penetrations in Equipment Rooms: Split-casting floor plate.

L. Sleeve Installation

1. General Requirements: Install sleeves for pipes and tubes passing through penetrations in floors, partitions, roofs, and walls.
2. Sleeves are not required for core-drilled holes.
3. Permanent sleeves are not required for holes formed by removable PE sleeves.
4. Cut sleeves to length for mounting flush with both surfaces unless otherwise indicated.
5. Install sleeves in new partitions, slabs, and walls as they are built.
6. For interior wall penetrations, seal annular space between sleeve and pipe or pipe insulation using joint sealants appropriate for size, depth, and location of joint. Comply with requirements in Division 07 Section "Joint Sealants" for joint sealants.
7. For exterior wall penetrations above grade, seal annular space between sleeve and pipe using joint sealants appropriate for size, depth, and location of joint. Comply with requirements in Division 07 Section "Joint Sealants" for joint sealants.
8. For exterior wall penetrations below grade, seal annular space between sleeve and pipe using sleeve seals **OR** wall penetration systems, **as directed**, specified in this Section.
9. Seal space outside of sleeves in concrete slabs and walls with grout.
10. Install sleeves that are large enough to provide **1/4-inch (6.4-mm)** annular clear space between sleeve and pipe or pipe insulation unless otherwise indicated.
11. Install sleeve materials according to the following applications:
 - a. Sleeves for Piping Passing through Concrete Floor Slabs: Molded PE **OR** Molded PVC **OR** Steel pipe, **as directed**.
 - b. Sleeves for Piping Passing through Concrete Floor Slabs of Mechanical Equipment Areas or Other Wet Areas: Steel pipe **OR** Stack sleeve fittings, **as directed**.
 - 1) Extend sleeves **2 inches (50 mm)** above finished floor level.
 - 2) For pipes penetrating floors with membrane waterproofing, extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified. Secure flashing between clamping flanges. Install section of cast-iron soil pipe to extend sleeve to **2 inches (50 mm)** above finished floor level. Comply with requirements in Division 07 Section "Sheet Metal Flashing And Trim" for flashing.
 - c. Sleeves for Piping Passing through Gypsum-Board Partitions:
 - 1) PVC pipe **OR** Steel pipe, **as directed**, sleeves for pipes smaller than **NPS 6 (DN 150)**.
 - 2) Galvanized-steel sheet sleeves for pipes **NPS 6 (DN 150)** and larger.
 - 3) Exception: Sleeves are not required for water supply tubes and waste pipes for individual plumbing fixtures if escutcheons will cover openings.
 - d. Sleeves for Piping Passing through Concrete Roof Slabs: Molded PE **OR** Molded PVC **OR** Steel pipe, **as directed**.
 - e. Sleeves for Piping Passing through Exterior Concrete Walls:
 - 1) Steel pipe sleeves for pipes smaller than **NPS 6 (DN 150)**.
 - 2) Cast-iron wall pipe sleeves for pipes **NPS 6 (DN 150)** and larger.
 - 3) Install sleeves that are large enough to provide **1-inch (25-mm)** annular clear space between sleeve and pipe or pipe insulation when sleeve seals are used.
 - 4) Do not use sleeves when wall penetration systems are used.
 - f. Sleeves for Piping Passing through Interior Concrete Walls:
 - 1) PVC pipe **OR** Steel pipe, **as directed**, sleeves for pipes smaller than **NPS 6 (DN 150)**.
 - 2) Galvanized-steel sheet sleeves for pipes **NPS 6 (DN 150)** and larger.
12. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Comply with requirements in Division 07 Section "Penetration Firestopping" for firestop materials and installations.

M. Sleeve Seal Installation

1. Install sleeve seals in sleeves in exterior concrete walls at water-service piping entries into building.
2. Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble sleeve seal components and install in annular space between pipe

and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

N. Wall Penetration System Installation

1. Install wall penetration systems in new, exterior concrete walls.
2. Assemble wall penetration system components with sleeve pipe. Install so that end of sleeve pipe and face of housing are flush with wall. Adjust locking devices to secure sleeve pipe in housing.

O. Identification

1. Identify system components. Comply with requirements in Division 22 Section "Identification For Plumbing Piping And Equipment" for identification materials and installation.
2. Label pressure piping with system operating pressure.

P. Field Quality Control

1. Perform tests and inspections.
2. Piping Inspections:
 - a. Do not enclose, cover, or put piping into operation until it has been inspected and approved by authorities having jurisdiction.
 - b. During installation, notify authorities having jurisdiction at least one day before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction:
 - 1) Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in and before setting fixtures.
 - 2) Final Inspection: Arrange final inspection for authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.
 - c. Reinspection: If authorities having jurisdiction find that piping will not pass tests or inspections, make required corrections and arrange for reinspection.
 - d. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.
3. Piping Tests:
 - a. Fill domestic water piping. Check components to determine that they are not air bound and that piping is full of water.
 - b. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit a separate report for each test, complete with diagram of portion of piping tested.
 - c. Leave new, altered, extended, or replaced domestic water piping uncovered and unconcealed until it has been tested and approved. Expose work that was covered or concealed before it was tested.
 - d. Cap and subject piping to static water pressure of 50 psig (345 kPa) above operating pressure, without exceeding pressure rating of piping system materials. Isolate test source and allow to stand for four hours. Leaks and loss in test pressure constitute defects that must be repaired.
 - e. Repair leaks and defects with new materials and retest piping or portion thereof until satisfactory results are obtained.
 - f. Prepare reports for tests and for corrective action required.
4. Domestic water piping will be considered defective if it does not pass tests and inspections.
5. Prepare test and inspection reports.

Q. Adjusting

1. Perform the following adjustments before operation:
 - a. Close drain valves, hydrants, and hose bibbs.
 - b. Open shutoff valves to fully open position.
 - c. Open throttling valves to proper setting.
 - d. Adjust balancing valves in hot-water-circulation return piping to provide adequate flow.

- 1) Manually adjust ball-type balancing valves in hot-water-circulation return piping to provide flow of hot water in each branch.
- 2) Adjust calibrated balancing valves to flows indicated.
- e. Remove plugs used during testing of piping and for temporary sealing of piping during installation.
- f. Remove and clean strainer screens. Close drain valves and replace drain plugs.
- g. Remove filter cartridges from housings and verify that cartridges are as specified for application where used and are clean and ready for use.
- h. Check plumbing specialties and verify proper settings, adjustments, and operation.

R. Cleaning

1. Clean and disinfect potable and non-potable, **as directed**, domestic water piping as follows:
 - a. Purge new piping and parts of existing piping that have been altered, extended, or repaired before using.
 - b. Use purging and disinfecting procedures prescribed by authorities having jurisdiction; if methods are not prescribed, use procedures described in either AWWA C651 or AWWA C652 or follow procedures described below:
 - 1) Flush piping system with clean, potable water until dirty water does not appear at outlets.
 - 2) Fill and isolate system according to either of the following:
 - a) Fill system or part thereof with water/chlorine solution with at least **50 ppm (50 mg/L)** of chlorine. Isolate with valves and allow to stand for 24 hours.
 - b) Fill system or part thereof with water/chlorine solution with at least **200 ppm (200 mg/L)** of chlorine. Isolate and allow to stand for three hours.
 - 3) Flush system with clean, potable water until no chlorine is in water coming from system after the standing time.
 - 4) Submit water samples in sterile bottles to authorities having jurisdiction. Repeat procedures if biological examination shows contamination.
2. Clean non-potable domestic water piping as follows:
 - a. Purge new piping and parts of existing piping that have been altered, extended, or repaired before using.
 - b. Use purging procedures prescribed by authorities having jurisdiction or; if methods are not prescribed, follow procedures described below:
 - 1) Flush piping system with clean, potable water until dirty water does not appear at outlets.
 - 2) Submit water samples in sterile bottles to authorities having jurisdiction. Repeat procedures if biological examination shows contamination.
3. Prepare and submit reports of purging and disinfecting activities.
4. Clean interior of domestic water piping system. Remove dirt and debris as work progresses.

S. Piping Schedule

1. Transition and special fittings with pressure ratings at least equal to piping rating may be used in applications below unless otherwise indicated.
2. Flanges and unions may be used for aboveground piping joints unless otherwise indicated.
3. Fitting Option: Extruded-tee connections and brazed joints may be used on aboveground copper tubing.
4. Under-building-slab, domestic water, building service piping, **NPS 3 (DN 80)** and smaller, shall be one of the following:
 - a. Soft copper tube, **ASTM B 88, Type K (ASTM B 88M, Type A) OR ASTM B 88, Type L (ASTM B 88M, Type B), as directed**; wrought-copper solder-joint fittings; and brazed **OR** copper pressure-seal fittings; and pressure-sealed, **as directed**, joints.
 - b. PVC, Schedule 40 pipe; PVC, Schedule 40 **OR** Schedule 80 pipe; PVC, Schedule 80, **as directed**, socket fittings; and solvent-cemented joints.
5. Under-building-slab, domestic water, building-service piping, **NPS 4 to NPS 8 (DN 100 to DN 200)** and larger, shall be one of the following:

- a. Soft copper tube, **ASTM B 88, Type K (ASTM B 88M, Type A) OR ASTM B 88, Type L (ASTM B 88M, Type B), as directed**; wrought-copper solder-joint fittings; and brazed joints.
- b. Mechanical-joint, ductile-iron pipe; standard-pattern **OR** compact-pattern, **as directed**, mechanical-joint fittings; and mechanical joints.
- c. Push-on-joint, ductile-iron pipe; standard-pattern **OR** compact-pattern, **as directed**, push-on-joint fittings; and gasketed joints.
- d. Plain-end, ductile-iron pipe; grooved-joint, ductile-iron-pipe appurtenances; and grooved joints.
- e. PVC, Schedule 40 pipe; PVC, Schedule 40 **OR** Schedule 80 pipe; PVC, Schedule 80, **as directed**, socket fittings; and solvent-cemented joints.
6. Under-building slab, combined domestic water, building-service, and fire-service-main piping, **NPS 6 to NPS 12 (DN 150 to DN 300)**, shall be one of the following:
 - a. Mechanical-joint, ductile-iron pipe; standard-pattern **OR** compact-pattern, **as directed**, mechanical-joint fittings; and mechanical joints.
 - b. Push-on-joint, ductile-iron pipe; standard-pattern **OR** compact-pattern, **as directed**, push-on-joint fittings; and gasketed joints.
 - c. Plain-end, ductile-iron pipe; grooved-joint, ductile-iron-pipe appurtenances; and grooved joints.
7. Under-building-slab, domestic water piping, **NPS 2 (DN 50)** and smaller, shall be one of the following:
 - a. Hard **OR** Soft, **as directed**, copper tube, **ASTM B 88, Type L (ASTM B 88M, Type B)**; wrought-copper solder-joint fittings; and brazed **OR** copper pressure-seal-joint fittings; and pressure-sealed, **as directed**, joints.
 - b. PVC, Schedule 40 pipe; PVC, Schedule 40 **OR** Schedule 80 pipe; PVC, Schedule 80, **as directed**, socket fittings; and solvent-cemented joints.
8. Aboveground domestic water piping, **NPS 2 (DN 50)** and smaller, shall be one of the following:
 - a. Galvanized-steel pipe and nipples; galvanized, gray-iron threaded fittings; and threaded joints.
 - b. Hard copper tube, **ASTM B 88, Type L (ASTM B 88M, Type B), as directed**; cast-copper **OR** wrought-copper, **as directed**, solder-joint fittings; and brazed **OR** soldered, **as directed**, joints.
 - c. Hard copper tube, **ASTM B 88, Type L (ASTM B 88M, Type B, as directed**; copper pressure-seal-joint fittings; and pressure-sealed joints.
 - d. Hard copper tube, **ASTM B 88, Type L (ASTM B 88M, Type B) OR, as directed**; copper push-on-joint fittings; and push-on joints.
 - e. CPVC, Schedule 40 pipe; CPVC, Schedule 40 **OR** Schedule 80 pipe; CPVC, Schedule 80, **as directed**, socket fittings; and solvent-cemented joints.
 - f. CPVC, Schedule 80 pipe; CPVC, Schedule 80 threaded fittings; and threaded joints.
 - g. CPVC Tubing System: CPVC tube; CPVC socket fittings; and solvent-cemented joints. **NPS 1-1/2 (DN 40) and NPS 2 (DN 50) CPVC pipe with CPVC socket fittings may be used instead of tubing.**
 - h. PEX Tube, **NPS 1 (DN 25)** and smaller; fittings for PEX tube; and crimped joints.
 - i. PVC, Schedule 40 pipe; PVC, Schedule 40 **OR** Schedule 80 pipe; PVC, Schedule 80, **as directed**, socket fittings; and solvent-cemented joints.
9. Aboveground domestic water piping, **NPS 2-1/2 to NPS 4 (DN 65 to DN 100)**, shall be one of the following:
 - a. Hard copper tube, **ASTM B 88, Type L (ASTM B 88M, Type B), as directed**; cast-copper **OR** wrought-copper, **as directed**, solder-joint fittings; and brazed **OR** soldered, **as directed**, joints.
 - b. Hard copper tube, **ASTM B 88, Type L (ASTM B 88M, Type B), as directed**; copper pressure-seal-joint fittings; and pressure-sealed joints.
 - c. Hard copper tube, **ASTM B 88, Type L (ASTM B 88M, Type B, as directed**; grooved-joint copper-tube appurtenances; and grooved joints.

- d. Galvanized-steel pipe and nipples; galvanized, gray-iron threaded fittings; and threaded joints.
 - e. Galvanized-steel pipe; grooved-joint, galvanized-steel-pipe appurtenances; and grooved joints.
 - f. CPVC, Schedule 40 pipe; CPVC, Schedule 40 **OR** Schedule 80 pipe; CPVC, Schedule 80, **as directed**, socket fittings; and solvent-cemented joints.
 - g. CPVC, Schedule 80 pipe; CPVC, Schedule 80 threaded fittings; and threaded joints.
 - h. PVC, Schedule 40 pipe; PVC, Schedule 40 **OR** Schedule 80 pipe; PVC, Schedule 80, **as directed**, socket fittings; and solvent-cemented joints.
10. Aboveground domestic water piping, **NPS 5 to NPS 8 (DN 125 to DN 200)**, shall be one of the following:
- a. Hard copper tube, **ASTM B 88, Type L (ASTM B 88M, Type B)**, **as directed**; cast-copper **OR** wrought-copper, **as directed**, solder-joint fittings; and brazed **OR** soldered, **as directed**, joints.
 - b. Hard copper tube, **ASTM B 88, Type L (ASTM B 88M, Type B)**, **as directed**; grooved-joint copper-tube appurtenances; and grooved joints.
 - c. Galvanized-steel pipe and nipples; galvanized, gray-iron threaded fittings; and threaded joints.
 - d. Galvanized-steel pipe; grooved-joint, galvanized-steel-pipe appurtenances; and grooved joints.
 - e. CPVC, Schedule 40 pipe; CPVC, Schedule 40 **OR** Schedule 80 pipe; CPVC, Schedule 80, **as directed**, socket fittings; and solvent-cemented joints.
 - f. CPVC, Schedule 80 pipe; CPVC, Schedule 80 threaded fittings; and threaded joints.
 - g. PVC, Schedule 40 pipe; PVC, Schedule 40 **OR** Schedule 80 pipe; PVC, Schedule 80, **as directed**, socket fittings; and solvent-cemented joints.
11. Aboveground, combined domestic-water-service and fire-service-main piping, **NPS 6 to NPS 12 (DN 150 to DN300)**, shall be one of the following:
- a. Plain-end, ductile-iron pipe; grooved-joint, ductile-iron-pipe appurtenances; and grooved joints.
 - b. Galvanized-steel pipe and nipples; galvanized, gray-iron threaded fittings; and threaded joints.
 - c. Galvanized-steel pipe; grooved-joint, galvanized-steel-pipe appurtenances; and grooved joints.
- T. Valve Schedule
1. Drawings indicate valve types to be used. Where specific valve types are not indicated, the following requirements apply:
 - a. Shutoff Duty: Use ball or gate valves for piping **NPS 2 (DN 50)** and smaller. Use butterfly, ball, or gate valves with flanged ends for piping **NPS 2-1/2 (DN 65)** and larger.
 - b. Throttling Duty: Use ball or globe valves for piping **NPS 2 (DN 50)** and smaller. Use butterfly or ball valves with flanged ends for piping **NPS 2-1/2 (DN 65)** and larger.
 - c. Hot-Water Circulation Piping, Balancing Duty: Calibrated **OR** Memory-stop, **as directed**, balancing valves.
 - d. Drain Duty: Hose-end drain valves.
 2. Use check valves to maintain correct direction of domestic water flow to and from equipment.
 3. Iron grooved-end valves may be used with grooved-end piping.
 4. CPVC and PVC valves matching piping materials may be used.

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SECTION 22 11 16 00a - SANITARY WASTE AND VENT PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Hub-and-spigot, cast-iron soil pipe and fittings.
2. Hubless, cast-iron soil pipe and fittings.
3. Galvanized-steel pipe and fittings.
4. Stainless steel drainage pipe and fittings.
5. Ductile-iron pipe and fittings.
6. Copper tube and fittings.
7. ABS pipe and fittings.
8. PVC pipe and fittings.
9. Specialty pipe fittings.
10. Encasement for underground metal piping.

B. Related Requirements:

1. Section 221313 "Facility Sanitary Sewers" for sanitary sewerage piping and structures outside the building.
2. Section 221329 "Sanitary Sewerage Pumps" for effluent and sewage pumps.
3. Section 226600 "Chemical-Waste Systems for Laboratory and Healthcare Facilities" for chemical-waste and vent piping systems.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Sustainable Design Submittals:

1. [<Double click to insert sustainable design text for adhesives.>](#)

C. Shop Drawings: For hubless, single-stack drainage system. Include plans, elevations, sections, and details.

1.3 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Plans and elevations, or Building Information Model (BIM) drawn to scale, showing items described in this Section and coordinated with all building trades.

B. Seismic Qualification Certificates: For waste and vent piping, accessories, and components, from manufacturer.

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
2. Detailed description of piping anchorage devices on which the certification is based and their installation requirements.

- C. Field quality-control reports.

1.4 FIELD CONDITIONS

- A. Interruption of Existing Sanitary Waste Service: Do not interrupt service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary service in accordance with requirements indicated:
1. Notify **[Architect] [Construction Manager] [Owner]** no fewer than **[two]** **<Insert number>** days in advance of proposed interruption of sanitary waste service.
 2. Do not proceed with interruption of sanitary waste service without **[Architect's] [Construction Manager's] [Owner's]** written permission.

1.5 WARRANTY

- A. Listed manufacturers to provide labeling and warranty of their respective products.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Components and installation are capable of withstanding the following minimum working pressure unless otherwise indicated:
1. Soil, Waste, and Vent Piping: **[10 ft. head of water (30 kPa head of water)] <Insert pressure>**.
 2. Waste, Force-Main Piping: **[50 psig (345 kPa)] [100 psig (690 kPa)] [150 psig (1035 kPa)] <Insert pressure>**.
- B. Seismic Performance: Soil, waste, and vent piping and support and installation to withstand the effects of earthquake motions determined in accordance with **[ASCE/SEI 7] <Insert requirement>**. See Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment":
1. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified **[and the unit will be fully operational after the seismic event]**."
 2. Component Importance Factor: **[1.5] [1.0]**.
- C. **<Insert requirements for Component Amplification Factor and Component Response Modification Factor>**.

2.2 PIPING MATERIALS

- A. Piping materials to bear label, stamp, or other markings of specified testing agency.
- B. Comply with requirements in "Piping Schedule" Article for applications of pipe, tube, fitting materials, and joining methods for specific services, service locations, and pipe sizes.

2.3 HUB-AND-SPIGOT, CAST-IRON SOIL PIPE AND FITTINGS

- A. [<Double click here to find, evaluate, and insert list of manufacturers and products.>](#)
- B. Pipe and Fittings:
 - 1. Marked with CISPI collective trademark.
 - 2. ASTM A74, **[service] [and] [extra-heavy]** cast iron.
- C. Gaskets: ASTM C564, rubber.
- D. Caulking Materials: ASTM B29, pure lead and oakum or hemp fiber.

2.4 HUBLESS, CAST-IRON SOIL PIPE AND FITTINGS

- A. [<Double click here to find, evaluate, and insert list of manufacturers and products.>](#)
- B. Pipe and Fittings:
 - 1. Marked with CISPI collective trademark.
 - 2. ASTM A888 or CISPI 301.
- C. Single-Stack Aerator Fittings: ASME B16.45, hubless, cast-iron aerator and deaerator drainage fittings.
 - 1. [<Double click here to find, evaluate, and insert list of manufacturers and products.>](#)
- D. CISPI, Hubless-Piping Couplings:
 - 1. [<Double click here to find, evaluate, and insert list of manufacturers and products.>](#)
 - 2. Standards: ASTM C1277 and CISPI 310.
 - 3. Description: Stainless steel corrugated shield with stainless steel bands and tightening devices; and ASTM C564, rubber sleeve with integral, center pipe stop.
- E. Heavy-Duty, Hubless-Piping Couplings:
 - 1. [<Double click here to find, evaluate, and insert list of manufacturers and products.>](#)
 - 2. Standards: ASTM C1277 and ASTM C1540. **<Insert standard>**.
 - 3. Description: Stainless steel shield with stainless steel bands and tightening devices; and ASTM C564, rubber sleeve with integral, center pipe stop.

2.5 GALVANIZED-STEEL PIPE AND FITTINGS

- A. [<Double click here to find, evaluate, and insert list of manufacturers and products.>](#)
- B. Galvanized-Steel Pipe: ASTM A53/A53M, Type E, standard-weight cast iron. Include square-cut-grooved or threaded ends matching joining method.
- C. **[Galvanized-]**Cast-Iron Drainage Fittings: ASME B16.12, threaded.
- D. Steel Pipe Pressure Fittings:
 - 1. **[Galvanized-]**Steel Pipe Nipples: ASTM A733, made of ASTM A53/A53M or ASTM A106/A106M, Schedule 40, seamless steel pipe. Include ends matching joining method.

2. Malleable-Iron Unions: ASME B16.39, Class 150, hexagonal-stock body with ball-and-socket, metal-to-metal, bronze seating surface; and female threaded ends.
3. **[Galvanized-]**Gray-Iron, Threaded Fittings: ASME B16.4, Class 125, standard pattern.

E. Cast-Iron Flanges: ASME B16.1, Class 125.

1. Flange Gasket Materials: ASME B16.21, full-face, flat, nonmetallic, asbestos-free, **1/8-inch (3.2-mm)** maximum thickness unless thickness or specific material is indicated.
2. Flange Bolts and Nuts: ASME B18.2.1, carbon steel unless otherwise indicated.

F. Grooved-Joint, Galvanized-Steel-Pipe Appurtenances:

1. [<Double click here to find, evaluate, and insert list of manufacturers and products.>](#)
2. Galvanized, Grooved-End Fittings for Galvanized-Steel Piping: ASTM A536, ductile-iron castings; ASTM A47/A47M, malleable-iron castings; ASTM A234/A234M, forged steel fittings; or ASTM A106/A106M, steel pipes with dimensions matching ASTM A53/A53M, steel pipe, and complying with AWWA C606 for grooved ends.
3. Grooved Mechanical Couplings for Galvanized-Steel Piping: ASTM F1476, Type I. Include ferrous housing sections with continuous curved keys, EPDM-rubber gasket suitable for hot and cold water, and bolts and nuts.

2.6 STAINLESS STEEL DRAINAGE PIPE AND FITTINGS

- A. [<Double click here to find, evaluate, and insert list of manufacturers and products.>](#)
- B. Description: Comply with requirements of ASME A112.3.1 drainage pattern.
- C. Material: **[Type 304 stainless steel] [Type 316L stainless steel] [Type 304 or 316L stainless steel]**.
- D. Pipe Construction: Seamless.
- E. Internal Sealing Rings: **[EPDM] [NBR] <Insert material> [, marked or color-coded for the application]**.
- F. Joints: Single or double, socket and spigot ends.

2.7 DUCTILE-IRON PIPE AND FITTINGS

- A. [<Double click here to find, evaluate, and insert list of manufacturers and products.>](#)
- B. Ductile-Iron, Mechanical-Joint Piping:
 1. Ductile-Iron Pipe: AWWA C151/A21.51, with mechanical-joint bell and plain spigot ends unless grooved or flanged ends are indicated.
 2. Ductile-Iron Fittings: AWWA C110/A21.10, mechanical-joint, ductile- or gray-iron standard pattern or AWWA C153/A21.53, ductile-iron compact pattern.
 3. Glands, Gaskets, and Bolts: AWWA C111/A21.11, ductile- or gray-iron glands, rubber gaskets, and steel bolts.
- C. Ductile-Iron, Push-on-Joint Piping:

1. Ductile-Iron Pipe: AWWA C151/A21.51, with push-on-joint bell and plain spigot ends unless grooved or flanged ends are indicated.
 2. Ductile-Iron Fittings: AWWA C110/A21.10, push-on-joint, ductile- or gray-iron standard pattern or AWWA C153/A21.53, ductile-iron compact pattern.
 3. Gaskets: AWWA C111/A21.11, rubber.
- D. Ductile-Iron, Grooved-Joint Piping: AWWA C151/A21.51, with round-cut-grooved ends in accordance with AWWA C606.
- E. Ductile-Iron, Grooved-End Pipe Appurtenances:
1. [<Double click here to find, evaluate, and insert list of manufacturers and products.>](#)
 2. Grooved-End, Ductile-Iron Fittings: ASTM A536, ductile-iron castings, with dimensions matching AWWA C110/A 21.10, ductile-iron pipe or AWWA C153/A 21.53, ductile-iron fittings, and complying with AWWA C606 for grooved ends.
 3. Grooved Mechanical Couplings for Ductile-Iron Pipe: ASTM F1476, Type I. Include ferrous housing sections with continuous curved keys, EPDM-rubber center-leg gasket suitable for hot and cold water, and bolts and nuts.

2.8 COPPER TUBE AND FITTINGS

- A. [<Double click here to find, evaluate, and insert list of manufacturers and products.>](#)
- B. Copper Type DWV Tube: ASTM B306, drainage tube, drawn temper.
- C. Copper Drainage Fittings: ASME B16.23, cast copper or ASME B16.29, wrought copper, solder-joint fittings.
- D. Hard Copper Tube: **ASTM B88, Type L and Type M** (**ASTM B88M, Type B and Type C**), water tube, drawn temper.
- E. Soft Copper Tube: **ASTM B88, Type L** (**ASTM B88M, Type B**), water tube, annealed temper.
- F. Copper Pressure Fittings:
1. Copper Fittings: ASME B16.18, cast-copper-alloy or ASME B16.22, wrought-copper, solder-joint fittings. Furnish wrought-copper fittings if indicated.
 2. Copper Unions: MSS SP-123, copper-alloy, hexagonal-stock body with ball-and-socket, metal-to-metal seating surfaces, and solder-joint or threaded ends.
- G. Copper Flanges: ASME B16.24, Class 150, cast copper with solder-joint end.
1. Flange Gasket Materials: ASME B16.21, full-face, flat, nonmetallic, asbestos-free, **1/8-inch (3.2-mm)** maximum thickness unless thickness or specific material is indicated.
 2. Flange Bolts and Nuts: ASME B18.2.1, carbon steel unless otherwise indicated.
- H. Solder: ASTM B32, lead free with ASTM B813, water-flushable flux.

2.9 ABS PIPE AND FITTINGS

- A. [<Double click here to find, evaluate, and insert list of manufacturers and products.>](#)

- B. NSF Marking: Comply with NSF 14 for plastic piping components. Include "NSF-dwv" marking for plastic drain, waste, and vent piping and "NSF-sewer" for plastic sewer piping.
- C. Solid-Wall ABS Pipe: ASTM D2661, Schedule 40.
- D. Cellular-Core ABS Pipe: ASTM F628, Schedule 40.
- E. ABS Socket Fittings: ASTM D2661, made in accordance with ASTM D3311, drain, waste, and vent patterns.
- F. Solvent Cement: ASTM D2235.
 - 1. [<Double click to insert sustainable design text for solvent cement.>](#)
 - 2. [<Double click to insert sustainable design text for solvent cement.>](#)

2.10 PVC PIPE AND FITTINGS

- A. [<Double click here to find, evaluate, and insert list of manufacturers and products.>](#)
- B. Comply with NSF 14 for plastic piping components. Include "NSF-dwv" marking for plastic drain, waste, and vent piping and "NSF-sewer" marking for plastic sewer piping.
- C. Solid-Wall PVC Pipe: ASTM D2665 drain, waste, and vent.
- D. Cellular-Core PVC Pipe: ASTM F891, Schedule 40.
- E. PVC Socket Fittings: ASTM D2665, made in accordance with ASTM D3311, drain, waste, and vent patterns and to fit Schedule 40 pipe.
- F. Adhesive Primer: ASTM F656.
 - 1. [<Double click to insert sustainable design text for adhesive primer.>](#)
 - 2. [<Double click to insert sustainable design text for adhesive primer.>](#)
- G. Solvent Cement: ASTM D2564.
 - 1. [<Double click to insert sustainable design text for solvent cement.>](#)

2.11 SPECIALTY PIPE FITTINGS

- A. Transition Couplings:
 - 1. General Requirements: Fitting or device for joining piping with small differences in ODs or of different materials. Include end connections of same size as and compatible with pipes to be joined.
 - 2. Fitting-Type Transition Couplings: Manufactured piping coupling or specified piping system fitting.
 - 3. Unshielded, Nonpressure Transition Couplings:
 - a. [<Double click here to find, evaluate, and insert list of manufacturers and products.>](#)
 - b. Standard: ASTM C1173.
 - c. Description: Elastomeric, sleeve-type, reducing or transition pattern. Include shear ring and corrosion-resistant-metal tension band and tightening mechanism on each end.

- d. End Connections: Same size as and compatible with pipes to be joined.
- e. Sleeve Materials:
 - 1) For Cast-Iron Soil Pipes: ASTM C564, rubber.
 - 2) For Plastic Pipes: ASTM F477, elastomeric seal or ASTM D5926 PVC.
 - 3) For Dissimilar Pipes: ASTM D5926 PVC or other material compatible with pipe materials being joined.
4. Shielded, Nonpressure Transition Couplings:
 - a. [<Double click here to find, evaluate, and insert list of manufacturers and products.>](#)
 - b. Standard: ASTM C1460.
 - c. Description: Elastomeric or rubber sleeve with full-length, corrosion-resistant outer shield and corrosion-resistant-metal tension band and tightening mechanism on each end.
 - d. End Connections: Same size as and compatible with pipes to be joined.
5. Pressure Transition Couplings:
 - a. [<Double click here to find, evaluate, and insert list of manufacturers and products.>](#)
 - b. Standard: AWWA C219.
 - c. Description: Metal sleeve-type same size as, with pressure rating at least equal to, and ends compatible with, pipes to be joined.
 - d. Center-Sleeve Material: **[Manufacturer's standard] [Carbon steel] [Stainless steel] [Ductile iron] [Malleable iron]**.
 - e. Gasket Material: Natural or synthetic rubber.
 - f. Metal Component Finish: Corrosion-resistant coating or material.
- B. Dielectric Fittings:
 1. General Requirements: Assembly of copper alloy and ferrous materials with separating nonconductive insulating material. Include end connections compatible with pipes to be joined.
 2. Dielectric Unions:
 - a. [<Double click here to find, evaluate, and insert list of manufacturers and products.>](#)
 - b. Description:
 - 1) Standard: ASSE 1079.
 - 2) Pressure Rating: **[125 psig (860 kPa) minimum at 180 deg F (82 deg C)] [150 psig (1035 kPa)] [250 psig (1725 kPa)] <Insert pressure>**.
 - 3) End Connections: Solder-joint copper alloy and threaded ferrous.
 3. Dielectric Flanges:
 - a. [<Double click here to find, evaluate, and insert list of manufacturers and products.>](#)
 - b. Description:
 - 1) Standard: ASSE 1079.
 - 2) Factory-fabricated, bolted, companion-flange assembly.
 - 3) Pressure Rating: **[125 psig (860 kPa) minimum at 180 deg F (82 deg C)] [150 psig (1035 kPa)] [175 psig (1200 kPa)] [300 psig (2070 kPa)] <Insert pressure>**.
 - 4) End Connections: Solder-joint copper alloy and threaded ferrous; threaded solder-joint copper alloy and threaded ferrous.
 4. Dielectric-Flange Insulating Kits:
 - a. [<Double click here to find, evaluate, and insert list of manufacturers and products.>](#)

b. Description:

- 1) Nonconducting materials for field assembly of companion flanges.
- 2) Pressure Rating: [**150 psig (1035 kPa)**] <Insert pressure>.
- 3) Gasket: Neoprene or phenolic.
- 4) Bolt Sleeves: Phenolic or polyethylene.
- 5) Washers: Phenolic with steel backing washers.

5. Dielectric Nipples:

a. [<Double click here to find, evaluate, and insert list of manufacturers and products.>](#)

b. Description:

- 1) Standard: IAPMO PS 66.
- 2) Electroplated steel nipple.
- 3) Pressure Rating: [**300 psig (2070 kPa) at 225 deg F (107 deg C)**] <Insert pressure and temperature>.
- 4) End Connections: Male threaded or grooved.
- 5) Lining: Inert and noncorrosive, propylene.

2.12 ENCASEMENT FOR UNDERGROUND METAL PIPING

- A. Standard: ASTM A674 or AWWA C105/A 21.5.
- B. Material: [**Linear low-density polyethylene film of 0.008-inch (0.20-mm)**] [or] [**high-density, cross-laminated polyethylene film of 0.004-inch (0.10-mm)**] minimum thickness.
- C. Form: [**Sheet**] [or] [**tube**].
- D. Color: [**Black**] [or] [**natural**] <Insert color>.

PART 3 - EXECUTION

3.1 EARTH MOVING

- A. Comply with requirements for excavating, trenching, and backfilling specified in Section 312000 "Earth Moving."

3.2 PIPING INSTALLATION

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems.
 1. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations.
 2. Install piping as indicated unless deviations to layout are approved on coordination drawings.
- B. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.

- C. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- D. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
- E. Install piping to permit valve servicing.
- F. Install piping at indicated slopes.
- G. Install piping free of sags and bends.
- H. Install fittings for changes in direction and branch connections.
- I. Install piping to allow application of insulation.
- J. Install seismic restraints on piping. Comply with requirements for seismic-restraint devices specified in [Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment"] [Section 220548.13 "Vibration Controls for Plumbing Piping and Equipment"].
- K. Make changes in direction for soil and waste drainage and vent piping using appropriate branches, bends, and long-sweep bends.
 - 1. Sanitary tees and short-sweep 1/4 bends may be used on vertical stacks if change in direction of flow is from horizontal to vertical.
 - 2. Use long-turn, double Y-branch, and 1/8-bend fittings if two fixtures are installed back to back or side by side with common drain pipe.
 - a. Straight tees, elbows, and crosses may be used on vent lines.
 - 3. Do not change direction of flow more than 90 degrees.
 - 4. Use proper size of standard increasers and reducers if pipes of different sizes are connected.
 - a. Reducing size of waste piping in direction of flow is prohibited.
- L. Lay buried building waste piping beginning at low point of each system.
 - 1. Install true to grades and alignment indicated, with unbroken continuity of invert. Place hub ends of piping upstream.
 - 2. Install required gaskets according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements.
 - 3. Maintain swab in piping and pull past each joint as completed.
- M. Install soil and waste and vent piping at the following minimum slopes unless otherwise indicated:
 - 1. Building Sanitary Waste: Two percent downward in direction of flow for piping **NPS 3 (DN 80)** and smaller; [1] [2] <Insert number> percent downward in direction of flow for piping **NPS 4 (DN 100)** and larger.
 - 2. Horizontal Sanitary Waste Piping: [Two] <Insert number> percent downward in direction of flow.
 - 3. Vent Piping: [One] <Insert number> percent down toward vertical fixture vent or toward vent stack.
- N. Install cast-iron soil piping in accordance with CISPI's "Cast Iron Soil Pipe and Fittings Handbook," Chapter IV, "Installation of Cast Iron Soil Pipe and Fittings."



1. Install encasement on underground piping in accordance with ASTM A674 or AWWA C105/A 21.5.
- O. Install steel piping in accordance with applicable plumbing code.
- P. Install stainless-steel piping in accordance with ASME A112.3.1 and applicable plumbing code.
- Q. Install aboveground copper tubing in accordance with CDA's "Copper Tube Handbook."
- R. Install aboveground ABS piping in accordance with ASTM D2661.
- S. Install aboveground PVC piping in accordance with ASTM D2665.
- T. Install underground **[ABS]** **[and]** **[PVC]** piping in accordance with ASTM D2321.
- U. Install engineered soil and waste and vent piping systems as follows:
 1. Combination Waste and Vent: Comply with standards of authorities having jurisdiction.
 2. Hubless, Single-Stack Drainage System: Comply with ASME B16.45 and hubless, single-stack aerator fitting manufacturer's written installation instructions.
 3. Reduced-Size Venting: Comply with standards of authorities having jurisdiction.
- V. Install underground, ductile-iron, force-main piping according to AWWA C600.
 1. Install buried piping inside building between wall and floor penetrations and connection to sanitary sewer piping outside building with restrained joints.
 2. Anchor pipe to wall or floor. Install thrust-block supports at vertical and horizontal offsets.
 3. Install encasement on piping in accordance with ASTM A674 or AWWA C105/A 21.5.
- W. Install underground, copper, force-main tubing in accordance with CDA's "Copper Tube Handbook."
 1. Install encasement on piping in accordance with ASTM A674 or AWWA C105/A 21.5.
- X. Install force mains at elevations indicated.
- Y. Plumbing Specialties:
 1. Install backwater valves in sanitary waster gravity-flow piping.
 - a. Comply with requirements for backwater valves specified in Section 221319 "Sanitary Waste Piping Specialties."
 2. Install cleanouts at grade and extend to where building sanitary drains connect to building sanitary sewers in sanitary waste gravity-flow piping.
 - a. Install cleanout fitting with closure plug inside the building in sanitary drainage force-main piping.
 - b. Comply with requirements for cleanouts specified in Section 221319 "Sanitary Waste Piping Specialties."
 3. Install drains in sanitary waste gravity-flow piping.
 - a. Comply with requirements for drains specified in Section 221319 "Sanitary Waste Piping Specialties."

- Z. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.
- AA. Install sleeves for piping penetrations of walls, ceilings, and floors.
 - 1. Comply with requirements for sleeves specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."
- BB. Install sleeve seals for piping penetrations of concrete walls and slabs.
 - 1. Comply with requirements for sleeve seals specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."
- CC. Install escutcheons for piping penetrations of walls, ceilings, and floors.
 - 1. Comply with requirements for escutcheons specified in Section 220518 "Escutcheons for Plumbing Piping."

3.3 JOINT CONSTRUCTION

- A. Hub-and-Spigot, Cast-Iron Soil Piping Gasketed Joints: Join in accordance with CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for compression joints.
- B. Hub-and-Spigot, Cast-Iron Soil Piping Caulked Joints: Join in accordance with CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for lead-and-oakum caulked joints.
- C. Hubless, Cast-Iron Soil Piping Coupled Joints:
 - 1. Join hubless, cast-iron soil piping in accordance with CISPI 310 and CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for hubless-piping coupling joints.
- D. Threaded Joints: Thread pipe with tapered pipe threads in accordance with ASME B1.20.1.
 - 1. Cut threads full and clean using sharp dies.
 - 2. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
 - a. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
 - b. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged.
 - c. Do not use pipe sections that have cracked or open welds.
- E. Join stainless-steel pipe and fittings with gaskets in accordance with ASME A112.3.1.
- F. Join copper tube and fittings with soldered joints in accordance with ASTM B828. Use ASTM B813, water-flushable, lead-free flux and ASTM B32, lead-free-alloy solder.
- G. Grooved Joints: Cut groove ends of pipe in accordance with AWWA C606. Lubricate and install gasket over ends of pipes or pipe and fitting. Install coupling housing sections over gasket, with keys seated in piping grooves. Install and tighten housing bolts.
- H. Flanged Joints: Align bolt holes. Select appropriate gasket material, size, type, and thickness. Install gasket concentrically positioned. Use suitable lubricants on bolt threads. Torque bolts in cross pattern.

- I. Plastic, Nonpressure-Piping, Solvent-Cement Joints: Clean and dry joining surfaces. Join pipe and fittings in accordance with the following:
 1. Comply with ASTM F402 for safe-handling practice of cleaners, primers, and solvent cements.
 2. ABS Piping: Join in accordance with ASTM D2235 and ASTM D2661 appendixes.
 3. PVC Piping: Join in accordance with ASTM D2855 and ASTM D2665 appendixes.
- J. Joint Restraints and Sway Bracing:
 1. Provide joint restraints and sway bracing for storm drainage piping joints to comply with the following conditions:
 - a. Provide axial restraint for pipe and fittings [5 inches (125 mm)] <Insert dimensions> and larger, upstream and downstream of all changes in direction, branches, and changes in diameter greater than two pipe sizes.
 - b. Provide rigid sway bracing for pipe and fittings [4 inches (100 mm)] <Insert dimensions> and larger, upstream and downstream of all changes in direction 45 degrees and greater.
 - c. Provide rigid sway bracing for pipe and fittings [5 inches (125 mm)] <Insert dimensions> and larger, upstream and downstream of all changes in direction and branch openings.

3.4 SPECIALTY PIPE FITTING INSTALLATION

- A. Transition Couplings:
 1. Install transition couplings at joints of piping with small differences in ODs.
 2. In Waste Drainage Piping: [Unshielded] [Shielded], nonpressure transition couplings.
 3. In Aboveground Force Main Piping: Fitting-type transition couplings.
 4. In Underground Force Main Piping:
 - a. NPS 1-1/2 (DN 40) and Smaller: Fitting-type transition couplings.
 - b. NPS 2 (DN 50) and Larger: Pressure transition couplings.
- B. Dielectric Fittings:
 1. Install dielectric fittings in piping at connections of dissimilar metal piping and tubing.
 2. Dielectric Fittings for [NPS 2 (DN 50)] <Insert pipe size> and Smaller: Use dielectric [nipples] [unions].
 3. Dielectric Fittings for [NPS 2-1/2 to NPS 4 (DN 65 to DN 100)] <Insert pipe size range>: Use dielectric [flanges] [flange kits] [nipples].
 4. Dielectric Fittings for [NPS 5 (DN 125)] <Insert pipe size> and Larger: Use dielectric flange kits.

3.5 VALVE INSTALLATION

- A. General valve installation requirements for general-duty valve installation are specified in the following Sections:
 1. Section 220523.12 "Ball Valves for Plumbing Piping."
 2. Section 220523.13 "Butterfly Valves for Plumbing Piping."
 3. Section 220523.14 "Check Valves for Plumbing Piping."
 4. Section 220523.15 "Gate Valves for Plumbing Piping."
- B. Shutoff Valves:

1. Install shutoff valve on each sewage pump discharge.
 2. Install **[gate]** **[full-port ball]** valve for piping **NPS 2 (DN 50)** and smaller.
 3. Install **[gate]** **<Insert type>** valve for piping **NPS 2-1/2 (DN 65)** and larger.
- C. Check Valves: Install swing check valve, between pump and shutoff valve, on each sewage pump discharge.
- D. Backwater Valves: Install backwater valves in piping subject to backflow.
1. Horizontal Piping: Horizontal backwater valves. **[Use normally closed type unless otherwise indicated.]**
 2. Floor Drains: Drain outlet backwater valves unless drain has integral backwater valve.
 3. Install backwater valves in accessible locations.
 4. Comply with requirements for backwater valve specified in Section 221319 "Sanitary Waste Piping Specialties."

3.6 INSTALLATION OF HANGERS AND SUPPORTS

- A. Comply with requirements for seismic-restraint devices specified in Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment."
- B. Comply with requirements for pipe hanger and support devices and installation specified in **[Section 220529 "Hangers and Supports for Plumbing Piping and Equipment"]** **[Section 220548.13 "Vibration Controls for Plumbing Piping and Equipment"]**.
1. Install **[carbon-steel]** **<Insert material>** pipe hangers for horizontal piping in noncorrosive environments.
 2. Install **[stainless steel]** **[fiberglass]** pipe hangers for horizontal piping in corrosive environments.
 3. Install **[carbon-steel]** **<Insert material>** pipe support clamps for vertical piping in noncorrosive environments.
 4. Install stainless steel pipe support clamps for vertical piping in corrosive environments.
 5. Vertical Piping: MSS Type 8 or Type 42 clamps.
 6. Install individual, straight, horizontal piping runs:
 - a. **100 Ft. (30 m)** and Less: MSS Type 1, adjustable, steel clevis hangers.
 - b. Longer Than **100 Ft. (30 m)**: MSS Type 43, adjustable roller hangers.
 - c. Longer Than **100 Ft. (30 m)** if Indicated: MSS Type 49, spring cushion rolls.
 7. Multiple, Straight, Horizontal Piping Runs **100 Ft. (30 m)** or Longer: MSS Type 44 pipe rolls. Support pipe rolls on trapeze.
 8. Base of Vertical Piping: MSS Type 52 spring hangers.
- C. Install hangers for **[cast-iron]** **[steel]** **[stainless steel]** **[and]** **[copper]** soil piping, with maximum horizontal spacing and minimum rod diameters, to comply with MSS SP-58, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.
- D. Install hangers for **[ABS]** **[and]** **[PVC]** piping, with maximum horizontal spacing and minimum rod diameters, to comply with manufacturer's written instructions, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.
- E. Support horizontal piping and tubing within **12 inches (300 mm)** of each fitting[, valve,] and coupling.
- F. Support vertical runs of **[cast-iron]** **[steel]** **[stainless steel]** **[and]** **[copper]** soil piping to comply with MSS SP-58, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.



- G. Support vertical runs of **[ABS]** **[and]** **[PVC]** piping to comply with manufacturer's written instructions, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.

3.7 CONNECTIONS

- A. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Connect soil and waste piping to exterior sanitary sewerage piping. Use transition fitting to join dissimilar piping materials.
- C. Connect waste and vent piping to the following:
1. Plumbing Fixtures: Connect waste piping in sizes indicated, but not smaller than required by plumbing code.
 2. Plumbing Fixtures and Equipment: Connect atmospheric vent piping in sizes indicated, but not smaller than required by authorities having jurisdiction.
 3. Plumbing Specialties: Connect waste and vent piping in sizes indicated, but not smaller than required by plumbing code.
 4. Install test tees (wall cleanouts) in conductors near floor and floor cleanouts with cover flush with floor.
 5. Install horizontal backwater valves **[with cleanout cover flush with floor]** **[in pit with pit cover flush with floor]** **<Insert description>**.
 6. Comply with requirements for **[backwater valves]** **[cleanouts]** **[and]** **[drains]** specified in Section 221319 "Sanitary Waste Piping Specialties."
 7. Equipment: Connect waste piping as indicated.
 - a. Provide shutoff valve if indicated and union for each connection.
 - b. Use flanges instead of unions for connections **NPS 2-1/2 (DN 65)** and larger.
- D. Connect force-main piping to the following:
1. Sanitary Sewer: To exterior force main.
 2. Sewage Pump: To sewage pump discharge.
- E. Where installing piping adjacent to equipment, allow space for service and maintenance of equipment.
- F. Make connections in accordance with the following unless otherwise indicated:
1. Install unions, in piping **NPS 2 (DN 50)** and smaller, adjacent to each valve and at final connection to each piece of equipment.
 2. Install flanges, in piping **NPS 2-1/2 (DN 65)** and larger, adjacent to flanged valves and at final connection to each piece of equipment.

3.8 IDENTIFICATION

- A. Identify exposed sanitary waste and vent piping.
- B. Comply with requirements for identification specified in Section 220553 "Identification for Plumbing Piping and Equipment."

3.9 FIELD QUALITY CONTROL

- A. During installation, notify authorities having jurisdiction at least 24 hours before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction.
 - 1. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in and before setting fixtures.
 - 2. Final Inspection: Arrange for final inspection by authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.
- B. Reinspection: If authorities having jurisdiction find that piping will not pass test or inspection, make required corrections and arrange for reinspection.
- C. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.
- D. Test sanitary waste and vent piping in accordance with procedures of authorities having jurisdiction or, in absence of published procedures, as follows:
 - 1. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired.
 - a. If testing is performed in segments, submit separate report for each test, complete with diagram of portion of piping tested.
 - 2. Leave uncovered and unconcealed new, altered, extended, or replaced waste and vent piping until it has been tested and approved.
 - a. Expose work that was covered or concealed before it was tested.
 - 3. Roughing-in Plumbing Test Procedure: Test waste and vent piping except outside leaders on completion of roughing-in.
 - a. Close openings in piping system and fill with water to point of overflow, but not less than **10 ft. head of water (30 kPa head of water)**.
 - b. From 15 minutes before inspection starts to completion of inspection, water level must not drop.
 - c. Inspect joints for leaks.
 - 4. Finished Plumbing Test Procedure: After plumbing fixtures have been set and traps filled with water, test connections and prove they are gastight and watertight.
 - a. Plug vent-stack openings on roof and building drains where they leave building. Introduce air into piping system equal to pressure of **1 inch wg (250 Pa)**.
 - b. Use U-tube or manometer inserted in trap of water closet to measure this pressure.
 - c. Air pressure must remain constant without introducing additional air throughout period of inspection.
 - d. Inspect plumbing fixture connections for gas and water leaks.
 - 5. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.
 - 6. Prepare reports for tests and required corrective action.
- E. Test force-main piping in accordance with procedures of authorities having jurisdiction or, in absence of published procedures, as follows:

1. Leave uncovered and unconcealed new, altered, extended, or replaced force-main piping until it has been tested and approved.
 - a. Expose work that was covered or concealed before it was tested.
2. Cap and subject piping to static-water pressure of **50 psig (345 kPa)** above operating pressure, without exceeding pressure rating of piping system materials.
 - a. Isolate test source and allow to stand for four hours.
 - b. Leaks and loss in test pressure constitute defects that must be repaired.
3. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.
4. Prepare reports for tests and required corrective action.

3.10 CLEANING AND PROTECTION

- A. Clean interior of piping. Remove dirt and debris as work progresses.
- B. Protect sanitary waste and vent piping during remainder of construction period to avoid clogging with dirt and debris and to prevent damage from traffic and construction work.
- C. Place plugs in ends of uncompleted piping at end of day and when work stops.
- D. Exposed **[ABS]** **[and]** **[PVC]** Piping: Protect plumbing vents exposed to sunlight with two coats of water-based latex paint.
- E. Repair damage to adjacent materials caused by waste and vent piping installation.

3.11 PIPING SCHEDULE

- A. Flanges and unions may be used on aboveground pressure piping unless otherwise indicated.
- B. Aboveground, soil and waste piping **[NPS 4 (DN 100) and smaller]** <Insert pipe size range> are to be **[any of]** the following:
 1. Service cast-iron soil pipe and fittings; gaskets; and gasketed joints.
 2. Hubless, cast-iron soil pipe and fittings **[and hubless, single-stack aerator fittings]; [CISPI]** **[heavy-duty]** hubless-piping couplings; and coupled joints.
 3. Galvanized-steel pipe, drainage fittings, and threaded joints.
 4. Stainless steel pipe and fittings, sealing rings, and gasketed joints.
 5. Copper Type DWV tube, copper drainage fittings, and soldered joints.
 6. **[Solid-wall]** **[Cellular-core]** ABS pipe, ABS socket fittings, and solvent-cemented joints.
 7. **[Solid-wall]** **[Cellular-core]** PVC pipe, PVC socket fittings, and solvent-cemented joints.
 8. Dissimilar Pipe-Material Couplings: **[Unshielded]** **[Shielded]**, nonpressure transition couplings.
- C. Aboveground, soil and waste piping **[NPS 5 (DN 125) and larger]** <Insert pipe size range> are to be **[any of]** the following:
 1. Service cast iron, cast-iron soil pipe and fittings; gaskets; and gasketed joints.
 2. Hubless, cast-iron soil pipe and fittings **[and hubless, single-stack aerator fittings]; [CISPI]** **[heavy-duty]** hubless-piping couplings; and coupled joints.

3. Galvanized-steel pipe, drainage fittings, and threaded joints.
 4. Stainless steel pipe and fittings, sealing rings, and gasketed joints.
 5. **[Solid-wall]** **[Cellular-core]** PVC pipe, PVC socket fittings, and solvent-cemented joints.
 6. Dissimilar Pipe-Material Couplings: **[Unshielded]** **[Shielded]**, nonpressure transition couplings.
- D. Aboveground, vent piping **[NPS 4 (DN 100) and smaller]** <Insert pipe size range> is to be **[any of]** the following:
1. Service cast iron, cast-iron soil pipe and fittings; gaskets; and gasketed joints.
 2. Hubless, cast-iron soil pipe and fittings; **[CISPI]** **[heavy-duty]** hubless-piping couplings; and coupled joints.
 3. Galvanized-steel pipe, drainage fittings, and threaded joints.
 4. Stainless steel pipe and fittings gaskets, and gasketed joints.
 5. Copper Type DWV tube, copper drainage fittings, and soldered joints.
 - a. Option for Vent Piping, **NPS 2-1/2 and NPS 3-1/2 (DN 65 and DN 90)**: Hard copper tube, **Type M (Type C)**; copper pressure fittings; and soldered joints.
 6. **[Solid-wall]** **[Cellular-core]** ABS pipe, ABS socket fittings, and solvent-cemented joints.
 7. **[Solid-wall]** **[Cellular-core]** PVC pipe, PVC socket fittings, and solvent-cemented joints.
 8. Dissimilar Pipe-Material Couplings: **[Unshielded]** **[Shielded]**, nonpressure transition couplings.
- E. Aboveground, vent piping **[NPS 5 (DN 125) and larger]** <Insert pipe size range> is to be **[any of]** the following:
1. Service cast iron, cast-iron soil pipe and fittings; gaskets; and gasketed joints.
 2. Hubless, cast-iron soil pipe and fittings; **[CISPI]** **[heavy-duty]** hubless-piping couplings; and coupled joints.
 3. Galvanized-steel pipe, drainage fittings, and threaded joints.
 4. **[Solid-wall]** **[Cellular-core]** PVC pipe, PVC socket fittings, and solvent-cemented joints.
 5. Dissimilar Pipe-Material Couplings: **[Unshielded]** **[Shielded]**, nonpressure transition couplings.
- F. Underground, soil, waste, and vent piping **[NPS 4 (DN 100) and smaller]** <Insert pipe size range> are to be **[any of]** the following:
1. **[Extra-heavy]** **[Service]** cast-iron soil piping; **[gaskets; and gasketed]** **[caulking materials; and caulked]** joints.
 2. Hubless, cast-iron soil pipe and fittings; **[CISPI]** **[heavy-duty]** **[cast-iron]** hubless-piping couplings; and coupled joints.
 3. Stainless steel pipe and fittings, gaskets, and gasketed joints.
 4. **[Solid-wall]** **[Cellular-core]** ABS pipe, ABS socket fittings, and solvent-cemented joints.
 5. **[Solid-wall]** **[Cellular-core]** PVC pipe, PVC socket fittings, and solvent-cemented joints.
 6. Dissimilar Pipe-Material Couplings: **[Unshielded]** **[Shielded]**, nonpressure transition couplings.
- G. Underground, soil and waste piping **[NPS 5 (DN 125) and larger]** <Insert pipe size range> are to be **[any of]** the following:
1. **[Extra-heavy]** **[Service]**, cast-iron soil piping; **[gaskets; and gasketed]** **[caulking materials; and caulked]** joints.
 2. Hubless, cast-iron soil pipe and fittings; **[CISPI]** **[heavy-duty]** **[cast-iron]** hubless-piping couplings; coupled joints.
 3. **[Solid-wall]** **[Cellular-core]** PVC pipe, PVC socket fittings, and solvent-cemented joints.
 4. Dissimilar Pipe-Material Couplings: **[Unshielded]** **[Shielded]**, nonpressure transition couplings.
- H. Aboveground sanitary-sewage force mains **[NPS 1-1/2 and NPS 2 (DN 40 and DN 50)]** <Insert pipe size range> are to be **[any of]** the following:



1. Hard copper tube, **Type L (Type B)**; copper pressure fittings; and soldered joints.
 2. Galvanized-steel pipe, pressure fittings, and threaded joints.
- I. Aboveground sanitary-sewage force mains [**NPS 2-1/2 to NPS 6 (DN 65 to DN 150)**] <Insert pipe size range> are to be[**any of**] the following:
1. Hard copper tube, **Type L (Type B)**; copper pressure fittings; and soldered joints.
 2. Galvanized-steel pipe, pressure fittings, and threaded joints.
 3. Grooved-end, galvanized-steel pipe; grooved-joint, galvanized-steel-pipe appurtenances; and grooved joints.
- J. Underground sanitary-sewage force mains [**NPS 4 (DN 100) and smaller**] <Insert pipe size range> are to be[**any of**] the following:
1. [**Hard**] [**Soft**] copper tube, **Type L (Type B)**; [**wrought**]-copper pressure fittings; and soldered joints.
 2. Ductile-iron, mechanical-joint piping and mechanical joints.
 3. Ductile-iron, push-on-joint piping and push-on joints.
 4. Ductile-iron, grooved-joint piping and grooved joints.
 5. Fitting-type transition coupling for piping smaller than **NPS 1-1/2 (DN 40)** and pressure transition coupling for **NPS 1-1/2 (DN 40)** and larger if dissimilar pipe materials.
- K. Underground sanitary-sewage force mains [**NPS 5 (DN 125) and larger**] <Insert pipe size range> are to be[**any of**] the following:
1. Hard copper tube, **Type L (Type B)**; [**wrought**]-copper pressure fittings; and soldered joints.
 2. Ductile-iron, mechanical-joint piping and mechanical joints.
 3. Ductile-iron, push-on-joint piping and push-on joints.
 4. Ductile-iron, grooved-joint piping and grooved joints.
 5. Pressure transition couplings if dissimilar pipe materials.

END OF SECTION 22 11 16 00a

SECTION 22 11 16 00b - STORM DRAINAGE PIPING

1.1 GENERAL

A. Description Of Work

1. This specification covers the furnishing and installation of materials for storm drainage piping. Products shall be as follows or as directed by the Owner. Installation procedures shall be in accordance with the products manufacturer's recommendations. Demolition and removal of materials shall be as required to support the work.

B. Summary

1. Section includes:
 - a. Pipe, tube, and fittings.
 - b. Special pipe fittings.
 - c. Encasement for underground metal piping.

C. Performance Requirements

1. Components and installation shall be capable of withstanding the following minimum working-pressure, unless otherwise indicated:
 - a. Storm Drainage Piping: 10-foot head of water (30 kPa).
 - b. Storm Drainage, Force-Main Piping: 50 psig (345 kPa) OR 100 psig (690 kPa) OR 150 psig (1035 kPa), as directed.
2. Seismic Performance: Soil, waste, and vent piping and support and installation shall be capable of withstanding the effects of seismic events determined according to ASCE 7, "Minimum Design Loads for Buildings and Other Structures."

D. Submittals

1. Product Data: For each type of product indicated.
2. LEED Submittal:
 - a. Product Data for Credit EQ 4.1: For solvent cements and adhesive primers, including printed statement of VOC content.
3. Shop Drawings: For controlled-flow OR siphonic roof drainage system, as directed by the Owner. Include calculations, plans, and details. Controlled-Flow Storm Drainage System: Include calculations, plans, and details.
4. Seismic Qualification Certificates: For storm drainage piping, accessories, and components, from manufacturer.
 - a. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
 - b. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
5. Field quality-control inspection and test reports.

E. Quality Assurance

1. Piping materials shall bear label, stamp, or other markings of specified testing agency.
2. Comply with NSF 14, "Plastics Piping Systems Components and Related Materials," for plastic piping components. Include marking with "NSF-drain" for plastic drain piping and "NSF-sewer" for plastic sewer piping.

F. Project Conditions

1. Interruption of Existing Storm-Drainage Service: Do not interrupt service to facilities occupied by the Owner or others unless permitted under the following conditions and then only after arranging to provide temporary service according to requirements indicated:
 - a. Notify the Owner no fewer than two days in advance of proposed interruption of storm-drainage service.



- b. Do not proceed with interruption of storm-drainage service without the Owner's written permission.

1.2 PRODUCTS

A. Piping Materials

- 1. Refer to Part 1.3 "Piping Applications" Article for applications of pipe, tube, fitting, and joining methods for specific services, service locations, and pipe sizes.

B. Hub-And-Spigot, Cast-Iron Soil Pipe And Fittings

- 1. Pipe and Fittings: ASTM A 74, Service and Extra-Heavy class(es).
- 2. Gaskets: ASTM C 564, rubber.
- 3. Calking Materials: ASTM B 29, pure lead and oakum or hemp fiber.

C. Hubless Cast-Iron Soil Pipe And Fittings

- 1. Pipe and Fittings: ASTM A 888 or CISPI 301.
- 2. Shielded Couplings: ASTM C 1277 assembly of metal shield or housing, corrosion-resistant fasteners, and rubber sleeve with integral, center pipe stop.
 - a. Standard, Shielded, Stainless-Steel Couplings: CISPI 310, with stainless-steel corrugated shield; stainless-steel bands and tightening devices; and ASTM C 564, rubber sleeve.
 - b. Heavy-Duty, Shielded, Stainless-Steel Couplings: With stainless-steel shield, stainless-steel bands and tightening devices, and ASTM C 564, rubber sleeve.
 - c. Heavy-Duty, Shielded, Cast-Iron Couplings: ASTM A 48/A 48M, two-piece, cast-iron housing; stainless-steel bolts and nuts; and ASTM C 564, rubber sleeve.
- 3. Rigid, Unshielded Couplings: ASTM C 1461, sleeve-type, reducing- or transition-type mechanical coupling molded from ASTM C 1440, TPE material with corrosion-resistant-metal tension band and tightening mechanism on each end.

D. Galvanized-Steel Pipe And Fittings

- 1. Steel Pipe: ASTM A 53/A 53M, Type E or S, Grade A or B, Standard Weight or Schedule 40, galvanized. Include ends matching joining method.
- 2. Drainage Fittings: ASME B16.12, galvanized, **as directed**, threaded, cast-iron drainage pattern.
- 3. Pressure Fittings:
 - a. Steel Pipe Nipples: ASTM A 733, made of ASTM A 53/A 53M or ASTM A 106, Schedule 40, galvanized, seamless steel pipe. Include ends matching joining method.
 - b. Malleable-Iron Unions: ASME B16.39; Class 150; hexagonal-stock body with ball-and-socket, metal-to-metal, bronze seating surface; and female threaded ends.
 - c. Gray-Iron, Threaded Fittings: ASME B16.4, Class 125, galvanized, **as directed**, standard pattern.
 - d. Cast-Iron Flanges: ASME B16.1, Class 125.
 - e. Cast-Iron, Flanged Fittings: ASME B16.1, Class 125, galvanized, **as directed**.
- 4. Grooved-Joint Systems:
 - a. Grooved-End, Steel-Piping Fittings: ASTM A 47/A 47M, galvanized, **as directed**, malleable-iron casting; ASTM A 106, galvanized-steel pipe; or ASTM A 536, galvanized, **as directed**, ductile-iron casting; with dimensions matching steel pipe.
 - b. Grooved-End, Steel-Piping Couplings: AWWA C606, for steel-pipe dimensions. Include ferrous housing sections, gasket suitable for water, and bolts and nuts.

E. Ductile-Iron, Pipe and Fittings

- 1. Ductile-Iron, Mechanical-Joint Piping
 - a. Ductile-Iron Pipe: AWWA C151/A21.51, with mechanical-joint bell and plain spigot end, unless grooved or flanged ends are indicated.
 - b. Ductile-Iron Fittings: AWWA C110/A21.10, mechanical-joint ductile- or gray-iron standard pattern or AWWA C153/A21.53, ductile-iron compact pattern.

- c. Glands, Gaskets, and Bolts: AWWA C111/A121.11, ductile- or gray-iron glands, rubber gaskets, and steel bolts.
 2. Ductile-Iron, Push-on-Joint,
 - a. Ductile-Iron Pipe: AWWA C151/A21.51, with push-on-joint bell and plain spigot end, unless grooved or flanged ends are indicated.
 - b. Ductile-Iron Fittings: AWWA C110/A21.10, ductile- or gray-iron standard pattern or AWWA C153/A21.53, ductile-iron compact pattern.
 - c. Gaskets: AWWA C111/A21.11, rubber.
 3. Ductile Iron, Grooved-Joint Piping:
 - a. Ductile-Iron Pipe: AWWA C151/A21.51 with round-cut-grooved ends according to AWWA C606.
 - b. Ductile-Iron-Pipe Appurtenances:
 - 1) Grooved-End, Ductile-Iron Fittings: ASTM A 536, ductile-iron castings with dimensions matching pipe. AWWA C110/A21.10 ductile-iron pipe or AWWA C153/A21.53 ductile-iron fittings and complying with AWWA C606 for grooved ends.
 - 2) Grooved Mechanical Couplings for Ductile-Iron Pipe: ASTM F 1476, Type I. Include ferrous housing sections with continuous curved keys, EPDM-rubber center-leg gasket suitable for hot and cold water, and bolts and nuts.
- F. Copper Tube And Fittings
 1. Copper DWV Tube: ASTM B 306, drainage tube, drawn temper.
 2. Copper Drainage Fittings: ASME B16.23, cast-copper or ASME B16.29, wrought-copper, solder-joint fittings.
 3. Hard Copper Tube: ASTM B 88, Types L and M (ASTM B 88M, Types B and C), water tube, drawn temper.
 4. Soft Copper Tube: ASTM B 88, Type L (ASTM B 88M, Type B), water tube, annealed temper.
 5. Copper Pressure Fittings:
 - a. Copper Pressure Fittings: ASME B16.18, cast-copper-alloy or ASME B16.22, wrought-copper, solder-joint fittings. Furnish wrought-copper fittings if indicated.
 - b. Copper Unions: MSS SP-123, copper-alloy, hexagonal-stock body with ball-and-socket, metal-to-metal seating surfaces, and solder-joint or threaded ends.
 6. Copper Flanges: ASME B16.24, Class 150, cast copper with solder-joint end.
 - a. Flange Gasket Materials: ASME B16.21, full-face, flat, nonmetallic, asbestos-free, 1/8-inch (3.2-mm) maximum thickness unless thickness or specific material is indicated.
 - b. Flange Bolts and Nuts: ASME B18.2.1, carbon steel unless otherwise indicated.
 7. Solder: ASTM B 32, lead free with ASTM B 813, water-flushable flux.
- G. ABS Pipe And Fittings
 1. Solid-Wall ABS Pipe: ASTM D 2661, Schedule 40.
 2. Cellular-Core ABS Pipe: ASTM F 628, Schedule 40.
 3. ABS Socket Fittings: ASTM D 2661, made to ASTM D 3311, drain, waste, and vent patterns.
 4. Solvent Cement: ASTM D 2235
 - a. Use ABS solvent cement that has a VOC content of 325 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- H. PVC Pipe And Fittings
 1. Solid-Wall PVC Pipe: ASTM D 2665, drain, waste, and vent.
 2. Cellular-Core PVC Pipe: ASTM F 891, Schedule 40.
 3. PVC Socket Fittings: ASTM D 2665, made to ASTM D 3311, drain, waste, and vent patterns and to fit Schedule 40 pipe.
 4. Adhesive Primer: ASTM F 656.
 - a. Use adhesive primer that has a VOC content of 550 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 5. Solvent Cement: ASTM D 2564.



- a. Use PVC solvent cement that has a VOC content of 510 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

I. Specialty Pipe Fittings

1. Transition Couplings:

- a. General Requirements: Fitting or device for joining piping with small differences in OD's or of different materials. Include end connections same size as and compatible with pipes to be joined.
- b. Fitting-Type Transition Couplings: Manufactured piping coupling or specified-piping-system fitting.
- c. Unshielded, Nonpressure Transition Couplings:
 - 1) Standard: ASTM C 1173.
 - 2) Description: Elastomeric, sleeve-type, reducing or transition pattern. Include shear ring and corrosion-resistant-metal tension band and tightening mechanism on each end.
 - 3) Sleeve Materials:
 - a) For Cast-Iron Soil Pipes: ASTM C 564, rubber.
 - b) For Plastic Pipes: ASTM F 477, elastomeric seal or ASTM D 5926, PVC.
 - c) For Dissimilar Pipes: ASTM D 5926, PVC or other material compatible with pipe materials being joined.
- d. Shielded, Nonpressure Transition Couplings:
 - 1) Standard: ASTM C 1460.
 - 2) Description: Elastomeric or rubber sleeve with full-length, corrosion-resistant outer shield and corrosion-resistant-metal tension band and tightening mechanism on each end.
- e. Pressure Transition Couplings:
- f. Standard: AWWA C219.
- g. Description: Metal, sleeve-type couplings same size as, with pressure rating at least equal to and ends compatible with, pipes to be joined.
- h. Center-Sleeve Material: Manufacturer's standard **OR** Carbon steel **OR** Stainless steel **OR** Ductile iron **OR** Malleable iron, **as directed**.
- i. Gasket Material: Natural or synthetic rubber.
- j. Metal Component Finish: Corrosion-resistant coating or material.

2. Dielectric Fittings:

- a. General Requirements: Assembly of copper alloy and ferrous materials with separating nonconductive insulating material. Include end connections compatible with pipes to be joined.
- b. Dielectric Unions:
 - 1) Description:
 - a) Standard: ASSE 1079.
 - b) Pressure Rating: **150 psig (1035 kPa) OR 250 psig (1725 kPa)** at **180 deg F (82 deg C)**, **as directed**.
 - c) End Connections: Solder-joint copper alloy and threaded ferrous.
- c. Dielectric Flanges:
 - 1) Description:
 - a) Standard: ASSE 1079.
 - b) Factory-fabricated, bolted, companion-flange assembly.
 - c) Pressure Rating: **150 psig (1035 kPa) OR 175 psig (1200 kPa)** minimum **OR 300 psig (2070 kPa)**, **as directed**.
 - d) End Connections: Solder-joint copper alloy and threaded ferrous; threaded solder-joint copper alloy and threaded ferrous.
- d. Dielectric-Flange Insulating Kits:
 - 1) Description:
 - a) Nonconducting materials for field assembly of companion flanges.

- b) Pressure Rating: **150 psig (1035 kPa)**
- c) Gasket: Neoprene or phenolic.
- d) Bolt Sleeves: Phenolic or polyethylene.
- e) Washers: Phenolic with steel-backing washers.
- e. Dielectric Nipples:
 - 1) Description:
 - a) Electroplated steel nipple complying with ASTM F 1545.
 - b) Pressure Rating: **300 psig (2070 kPa) at 225 deg F (107 deg C).**
 - c) End Connections: Male threaded or grooved.
 - d) Lining: Inert and noncorrosive, propylene.

J. Encasement For Underground Metal Piping

- 1. Description: ASTM A 674 or AWWA C105
- 2. Material: High-density, crosslaminated PE film of **0.004-inch (0.10-mm) OR LLDPE film of 0.008-inch (0.20-mm), as directed**, minimum thickness.
- 3. Form: Sheet **OR** Tube, **as directed**.
- 4. Color: Black **OR** Natural, **as directed**.

1.3 EXECUTION

A. Earth Moving

- 1. Refer to Division 31 Section "Earth Moving" for excavating, trenching, and backfilling.

B. Piping Installation

- 1. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations from layout are approved on coordination drawings.
- 2. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.
- 3. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- 4. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
- 5. Install piping to permit valve servicing.
- 6. Install piping at indicated slopes.
- 7. Install piping free of sags and bends.
- 8. Install fittings for changes in direction and branch connections.
- 9. Install piping to allow application of insulation.
- 10. Install seismic restraints on piping. Comply with requirements for seismic-restraint devices specified in Division 22 Section "Vibration And Seismic Controls For Plumbing Piping And Equipment".
- 11. Make changes in direction for storm drainage piping using appropriate branches, bends, and long-sweep bends. Do not change direction of flow more than 90 degrees. Use proper size of standard increasers and reducers if pipes of different sizes are connected. Reducing size of drainage piping in direction of flow is prohibited.
- 12. Lay buried building storm drainage piping beginning at low point of each system. Install true to grades and alignment indicated, with unbroken continuity of invert. Place hub ends of piping upstream. Install required gaskets according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements. Maintain swab in piping and pull past each joint as completed.
- 13. Install storm drainage piping at the following minimum slopes unless otherwise indicated:
 - a. Building Storm Drain: 1 percent **OR** 2 percent, **as directed**, downward in direction of flow for piping **NPS 3 (DN 80)** and smaller; 1 percent **OR** 2 percent, **as directed**, downward in direction of flow for piping **NPS 4 (DN 100)** and larger.

- b. Horizontal Storm-Drainage Piping: **2 percent** downward in direction of flow.
- 14. Install cast-iron soil piping according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook," Chapter IV, "Installation of Cast Iron Soil Pipe and Fittings."
 - a. Install encasement on underground piping according to ASTM A 674 or AWWA C105.
- 15. Install steel piping according to applicable plumbing code.
- 16. Install aboveground copper tubing according to CDA's "Copper Tube Handbook."
- 17. Install aboveground ABS piping according to ASTM D 2661.
- 18. Install aboveground PVC piping according to ASTM D 2665.
- 19. Install underground ABS and PVC piping according to ASTM D 2321.
- 20. Install engineered controlled-flow **OR** siphonic, **as directed**, drain specialties and storm drainage piping in locations indicated.
- 21. Install underground, ductile-iron, force-main piping according to AWWA C600. Install buried piping inside building between wall and floor penetrations and connection to storm sewer piping outside building with restrained joints. Anchor pipe to wall or floor. Install thrust-block supports at vertical and horizontal offsets.
 - a. Install encasement on piping according to ASTM A 674 or AWWA C105.
- 22. Install underground, copper, force-main tubing according to CDA's "Copper Tube Handbook."
 - a. Install encasement on piping according to ASTM A 674 or AWWA C105.
- 23. Install force mains at elevations indicated.
- 24. Plumbing Specialties:
 - a. Install backwater valves in storm drainage gravity-flow piping. Comply with requirements for backwater valves specified in Division 33 Section "Storm Utility Drainage Piping".
 - b. Install cleanouts at grade and extend to where building storm drains connect to building storm sewers in storm drainage gravity-flow piping. Install cleanout fitting with closure plug inside the building in storm drainage force-main piping. Comply with requirements for cleanouts specified in Division 33 Section "Storm Utility Drainage Piping".
 - c. Install drains in storm drainage gravity-flow piping. Comply with requirements for drains specified in Division 33 Section "Storm Utility Drainage Piping".
- 25. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.
- 26. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Division 22 Section "Common Work Results For Plumbing".
- 27. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Division 22 Section "Common Work Results For Plumbing".
- 28. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Division 22 Section "Common Work Results For Plumbing".

C. Joint Construction

- 1. Basic piping joint construction requirements are specified in Division 22 Section "Common Work Results For Plumbing".
- 2. Hub-and-Spigot, Cast-Iron Soil Piping Gasketed Joints: Join according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for compression joints.
- 3. Hub-and-Spigot, Cast-Iron Soil Piping Calked Joints: Join according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for lead and oakum calked joints.
- 4. Hubless Cast-Iron Soil Piping Coupled Joints: Join according to CISPI 310 and CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for hubless-coupling joints.
- 5. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
 - a. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
 - b. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.

6. Join copper tube and fittings with soldered joints according to ASTM B 828 procedure. Use ASTM B 813, water-flushable, lead-free flux and ASTM B 32, lead-free-alloy solder.
 7. Grooved Joints: Cut groove ends of pipe according to AWWA C606. Lubricate and install gasket over ends of pipes or pipe and fittings. Install coupling housing sections, over gasket, with keys seated in piping grooves. Install and tighten housing bolts.
 8. Flanged Joints: Align bolt holes. Select appropriate gasket material, size, type, and thickness. Install gasket concentrically positioned. Use suitable lubricants on bolt threads. Torque bolts in cross pattern.
 9. Plastic, Nonpressure-Piping, Solvent-Cemented Joints: Clean and dry joining surfaces. Join pipe and fittings according to the following:
 - a. Comply with ASTM F 402 for safe-handling practice of cleaners, primers, and solvent cements.
 - b. ABS Piping: Join according to ASTM D 2235 and ASTM D 2661 Appendixes.
 - c. PVC Piping: Join according to ASTM D 2855 and ASTM D 2665 Appendixes.
- D. Specialty Pipe Fitting Installation
1. Transition Couplings:
 - a. Install transition couplings at joints of piping with small differences in OD's.
 - b. In Drainage Piping: Unshielded **OR** Shielded, **as directed** nonpressure transition couplings.
 - c. In Aboveground Force-Main Piping: Fitting-type transition couplings.
 - d. In Underground Force-Main Piping:
 - 1) **NPS 1-1/2 (DN 40)** and Smaller: Fitting-type transition couplings.
 - 2) **NPS 2 (DN 50)** and Larger: Pressure transition couplings.
 2. Dielectric Fittings:
 - a. Install dielectric fittings in piping at connections of dissimilar metal piping and tubing.
 - b. Dielectric Fittings for **NPS 2 (DN 50)** and Smaller: Use dielectric nipples **OR** unions, **as directed**.
 - c. Dielectric Fittings for **NPS 2-1/2 to NPS 4 (DN 65 to DN 100)**: Use dielectric flanges **OR** flange kits **OR** nipples, **as directed**.
 - d. Dielectric Fittings for **NPS 5 (DN 125)** and Larger: Use dielectric flange kits.
- E. Valve Installation
1. General valve installation requirements are specified in Division 22 Section "General-duty Valves For Plumbing Piping".
 2. Shutoff Valves: Install shutoff valve on each sump pump discharge.
 - a. Install gate or full-port ball valve for piping **NPS 2 (DN 50)** and smaller.
 - b. Install gate valve for piping **NPS 2-1/2 (DN 65)** and larger.
 3. Check Valves: Install swing check valve, between pump and shutoff valve, on each sump pump discharge.
 4. Backwater Valves: Install backwater valves in piping subject to backflow.
 - a. Horizontal Piping: Horizontal backwater valves. Use normally closed type, unless otherwise indicated.
 - b. Install backwater valves in accessible locations.
 - c. Comply with requirements for backwater valve specified in Division 22 Section "Storm Drainage Piping Specialties".
- F. Hanger And Support Installation
1. Comply with requirements for seismic-restraint devices specified in Division 22 Section "Vibration And Seismic Controls For Plumbing Piping And Equipment".
 2. Comply with requirements for pipe hangers and supports and installation specified in Division 22 Section "Hangers And Supports For Plumbing Piping And Equipment".
 - a. Install carbon-steel pipe hangers for horizontal piping in noncorrosive environments.
 - b. Install stainless-steel **OR** fiberglass pipe hangers, **as directed**, for horizontal piping in corrosive environments.
 - c. Install carbon-steel pipe support clamps for vertical piping in noncorrosive environments.

- d. Install stainless-steel pipe support clamps for vertical piping in corrosive environments.
- e. Vertical Piping: MSS Type 8 or Type 42, clamps.
- f. Individual, Straight, Horizontal Piping Runs:
 - 1) 100 Feet (30 m) and Less: MSS Type 1, adjustable, steel clevis hangers.
 - 2) Longer Than 100 Feet (30 m): MSS Type 43, adjustable roller hangers.
 - 3) Longer Than 100 Feet (30 m), if Indicated: MSS Type 49, spring cushion rolls.
- g. Multiple, Straight, Horizontal Piping Runs 100 Feet (30 m) or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
- h. Base of Vertical Piping: MSS Type 52, spring hangers.
3. Support horizontal piping and tubing within 12 inches (300 mm) of each fitting, valve, and coupling.
4. Support vertical piping and tubing at base and at each floor.
5. Rod diameter may be reduced 1 size for double-rod hangers, with 3/8-inch (10-mm) minimum rods.
6. Install hangers for cast-iron soil piping with the following maximum horizontal spacing and minimum rod diameters:
 - a. NPS 1-1/2 and NPS 2 (DN 40 and DN 50): 60 inches (1500 mm) with 3/8-inch (10-mm) rod.
 - b. NPS 3 (DN 80): 60 inches (1500 mm) with 1/2-inch (13-mm) rod.
 - c. NPS 4 and NPS 5 (DN 100 and DN 125): 60 inches (1500 mm) with 5/8-inch (16-mm) rod.
 - d. NPS 6 (DN 150): 60 inches (1500 mm) with 3/4-inch (19-mm) rod.
 - e. NPS 8 to NPS 12 (DN 200 to DN 300): 60 inches (1500 mm) with 7/8-inch (22-mm) rod.
 - f. Spacing for 10-foot (3-m) lengths may be increased to 10 feet (3 m). Spacing for fittings is limited to 60 inches (1500 mm).
7. Install supports for vertical cast-iron soil piping every 15 feet (4.5 m).
8. Install hangers for steel piping with the following maximum horizontal spacing and minimum rod diameters:
 - a. NPS 1-1/4 (DN 32): 84 inches (2100 mm) with 3/8-inch (10-mm) rod.
 - b. NPS 1-1/2 (DN 40): 108 inches (2700 mm) with 3/8-inch (10-mm) rod.
 - c. NPS 2 (DN 50): 10 feet (3 m) with 3/8-inch (10-mm) rod.
 - d. NPS 2-1/2 (DN 65): 11 feet (3.4 m) with 1/2-inch (13-mm) rod.
 - e. NPS 3 (DN 80): 12 feet (3.7 m) with 1/2-inch (13-mm) rod.
 - f. NPS 4 and NPS 5 (DN 100 and DN 125): 12 feet (3.7 m) with 5/8-inch (16-mm) rod.
 - g. NPS 6 (DN 150): 12 feet (3.7 m) with 3/4-inch (19-mm) rod.
 - h. NPS 8 to NPS 12 (DN 200 to DN 300): 12 feet (3.7 m) with 7/8-inch (22-mm) rod.
9. Install supports for vertical steel piping every 15 feet (4.5 m).
10. Install hangers for copper tubing with the following maximum horizontal spacing and minimum rod diameters:
 - a. NPS 1-1/4 (DN 32): 72 inches (1800 mm) with 3/8-inch (10-mm) rod.
 - b. NPS 1-1/2 and NPS 2 (DN 40 and DN 50): 96 inches (2400 mm) with 3/8-inch (10-mm) rod.
 - c. NPS 2-1/2 (DN 65): 108 inches (2700 mm) with 1/2-inch (13-mm) rod.
 - d. NPS 3 to NPS 5 (DN 80 to DN 125): 10 feet (3 m) with 1/2-inch (13-mm) rod.
 - e. NPS 6 (DN 150): 10 feet (3 m) with 5/8-inch (16-mm) rod.
 - f. NPS 8 (DN 200): 10 feet (3 m) with 3/4-inch (19-mm) rod.
11. Install supports for vertical copper tubing every 10 feet (3 m).
12. Install hangers for ABS and PVC piping with the following maximum horizontal spacing and minimum rod diameters:
 - a. NPS 1-1/2 and NPS 2 (DN 40 and DN 50): 48 inches (1200 mm) with 3/8-inch (10-mm) rod.
 - b. NPS 3 (DN 80): 48 inches (1200 mm) with 1/2-inch (13-mm) rod.
 - c. NPS 4 and NPS 5 (DN 100 and DN 125): 48 inches (1200 mm) with 5/8-inch (16-mm) rod.
 - d. NPS 6 (DN 150): 48 inches (1200 mm) with 3/4-inch (19-mm) rod.
 - e. NPS 8 to NPS 12 (DN 200 to DN 300): 48 inches (1200 mm) with 7/8-inch (22-mm) rod.
13. Install supports for vertical ABS and PVC piping every 48 inches (1200 mm).

14. Support piping and tubing not listed above according to MSS SP-69 and manufacturer's written instructions.

G. Connections

1. Drawings indicate general arrangement of piping, fittings, and specialties.
2. Connect interior storm drainage piping to exterior storm drainage piping. Use transition fitting to join dissimilar piping materials.
3. Connect storm drainage piping to roof drains and storm drainage specialties.
 - a. Install test tees (wall cleanouts) in conductors near floor, and floor cleanouts with cover flush with floor.
 - b. Install horizontal backwater valves with cleanout cover flush with floor **OR** in pit with pit cover flush with floor, **as directed**.
 - c. Comply with requirements for backwater valves, cleanouts and drains specified in Division 22 Section "Storm Drainage Piping Specialties".
4. Connect force-main piping to the following:
 - a. Storm Sewer: To exterior force main or storm manhole.
 - b. Sump Pumps: To sump pump discharge.
5. Where installing piping adjacent to equipment, allow space for service and maintenance of equipment.
6. Make connections according to the following unless otherwise indicated:
 - a. Install unions, in piping **NPS 2 (DN 50)** and smaller, adjacent to each valve and at final connection to each piece of equipment.
 - b. Install flanges, in piping **NPS 2-1/2 (DN 65)** and larger, adjacent to flanged valves and at final connection to each piece of equipment.

H. Identification

1. Identify exposed storm drainage piping. Comply with requirements for identification specified in Division 22 Section "Identification For Plumbing Piping And Equipment".

I. Field Quality Control

1. During installation, notify authorities having jurisdiction at least 24 hours before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction.
 - a. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in.
 - b. Final Inspection: Arrange for final inspection by authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.
2. Reinspection: If authorities having jurisdiction find that piping will not pass test or inspection, make required corrections and arrange for reinspection.
3. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.
4. Test storm drainage piping according to procedures of authorities having jurisdiction or, in absence of published procedures, as follows:
 - a. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit separate report for each test, complete with diagram of portion of piping tested.
 - b. Leave uncovered and unconcealed new, altered, extended, or replaced storm drainage piping until it has been tested and approved. Expose work that was covered or concealed before it was tested.
 - c. Test Procedure: Test storm drainage piping, except outside leaders, **as directed**, on completion of roughing-in. Close openings in piping system and fill with water to point of overflow, but not less than **10-foot head of water (30 kPa)**. From 15 minutes before inspection starts to completion of inspection, water level must not drop. Inspect joints for leaks.
 - d. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.
 - e. Prepare reports for tests and required corrective action.

5. Test force-main piping according to procedures of authorities having jurisdiction or, in absence of published procedures, as follows:
 - a. Leave uncovered and unconcealed new, altered, extended, or replaced force-main piping until it has been tested and approved. Expose work that was covered or concealed before it was tested.
 - b. Cap and subject piping to static-water pressure of **50 psig (345 kPa)** above operating pressure, without exceeding pressure rating of piping system materials. Isolate test source and allow to stand for four hours. Leaks and loss in test pressure constitute defects that must be repaired.
 - c. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.
 - d. Prepare reports for tests and required corrective action.

J. Cleaning

1. Clean interior of piping. Remove dirt and debris as work progresses.
2. Protect drains during remainder of construction period to avoid clogging with dirt and debris and to prevent damage from traffic and construction work.
3. Place plugs in ends of uncompleted piping at end of day and when work stops.

K. Piping Schedule

1. Flanges and unions may be used on aboveground pressure piping unless otherwise indicated.
2. Aboveground storm drainage piping **NPS 6 (DN 150)** and smaller shall be any of the following:
 - a. Service class, cast-iron soil pipe and fittings; gaskets; and gasketed joints.
 - b. Hubless, cast-iron soil pipe and fittings; **CISPI, heavy-duty**, hubless-piping couplings; and coupled joints.
 - c. Galvanized-steel pipe, drainage fittings, and threaded joints.
 - d. Copper tube and fittings in first subparagraph below are only available in NPS 1-1/4 to NPS 8 (DN 32 to DN 200).
 - e. Copper DWV tube, copper drainage fittings, and soldered joints.
 - f. Solid-wall **OR** Cellular-core ABS pipe, **as directed**, ABS socket fittings, and solvent-cemented joints.
 - g. Solid-wall **OR** Cellular-core PVC pipe, **as directed**, PVC socket fittings, and solvent-cemented joints.
 - h. Dissimilar Pipe-Material Couplings: Unshielded **OR** Shielded, **as directed**, nonpressure transition couplings.
3. Aboveground, storm drainage piping **NPS 8 (DN 200)** and larger shall be any of the following:
 - a. Service class, cast-iron soil pipe and fittings; gaskets; and gasketed joints.
 - b. Hubless, cast-iron soil pipe and fittings; **CISPI, heavy-duty**, hubless-piping couplings; and coupled joints.
 - c. Galvanized-steel pipe, drainage fittings, and threaded joints.
 - d. Copper DWV tube, copper drainage fittings, and soldered joints.
 - e. Solid-wall **OR** Cellular-core PVC pipe, **as directed**, PVC socket fittings, and solvent-cemented joints.
 - f. Dissimilar Pipe-Material Couplings: Unshielded **OR** Shielded, **as directed**, nonpressure transition couplings.
4. Underground storm drainage piping **NPS 6 (DN 150)** and smaller shall be **any of** the following:
 - a. Extra Heavy **OR** Service class, **as directed**, cast-iron soil pipe and fittings; gaskets; and gasketed **OR** calking materials; and calked joints, **as directed**.
 - b. Hubless, cast-iron soil pipe and fittings; **CISPI, heavy-duty, cast-iron**, hubless-piping couplings; and coupled joints.
 - c. Solid-wall **OR** Cellular-core ABS pipe, **as directed**, ABS socket fittings, and solvent-cemented joints.
 - d. **Solid-wall OR Cellular-core** PVC pipe, **as directed**, PVC socket fittings, and solvent-cemented joints.

- e. Dissimilar Pipe-Material Couplings: Unshielded **OR** Shielded, **as directed**, nonpressure transition couplings.
- 5. Underground, storm drainage piping **NPS 8 (DN 200) and larger** shall be **any of** the following:
 - a. Extra Heavy **OR** Service class, **as directed**, cast-iron soil pipe and fittings; gaskets; and gasketed **OR** calking materials; and calked joints **as directed**.
 - b. Hubless, cast-iron soil pipe and fittings; **CISPI, heavy-duty, cast-iron**, hubless-piping couplings; and coupled joints.
 - c. **Solid-wall OR Cellular-core** PVC pipe, **as directed**, PVC socket fittings, and solvent-cemented joints.
 - d. Cellular-core, sewer and drain series, PVC pipe; PVC socket fittings; and solvent-cemented joints.
 - e. Dissimilar Pipe-Material Couplings: **Unshielded OR Shielded, as directed**, nonpressure transition couplings.
- 6. Aboveground storm drainage force mains **NPS 1-1/2 and NPS 2 (DN 40 and DN 50)** shall be **any of** the following:
 - a. Hard copper tube, copper pressure fittings, and soldered joints.
 - b. Galvanized-steel pipe, pressure fittings, and threaded joints.
- 7. Aboveground storm drainage force mains **NPS 2-1/2 to NPS 6 (DN 65 to DN 150)** shall be any of the following:
 - a. Hard copper tube, copper pressure fittings, and soldered joints.
 - b. Galvanized-steel pipe, pressure fittings, and threaded joints.
 - c. Grooved-end, galvanized-steel pipe; grooved-joint, galvanized-steel-pipe appurtenances; and grooved joints.
 - d. Fitting-type transition couplings if dissimilar pipe materials.
- 8. Underground storm drainage force mains **NPS 4 (DN 100)** and smaller shall be any of the following:
 - a. Hard **OR** Soft, **as directed** copper tube; **wrought-copper** pressure fittings; and soldered joints.
 - b. Ductile-iron, mechanical-joint piping and mechanical joints.
 - c. Ductile-iron, push-on-joint piping and push-on joints.
 - d. Ductile-iron, grooved-joint piping and grooved joints.
 - e. Fitting-type transition coupling for piping smaller than **NPS 1-1/2 (DN 40)** and pressure transition coupling for **NPS 1-1/2 (DN 40)** and larger if dissimilar pipe materials.
- 9. Underground storm drainage force mains **NPS 5 (DN 125)** and larger shall be any of the following:
 - a. Hard copper tube; **wrought-copper** pressure fittings; and soldered joints.
 - b. Ductile-iron, mechanical-joint piping and mechanical joints.
 - c. Ductile-iron, push-on-joint piping and push-on joints.
 - d. Ductile-iron, grooved-joint piping and grooved joints.
 - e. Pressure transition couplings if dissimilar pipe materials.

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SECTION 22 11 16 00c - HYDRONIC PIPING

1.1 GENERAL

A. Description Of Work

1. This specification covers the furnishing and installation of materials for hydronic piping. Products shall be as follows or as directed by the Owner. Installation procedures shall be in accordance with the products manufacturer's recommendations. Demolition and removal of materials shall be as required to support the work.

B. Summary

1. This Section includes pipe and fitting materials, joining methods, special-duty valves, and specialties for the following:
 - a. Hot-water heating piping.
 - b. Chilled-water piping.
 - c. Dual-temperature heating and cooling water piping.
 - d. Condenser-water piping.
 - e. Glycol cooling-water piping.
 - f. Makeup-water piping.
 - g. Condensate-drain piping.
 - h. Blowdown-drain piping.
 - i. Air-vent piping.
 - j. Safety-valve-inlet and -outlet piping.

C. Definitions

1. PTFE: Polytetrafluoroethylene.
2. RTRF: Reinforced thermosetting resin (fiberglass) fittings.
3. RTRP: Reinforced thermosetting resin (fiberglass) pipe.

D. Performance Requirements

1. Hydronic piping components and installation shall be capable of withstanding the following minimum working pressure and temperature:
 - a. Hot-Water Heating Piping: **psig (kPa)**, as directed by the Owner at **200 deg F (93 deg C)**.
 - b. Chilled-Water Piping: **psig (kPa)**, as directed by the Owner at **200 deg F (93 deg C)**.
 - c. Dual-Temperature Heating and Cooling Water Piping: **psig (kPa)**, ethylene at **200 deg F (93 deg C)**.
 - d. Condenser-Water Piping: **psig (kPa)**, as directed by the Owner at **150 deg F (66 deg C)**.
 - e. Glycol Cooling-Water Piping: **psig (kPa)**, as directed by the Owner at **150 deg F (66 deg C)**.
 - f. Makeup-Water Piping: **80 psig (552 kPa)** at **150 deg F (66 deg C)**.
 - g. Condensate-Drain Piping: **150 deg F (66 deg C)**.
 - h. Blowdown-Drain Piping: **200 deg F (93 deg C)**.
 - i. Air-Vent Piping: **200 deg F (93 deg C)**.
 - j. Safety-Valve-Inlet and -Outlet Piping: Equal to the pressure of the piping system to which it is attached.

E. Submittals

1. Product Data: For each type of the following:
 - a. Plastic pipe and fittings with solvent cement.
 - b. RTRP and RTRF with adhesive.
 - c. Pressure-seal fittings.
 - d. Valves. Include flow and pressure drop curves based on manufacturer's testing for calibrated-orifice balancing valves and automatic flow-control valves.
 - e. Air control devices.

- f. Chemical treatment.
- g. Hydronic specialties.
- 2. LEED Submittal:
 - a. Product Data for Credit EQ 4.1: For solvent cements and adhesive primers, including printed statement of VOC content.
- 3. Shop Drawings: Detail, at **1/4 (1:50)** scale, the piping layout, fabrication of pipe anchors, hangers, supports for multiple pipes, alignment guides, expansion joints and loops, and attachments of the same to the building structure. Detail location of anchors, alignment guides, and expansion joints and loops.
- 4. Welding certificates.
- 5. Qualification Data: For Installer.
- 6. Field quality-control test reports.
- 7. Operation and Maintenance Data: For air control devices, hydronic specialties, and special-duty valves to include in emergency, operation, and maintenance manuals.
- 8. Water Analysis: Submit a copy of the water analysis to illustrate water quality available at Project site.

F. Quality Assurance

- 1. Installer Qualifications:
 - a. Installers of Pressure-Sealed Joints: Installers shall be certified by the pressure-seal joint manufacturer as having been trained and qualified to join piping with pressure-seal pipe couplings and fittings.
 - b. Fiberglass Pipe and Fitting Installers: Installers of RTRF and RTRP shall be certified by the manufacturer of pipes and fittings as having been trained and qualified to join fiberglass piping with manufacturer-recommended adhesive.
- 2. Steel Support Welding: Qualify processes and operators according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- 3. Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX.
 - a. Comply with provisions in ASME B31 Series, "Code for Pressure Piping."
 - b. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.
- 4. ASME Compliance: Comply with ASME B31.9, "Building Services Piping," for materials, products, and installation. Safety valves and pressure vessels shall bear the appropriate ASME label. Fabricate and stamp air separators and expansion tanks to comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.

1.2 PRODUCTS

A. Copper Tube And Fittings

- 1. Drawn-Temper Copper Tubing: **ASTM B 88, Type L (ASTM B 88M, Type B) OR ASTM B 88, Type M (ASTM B 88M, Type C), as directed.**
- 2. Annealed-Temper Copper Tubing: **ASTM B 88, Type K (ASTM B 88M, Type A).**
- 3. DWV Copper Tubing: ASTM B 306, Type DWV.
- 4. Wrought-Copper Fittings: ASME B16.22.
 - a. Grooved-End Copper Fittings: **ASTM B 75 (ASTM B 75M)**, copper tube or ASTM B 584, bronze casting.
 - b. Grooved-End-Tube Couplings: Rigid pattern, unless otherwise indicated; gasketed fitting. Ductile-iron housing with keys matching pipe and fitting grooves, prelubricated, **as directed**, EPDM gasket rated for minimum **230 deg F (110 deg C)** for use with housing, and steel bolts and nuts.
- 5. Copper or Bronze Pressure-Seal Fittings:
 - a. Housing: Copper.
 - b. O-Rings and Pipe Stops: EPDM.

- c. Tools: Manufacturer's special tools.
 - d. Minimum **200-psig (1379-kPa)** working-pressure rating at **250 deg F (121 deg C)**.
 6. Copper, Mechanically Formed Tee Option: For forming T-branch on copper water tube.
 7. Wrought-Copper Unions: ASME B16.22.
- B. Steel Pipe And Fittings
 1. Steel Pipe: ASTM A 53/A 53M, black steel with plain ends; type, grade, and wall thickness as indicated in Part 1.3 "Piping Applications" Article.
 2. Cast-Iron Threaded Fittings: ASME B16.4; Classes 125 and 250 as indicated in Part 1.3 "Piping Applications" Article.
 3. Malleable-Iron Threaded Fittings: ASME B16.3, Classes 150 and 300 as indicated in Part 1.3 "Piping Applications" Article.
 4. Malleable-Iron Unions: ASME B16.39; Classes 150, 250, and 300 as indicated in Part 1.3 "Piping Applications" Article.
 5. Cast-Iron Pipe Flanges and Flanged Fittings: ASME B16.1, Classes 25, 125, and 250; raised ground face, and bolt holes spot faced as indicated in Part 1.3 "Piping Applications" Article.
 6. Wrought-Steel Fittings: ASTM A 234/A 234M, wall thickness to match adjoining pipe.
 7. Wrought Cast- and Forged-Steel Flanges and Flanged Fittings: ASME B16.5, including bolts, nuts, and gaskets of the following material group, end connections, and facings:
 - a. Material Group: 1.1.
 - b. End Connections: Butt welding.
 - c. Facings: Raised face.
 8. Grooved Mechanical-Joint Fittings and Couplings:
 - a. Joint Fittings: ASTM A 536, Grade 65-45-12 ductile iron; ASTM A 47/A 47M, Grade 32510 malleable iron; ASTM A 53/A 53M, Type F, E, or S, Grade B fabricated steel; or ASTM A 106, Grade B steel fittings with grooves or shoulders constructed to accept grooved-end couplings; with nuts, bolts, locking pin, locking toggle, or lugs to secure grooved pipe and fittings.
 - b. Couplings: Ductile- or malleable-iron housing and synthetic rubber gasket of central cavity pressure-responsive design; with nuts, bolts, locking pin, locking toggle, or lugs to secure grooved pipe and fittings.
 9. Steel Pressure-Seal Fittings:
 - a. Housing: Steel.
 - b. O-Rings and Pipe Stop: EPDM.
 - c. Tools: Manufacturer's special tool.
 - d. Minimum **300-psig (2070-kPa)** working-pressure rating at **230 deg F (110 deg C)**.
 10. Steel Pipe Nipples: ASTM A 733, made of same materials and wall thicknesses as pipe in which they are installed.
- C. Plastic Pipe And Fittings
 1. CPVC Plastic Pipe: ASTM F 441/F 441M, Schedules 40 and 80, plain ends as indicated in Part 1.3 "Piping Applications" Article.
 2. CPVC Plastic Pipe Fittings: Socket-type pipe fittings, ASTM F 438 for Schedule 40 pipe; ASTM F 439 for Schedule 80 pipe.
 3. PVC Plastic Pipe: ASTM D 1785, Schedules 40 and 80, plain ends as indicated in Part 1.3 "Piping Applications" Article.
 4. PVC Plastic Pipe Fittings: Socket-type pipe fittings, ASTM D 2466 for Schedule 40 pipe; ASTM D 2467 for Schedule 80 pipe.
- D. Fiberglass Pipe And Fittings
 1. RTRP: ASTM D 2996, filament-wound pipe with tapered bell and spigot ends for adhesive joints.
 2. RTRF: Compression or spray-up/contact molded of same material, pressure class, and joining method as pipe.
 3. Flanges: ASTM D 4024. Full-face gaskets suitable for the service, minimum **1/8-inch (3.2-mm)** thick, 60-70 durometer. ASTM A 307, Grade B, hex head bolts with washers.



E. Joining Materials

1. Pipe-Flange Gasket Materials: Suitable for chemical and thermal conditions of piping system contents.
 - a. ASME B16.21, nonmetallic, flat, asbestos free, **1/8-inch (3.2-mm)** maximum thickness unless thickness or specific material is indicated.
 - 1) Full-Face Type: For flat-face, Class 125, cast-iron and cast-bronze flanges.
 - 2) Narrow-Face Type: For raised-face, Class 250, cast-iron and steel flanges.
2. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated.
3. Plastic, Pipe-Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer, unless otherwise indicated.
4. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.
5. Brazing Filler Metals: AWS A5.8, BCuP Series, copper-phosphorus alloys for joining copper with copper; or BAg-1, silver alloy for joining copper with bronze or steel.
6. Welding Filler Metals: Comply with AWS D10.12/D10.12M for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.
7. Solvent Cements for Joining Plastic Piping:
 - a. CPVC Piping: ASTM F 493.
 - 1) Use CPVC solvent cement that has a VOC content of 490 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 - 2) Use adhesive primer that has a VOC content of 550 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 - b. PVC Piping: ASTM D 2564. Include primer according to ASTM F 656.
 - 1) Use PVC solvent cement that has a VOC content of 510 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 - 2) Use adhesive primer that has a VOC content of 550 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
8. Fiberglass Pipe Adhesive: As furnished or recommended by pipe manufacturer.
 - a. Use fiberglass adhesive that has a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
9. Gasket Material: Thickness, material, and type suitable for fluid to be handled and working temperatures and pressures.

F. Transition Fittings

1. Plastic-to-Metal Transition Fittings:
 - a. CPVC **OR** PVC, **as directed**, one-piece fitting with one threaded brass or copper insert and one Schedule 80 solvent-cement-joint end.
2. Plastic-to-Metal Transition Unions:
 - a. MSS SP-107, CPVC **OR** PVC, **as directed**, union. Include brass or copper end, Schedule 80 solvent-cement-joint end, rubber gasket, and threaded union.

G. Dielectric Fittings

1. Description: Combination fitting of copper-alloy and ferrous materials with threaded, solder-joint, plain, or weld-neck end connections that match piping system materials.
2. Insulating Material: Suitable for system fluid, pressure, and temperature.
3. Dielectric Unions:
 - a. Factory-fabricated union assembly, for **250-psig (1725-kPa)** minimum working pressure at **180 deg F (82 deg C)**.
4. Dielectric Flanges:
 - a. Factory-fabricated companion-flange assembly, for **150- or 300-psig (1035- or 2070-kPa)** minimum working pressure as required to suit system pressures.
5. Dielectric-Flange Kits:
 - a. Companion-flange assembly for field assembly. Include flanges, full-face- or ring-type neoprene or phenolic gasket, phenolic or polyethylene bolt sleeves, phenolic washers, and steel backing washers.

- b. Separate companion flanges and steel bolts and nuts shall have 150- or 300-psig (1035- or 2070-kPa) minimum working pressure where required to suit system pressures.
 - 6. Dielectric Couplings:
 - a. Galvanized-steel coupling with inert and noncorrosive thermoplastic lining; threaded ends; and 300-psig (2070-kPa) minimum working pressure at 225 deg F (107 deg C).
 - 7. Dielectric Nipples:
 - a. Electroplated steel nipple with inert and noncorrosive, thermoplastic lining; plain, threaded, or grooved ends; and 300-psig (2070-kPa) minimum working pressure at 225 deg F (107 deg C).
- H. Valves
- 1. Gate, Globe, Check, Ball, and Butterfly Valves: Comply with requirements specified in Division 22 Section(s) "General-duty Valves For Plumbing Piping" OR Division 23 Section(s) "General-duty Valves For Hvac Piping".
 - 2. Automatic Temperature-Control Valves, Actuators, and Sensors: Comply with requirements specified in Division 23 Section "Instrumentation And Control For Hvac".
 - 3. Plastic Ball Valves:
 - a. Body: One-, two-, or three-piece CPVC or PVC to match piping.
 - b. Ball: Full-port CPVC or PVC to match piping.
 - c. Seats: PTFE.
 - d. Seals: EPDM.
 - e. End Connections: Socket, union, or flanged.
 - f. Handle Style: Tee shape.
 - g. CWP Rating: Equal to piping service.
 - h. Maximum Operating Temperature: Equal to piping service.
 - i. Comply with MSS SP-122.
 - 4. Plastic Butterfly Valves:
 - a. Body: PVC or CPVC to match piping wafer type for installation between flanges.
 - b. Disc: EPDM-coated steel.
 - c. Seats: PTFE.
 - d. Handle Style: Locking lever.
 - e. CWP Rating: Equal to piping service.
 - f. Maximum Operating Temperature: Equal to piping service.
 - 5. Plastic Check Valves:
 - a. Body: One-, two-, or three-piece PVC or CPVC to match piping.
 - b. Ends: Socket or flanged.
 - c. Seats: PTFE.
 - d. Check Style: Swing or ball type.
 - e. CWP Rating: Equal to piping service.
 - f. Maximum Operating Temperature: Equal to piping service.
 - 6. Bronze, Calibrated-Orifice, Balancing Valves:
 - a. Body: Bronze, ball or plug type with calibrated orifice or venturi.
 - b. Ball: Brass or stainless steel.
 - c. Plug: Resin.
 - d. Seat: PTFE.
 - e. End Connections: Threaded or socket.
 - f. Pressure Gage Connections: Integral seals for portable differential pressure meter.
 - g. Handle Style: Lever, with memory stop to retain set position.
 - h. CWP Rating: Minimum 125 psig (860 kPa).
 - i. Maximum Operating Temperature: 250 deg F (121 deg C).
 - 7. Cast-Iron or Steel, Calibrated-Orifice, Balancing Valves:
 - a. Body: Cast-iron or steel body, ball, plug, or globe pattern with calibrated orifice or venturi.
 - b. Ball: Brass or stainless steel.
 - c. Stem Seals: EPDM O-rings.
 - d. Disc: Glass and carbon-filled PTFE.
 - e. Seat: PTFE.

- f. End Connections: Flanged or grooved.
- g. Pressure Gage Connections: Integral seals for portable differential pressure meter.
- h. Handle Style: Lever, with memory stop to retain set position.
- i. CWP Rating: Minimum **125 psig (860 kPa)**.
- j. Maximum Operating Temperature: **250 deg F (121 deg C)**.
- 8. Diaphragm-Operated, Pressure-Reducing Valves:
 - a. Body: Bronze or brass.
 - b. Disc: Glass and carbon-filled PTFE.
 - c. Seat: Brass.
 - d. Stem Seals: EPDM O-rings.
 - e. Diaphragm: EPT.
 - f. Low inlet-pressure check valve.
 - g. Inlet Strainer: removable without system shutdown.
 - h. Valve Seat and Stem: Noncorrosive.
 - i. Valve Size, Capacity, and Operating Pressure: Selected to suit system in which installed, with operating pressure and capacity factory set and field adjustable.
- 9. Diaphragm-Operated Safety Valves:
 - a. Body: Bronze or brass.
 - b. Disc: Glass and carbon-filled PTFE.
 - c. Seat: Brass.
 - d. Stem Seals: EPDM O-rings.
 - e. Diaphragm: EPT.
 - f. Wetted, Internal Work Parts: Brass and rubber.
 - g. Inlet Strainer: removable without system shutdown.
 - h. Valve Seat and Stem: Noncorrosive.
 - i. Valve Size, Capacity, and Operating Pressure: Comply with ASME Boiler and Pressure Vessel Code: Section IV, and selected to suit system in which installed, with operating pressure and capacity factory set and field adjustable.
- 10. Automatic Flow-Control Valves:
 - a. Body: Brass or ferrous metal.
 - b. Piston and Spring Assembly: Stainless steel **OR** Corrosion resistant, **as directed**, tamper proof, self cleaning, and removable.
 - c. Combination Assemblies: Include bronze or brass-alloy ball valve.
 - d. Identification Tag: Marked with zone identification, valve number, and flow rate.
 - e. Size: Same as pipe in which installed.
 - f. Performance: Maintain constant flow, plus or minus 5 percent over system pressure fluctuations.
 - g. Minimum CWP Rating: **175 psig (1207 kPa) OR 300 psig (2070 kPa), as directed.**
 - h. Maximum Operating Temperature: **200 deg F (93 deg C) OR 250 deg F (121 deg C), as directed.**
- I. Air Control Devices
 - 1. Manual Air Vents:
 - a. Body: Bronze.
 - b. Internal Parts: Nonferrous.
 - c. Operator: Screwdriver or thumbscrew.
 - d. Inlet Connection: **NPS 1/2 (DN 15)**.
 - e. Discharge Connection: **NPS 1/8 (DN 6)**.
 - f. CWP Rating: **150 psig (1035 kPa)**.
 - g. Maximum Operating Temperature: **225 deg F (107 deg C)**.
 - 2. Automatic Air Vents:
 - a. Body: Bronze or cast iron.
 - b. Internal Parts: Nonferrous.
 - c. Operator: Noncorrosive metal float.
 - d. Inlet Connection: **NPS 1/2 (DN 15)**.

- e. Discharge Connection: **NPS 1/4 (DN 8)**.
- f. CWP Rating: **150 psig (1035 kPa)**.
- g. Maximum Operating Temperature: **240 deg F (116 deg C)**.
3. Expansion Tanks:
 - a. Tank: Welded steel, rated for **125-psig (860-kPa)** working pressure and **375 deg F (191 deg C)** maximum operating temperature, with taps in bottom of tank for tank fitting and taps in end of tank for gage glass. Tanks shall be factory tested with taps fabricated and labeled according to ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.
 - b. Air-Control Tank Fitting: Cast-iron body, copper-plated tube, brass vent tube plug, and stainless-steel ball check, **100-gal. (379-L)** unit only; sized for compression-tank diameter. Provide tank fittings for **125-psig (860-kPa)** working pressure and **250 deg F (121 deg C)** maximum operating temperature.
 - c. Tank Drain Fitting: Brass body, nonferrous internal parts; **125-psig (860-kPa)** working pressure and **240 deg F (116 deg C)** maximum operating temperature; constructed to admit air to compression tank, drain water, and close off system.
 - d. Gage Glass: Full height with dual manual shutoff valves, **3/4-inch- (20-mm-)** diameter gage glass, and slotted-metal glass guard.
4. Diaphragm-Type **OR** Bladder-Type, **as directed**, Expansion Tanks:
 - a. Tank: Welded steel, rated for **125-psig (860-kPa)** working pressure and **375 deg F (191 deg C)** maximum operating temperature. Factory test with taps fabricated and supports installed and labeled according to ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.
 - b. Diaphragm **OR** Bladder, **as directed**: Securely sealed into tank to separate air charge from system water to maintain required expansion capacity.
 - c. Air-Charge Fittings: Schrader valve, stainless steel with EPDM seats.
5. Tangential-Type Air Separators:
 - a. Tank: Welded steel; ASME constructed and labeled for **125-psig (860-kPa)** minimum working pressure and **375 deg F (191 deg C)** maximum operating temperature.
 - b. Air Collector Tube: Perforated stainless steel, constructed to direct released air into expansion tank.
 - c. Tangential Inlet and Outlet Connections: Threaded for **NPS 2 (DN 50)** and smaller; flanged connections for **NPS 2-1/2 (DN 65)** and larger.
 - d. Blowdown Connection: Threaded.
 - e. Size: Match system flow capacity.
6. In-Line Air Separators:
 - a. Tank: One-piece cast iron with an integral weir constructed to decelerate system flow to maximize air separation.
 - b. Maximum Working Pressure: Up to **175 psig (1207 kPa)**.
 - c. Maximum Operating Temperature: Up to **300 deg F (149 deg C)**.
7. Air Purgers:
 - a. Body: Cast iron with internal baffles that slow the water velocity to separate the air from solution and divert it to the vent for quick removal.
 - b. Maximum Working Pressure: **150 psig (1035 kPa)**.
 - c. Maximum Operating Temperature: **250 deg F (121 deg C)**.
- J. Chemical Treatment
 1. Bypass Chemical Feeder: Welded steel construction; **125-psig (860-kPa)** working pressure; **5-gal. (19-L)** capacity; with fill funnel and inlet, outlet, and drain valves.
 - a. Chemicals: Specially formulated, based on analysis of makeup water, to prevent accumulation of scale and corrosion in piping and connected equipment.
 2. Ethylene and Propylene Glycol: Industrial grade with corrosion inhibitors and environmental-stabilizer additives for mixing with water in systems indicated to contain antifreeze or glycol solutions.
- K. Hydronic Piping Specialties
 1. Y-Pattern Strainers:

- a. Body: ASTM A 126, Class B, cast iron with bolted cover and bottom drain connection.
- b. End Connections: Threaded ends for **NPS 2 (DN 50)** and smaller; flanged ends for **NPS 2-1/2 (DN 65)** and larger.
- c. Strainer Screen: 40 **OR** 60, **as directed**, -mesh startup strainer, and perforated stainless-steel basket with 50 percent free area.
- d. CWP Rating: **125 psig (860 kPa)**.
2. Basket Strainers:
 - a. Body: ASTM A 126, Class B, high-tensile cast iron with bolted cover and bottom drain connection.
 - b. End Connections: Threaded ends for **NPS 2 (DN 50)** and smaller; flanged ends for **NPS 2-1/2 (DN 65)** and larger.
 - c. Strainer Screen: 40 **OR** 60, **as directed**, -mesh startup strainer, and perforated stainless-steel basket with 50 percent free area.
 - d. CWP Rating: **125 psig (860 kPa)**.
3. T-Pattern Strainers:
 - a. Body: Ductile or malleable iron with removable access coupling and end cap for strainer maintenance.
 - b. End Connections: Grooved ends.
 - c. Strainer Screen: 40 **OR** 60, **as directed**, -mesh startup strainer, and perforated stainless-steel basket with 57 percent free area.
 - d. CWP Rating: **750 psig (5170 kPa)**.
4. Stainless-Steel Bellow, Flexible Connectors:
 - a. Body: Stainless-steel bellows with woven, flexible, bronze, wire-reinforcing protective jacket.
 - b. End Connections: Threaded or flanged to match equipment connected.
 - c. Performance: Capable of **3/4-inch (20-mm)** misalignment.
 - d. CWP Rating: **150 psig (1035 kPa)**.
 - e. Maximum Operating Temperature: **250 deg F (121 deg C)**.
5. Spherical, Rubber, Flexible Connectors:
 - a. Body: Fiber-reinforced rubber body.
 - b. End Connections: Steel flanges drilled to align with Classes 150 and 300 steel flanges.
 - c. Performance: Capable of misalignment.
 - d. CWP Rating: **150 psig (1035 kPa)**.
 - e. Maximum Operating Temperature: **250 deg F (121 deg C)**.
6. Expansion fittings are specified in Division 22 Section(s) "Expansion Fittings And Loops For Plumbing Piping" **OR** Division 23 Section(s) "Expansion Fittings And Loops For Hvac Piping".

1.3 EXECUTION

1. Hot-water heating piping, aboveground, **NPS 2 (DN 50)** and smaller, shall be any of the following:
 - a. Type **L (B) OR M (C)**, **as directed**, drawn-temper copper tubing, wrought-copper fittings, and soldered **OR** brazed **OR** pressure-seal, **as directed**, joints.
 - b. Schedule 40 **OR** 30 **OR** 20, **as directed**, steel pipe; Class 125, cast-iron **OR** 150, malleable-iron **OR** 250, cast-iron **OR** 300, malleable-iron, **as directed**, fittings; cast-iron flanges and flange fittings; and threaded joints.
 - c. Schedule 5 steel pipe; steel, pressure-seal couplings and fittings; and pressure-seal joints.
 - d. Schedule 40 **OR** 80, **as directed**, CPVC plastic pipe and fittings and solvent-welded joints.
2. Hot-water heating piping, aboveground, **NPS 2-1/2 (DN 65)** and larger, shall be any of the following:
 - a. Type **L (B) OR M (C)**, **as directed**, drawn-temper copper tubing, wrought-copper fittings, and soldered **OR** brazed, **as directed**, joints.
 - b. Schedule 40 **OR** 30 **OR** 20, **as directed**, steel pipe, wrought-steel fittings and wrought-cast or forged-steel flanges and flange fittings, and welded and flanged joints.
 - c. Schedule 40 **OR** 30 **OR** 20, **as directed**, steel pipe; grooved, mechanical joint coupling and fittings; and grooved, mechanical joints.

- d. Schedule 40 **OR** 80, **as directed**, CPVC plastic pipe and fittings and solvent-welded joints.
- e. RTRP and RTRF with adhesive or flanged joints.
3. Hot-water heating piping installed belowground and within slabs shall be either of the following:
 - a. Type **K (A)**, annealed-temper copper tubing, wrought-copper fittings, and soldered **OR** brazed, **as directed**, joints. Use the fewest possible joints.
 - b. RTRP and RTRF with adhesive or flanged joints.
4. Chilled-water piping, aboveground, **NPS 2 (DN 50)** and smaller, shall be any of the following:
 - a. Type **L (B) OR M (C)**, **as directed**, drawn-temper copper tubing, wrought-copper fittings, and soldered **OR** brazed **OR** pressure-seal, **as directed**, joints.
 - b. Schedule 40 **OR** 30 **OR** 20, **as directed**, steel pipe; Class 125, cast-iron **OR** 150, malleable-iron **OR** 250, cast-iron **OR** 300, malleable-iron, **as directed**, fittings; cast-iron flanges and flange fittings; and threaded joints.
 - c. Schedule 5 steel pipe; steel, pressure-seal couplings and fittings; and pressure-seal joints.
 - d. Schedule 40 **OR** 80, **as directed**, CPVC plastic pipe and fittings and solvent-welded joints.
5. Chilled-water piping, aboveground, **NPS 2-1/2 (DN 65)** and larger, shall be any of the following:
 - a. Type **L (B) OR M (C)**, **as directed**, drawn-temper copper tubing, wrought-copper fittings, and soldered **OR** brazed, **as directed**, joints.
 - b. Schedule 40 **OR** 30 **OR** 20, **as directed**, steel pipe, wrought-steel fittings and wrought-cast or forged-steel flanges and flange fittings, and welded and flanged joints.
 - c. Schedule 40 **OR** 30 **OR** 20, **as directed**, steel pipe; grooved, mechanical joint coupling and fittings; and grooved, mechanical joints.
 - d. Schedule 40 **OR** 80, **as directed**, CPVC plastic pipe and fittings and solvent-welded joints.
 - e. RTRP and RTRF with adhesive or flanged joints.
6. Chilled-water piping installed belowground and within slabs shall be either of the following:
 - a. Type **K (A)**, annealed-temper copper tubing, wrought-copper fittings, and soldered **OR** brazed, **as directed**, joints. Use the fewest possible joints.
 - b. RTRP and RTRF with adhesive or flanged joints.
7. Dual-temperature heating and cooling water piping, aboveground, **NPS 2 (DN 50)** and smaller, shall be any of the following:
 - a. Type **L (B) OR M (C)**, **as directed**, drawn-temper copper tubing, wrought-copper fittings, and soldered **OR** brazed **OR** pressure-seal, **as directed**, joints.
 - b. Schedule 40 **OR** 30 **OR** 20, **as directed**, steel pipe; Class 125, cast-iron **OR** 150, malleable-iron **OR** 250, cast-iron **OR** 300, malleable-iron, **as directed**, fittings; cast-iron flanges and flange fittings; and threaded joints.
 - c. Schedule 5 steel pipe; steel, pressure-seal couplings and fittings; and pressure-seal joints.
 - d. Schedule 40 **OR** 80, **as directed**, CPVC plastic pipe and fittings and solvent-welded joints.
8. Dual-temperature heating and cooling water piping, aboveground, **NPS 2-1/2 (DN 65)** and larger, shall be any of the following:
 - a. Type **L (B) OR M (C)**, **as directed**, drawn-temper copper tubing, wrought-copper fittings, and soldered **OR** brazed, **as directed**, joints.
 - b. Schedule 40 **OR** 30 **OR** 20, **as directed**, steel pipe, wrought-steel fittings and wrought-cast or forged-steel flanges and flange fittings, and welded and flanged joints.
 - c. Schedule 40 **OR** 30 **OR** 20, **as directed**, steel pipe; grooved, mechanical joint coupling and fittings; and grooved, mechanical joints.
 - d. Schedule 40 **OR** 80, **as directed**, CPVC plastic pipe and fittings and solvent-welded joints.
 - e. RTRP and RTRF with adhesive or flanged joints.
9. Dual-temperature heating and cooling water piping installed belowground and within slabs shall be either of the following:
 - a. Type **K (A)**, annealed-temper copper tubing, wrought-copper fittings, and soldered **OR** brazed, **as directed**, joints. Use the fewest possible joints.
 - b. RTRP and RTRF with adhesive or flanged joints.
10. Condenser-water piping, aboveground, **NPS 2 (DN 50)** and smaller, shall be any of the following:
 - a. Type **L (B) OR M (C)**, **as directed**, drawn-temper copper tubing, wrought-copper fittings, and soldered **OR** brazed **OR** pressure-seal, **as directed**, joints.

- b. Schedule 80 **OR** 40 **OR** 30 **OR** 20, **as directed**, steel pipe; Class 125, cast-iron **OR** 150, malleable-iron **OR** 250, cast-iron **OR** 300, malleable-iron, **as directed**, fittings; cast-iron flanges and flange fittings; and threaded joints.
- c. Schedule 5 steel pipe; steel, pressure-seal couplings and fittings; and pressure-seal joints.
- d. Schedule 40 **OR** 80, **as directed**, CPVC plastic pipe and fittings and solvent-welded joints.
- 11. Condenser-water piping, aboveground, **NPS 2-1/2 (DN 65)** and larger, shall be any of the following:
 - a. Type **L (B) OR M (C)**, **as directed**, drawn-temper copper tubing, wrought-copper fittings, and soldered **OR** brazed, **as directed**, joints.
 - b. Schedule 80 **OR** 40 **OR** 30 **OR** 20, **as directed**, steel pipe, wrought-steel fittings and wrought-cast or forged-steel flanges and flange fittings, and welded and flanged joints.
 - c. Schedule 80 **OR** 40 **OR** 30 **OR** 20, **as directed**, steel pipe; grooved, mechanical joint coupling and fittings; and grooved, mechanical joints.
 - d. Schedule 40 **OR** 80, **as directed**, CPVC plastic pipe and fittings and solvent-welded joints.
 - e. RTRP and RTRF with adhesive or flanged joints.
- 12. Condenser-water piping installed belowground and within slabs shall be either of the following:
 - a. Type **K (A)**, annealed-temper copper tubing, wrought-copper fittings, and soldered **OR** brazed, **as directed**, joints. Use the fewest possible joints.
 - b. RTRP and RTRF with adhesive or flanged joints.
- 13. Glycol cooling-water piping, aboveground, **NPS 2 (DN 50)** and smaller, shall be any of the following:
 - a. Type **L (B) OR M (C)**, **as directed**, drawn-temper copper tubing, wrought-copper fittings, and soldered **OR** brazed **OR** pressure-seal, **as directed**, joints.
 - b. Schedule 40 **OR** 30 **OR** 20, **as directed**, steel pipe; Class 125, cast-iron **OR** 150, malleable-iron **OR** 250, cast-iron **OR** 300, malleable-iron, **as directed**, fittings; cast-iron flanges and flange fittings; and threaded joints.
 - c. Schedule 5 steel pipe; steel, pressure-seal couplings and fittings; and pressure-seal joints.
 - d. Schedule 40 **OR** 80, **as directed**, CPVC plastic pipe and fittings and solvent-welded joints.
- 14. Glycol cooling-water piping, aboveground, **NPS 2-1/2 (DN 65)** and larger, shall be any of the following:
 - a. Type **L (B) OR M (C)**, **as directed**, drawn-temper copper tubing, wrought-copper fittings, and soldered **OR** brazed, **as directed**, joints.
 - b. Schedule 40 **OR** 30 **OR** 20, **as directed**, steel pipe, wrought-steel fittings and wrought-cast or forged-steel flanges and flange fittings, and welded and flanged joints.
 - c. Schedule 40 **OR** 30 **OR** 20, **as directed**, steel pipe; grooved, mechanical joint coupling and fittings; and grooved, mechanical joints.
 - d. Schedule 40 **OR** 80, **as directed**, CPVC plastic pipe and fittings and solvent-welded joints.
 - e. RTRP and RTRF with adhesive or flanged joints.
- 15. Glycol cooling-water piping installed belowground and within slabs shall be either of the following:
 - a. Type **K (A)**, annealed-temper copper tubing, wrought-copper fittings, and soldered **OR** brazed, **as directed**, joints. Use the fewest possible joints.
 - b. RTRP and RTRF with adhesive or flanged joints.
- 16. Makeup-water piping installed aboveground shall be either of the following:
 - a. Type **L (B) OR M (C)**, **as directed**, drawn-temper copper tubing, wrought-copper fittings, and soldered **OR** brazed, **as directed**, joints.
 - b. Schedule 40 **OR** 80, **as directed**, CPVC plastic pipe and fittings, and solvent-welded joints.
- 17. Makeup-Water Piping Installed Belowground and within Slabs: Type **K (A)**, annealed-temper copper tubing, wrought-copper fittings, and soldered joints. Use the fewest possible joints.
- 18. Condensate-Drain Piping: Type **M (C) OR DWV**, **as directed**, drawn-temper copper tubing, wrought-copper fittings, and soldered joints or Schedule 40 PVC plastic pipe and fittings and solvent-welded joints, **as directed**.
OR
Condensate-Drain Piping: Schedule 40 PVC plastic pipe and fittings and solvent-welded joints.

19. Blowdown-Drain Piping: Same materials and joining methods as for piping specified for the service in which blowdown drain is installed.
 20. Air-Vent Piping:
 - a. Inlet: Same as service where installed with metal-to-plastic transition fittings for plastic piping systems according to the piping manufacturer's written instructions.
 - b. Outlet: Type **K (A)**, annealed-temper copper tubing with soldered or flared joints.
 21. Safety-Valve-Inlet and -Outlet Piping for Hot-Water Piping: Same materials and joining methods as for piping specified for the service in which safety valve is installed with metal-to-plastic transition fittings for plastic piping systems according to the piping manufacturer's written instructions.
- B. Valve Applications
1. Install shutoff-duty valves at each branch connection to supply mains, and at supply connection to each piece of equipment.
 2. Install throttling-duty **OR** calibrated-orifice, balancing, **as directed**, valves at each branch connection to return main.
 3. Install calibrated-orifice, balancing valves in the return pipe of each heating or cooling terminal.
 4. Install check valves at each pump discharge and elsewhere as required to control flow direction.
 5. Install safety valves at hot-water generators and elsewhere as required by ASME Boiler and Pressure Vessel Code. Install drip-pan elbow on safety-valve outlet and pipe without valves to the outdoors; and pipe drain to nearest floor drain or as indicated on Drawings. Comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 1, for installation requirements.
 6. Install pressure-reducing valves at makeup-water connection to regulate system fill pressure.
- C. Piping Installations
1. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicate piping locations and arrangements if such were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.
 2. Install piping in concealed locations, unless otherwise indicated and except in equipment rooms and service areas.
 3. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
 4. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
 5. Install piping to permit valve servicing.
 6. Install piping at indicated slopes.
 7. Install piping free of sags and bends.
 8. Install fittings for changes in direction and branch connections.
 9. Install piping to allow application of insulation.
 10. Select system components with pressure rating equal to or greater than system operating pressure.
 11. Install groups of pipes parallel to each other, spaced to permit applying insulation and servicing of valves.
 12. Install drains, consisting of a tee fitting, **NPS 3/4 (DN 20)** ball valve, and short **NPS 3/4 (DN 20)** threaded nipple with cap, at low points in piping system mains and elsewhere as required for system drainage.
 13. Install piping at a uniform grade of 0.2 percent upward in direction of flow.
 14. Reduce pipe sizes using eccentric reducer fitting installed with level side down.
 15. Install branch connections to mains using mechanically formed, **as directed**, tee fittings in main pipe, with the branch connected to the bottom of the main pipe. For up-feed risers, connect the branch to the top of the main pipe.
 16. Install valves according to Division 22 Section(s) "General-duty Valves For Plumbing Piping" OR Division 23 Section(s) "General-duty Valves For Hvac Piping".
 17. Install unions in piping, **NPS 2 (DN 50)** and smaller, adjacent to valves, at final connections of equipment, and elsewhere as indicated.

18. Install flanges in piping, **NPS 2-1/2 (DN 65)** and larger, at final connections of equipment and elsewhere as indicated.
19. Install strainers on inlet side of each control valve, pressure-reducing valve, solenoid valve, in-line pump, and elsewhere as indicated. Install **NPS 3/4 (DN 20)** nipple and ball valve in blowdown connection of strainers **NPS 2 (DN 50)** and larger. Match size of strainer blowoff connection for strainers smaller than **NPS 2 (DN 50)**.
20. Install expansion loops, expansion joints, anchors, and pipe alignment guides as specified in Division 22 Section(s) "Expansion Fittings And Loops For Plumbing Piping" OR Division 23 Section(s) "Expansion Fittings And Loops For Hvac Piping".
21. Identify piping as specified in Division 22 Section(s) "Identification For Plumbing Piping And Equipment" OR Division 23 Section(s) "Identification For Hvac Piping And Equipment".

D. Hangers And Supports

1. Hanger, support, and anchor devices are specified in Division 22 Section(s) "Hangers And Supports For Plumbing Piping And Equipment" OR Division 23 Section(s) "Hangers And Supports For Hvac Piping And Equipment". Comply with the following requirements for maximum spacing of supports.
2. Seismic restraints are specified in Division 21 Section(s) "Vibration And Seismic Controls For Fire-suppression Piping And Equipment" OR Division 22 Section(s) "Vibration And Seismic Controls For Plumbing Piping And Equipment" OR Division 23 Section(s) "Vibration And Seismic Controls For Hvac Piping And Equipment".
3. Install the following pipe attachments:
 - a. Adjustable steel clevis hangers for individual horizontal piping less than **20 feet (6 m)** long.
 - b. Adjustable roller hangers and spring hangers for individual horizontal piping **20 feet (6 m)** or longer.
 - c. Pipe Roller: MSS SP-58, Type 44 for multiple horizontal piping **20 feet (6 m)** or longer, supported on a trapeze.
 - d. Spring hangers to support vertical runs.
 - e. Provide copper-clad hangers and supports for hangers and supports in direct contact with copper pipe.
 - f. On plastic pipe, install pads or cushions on bearing surfaces to prevent hanger from scratching pipe.
4. Install hangers for steel piping with the following maximum spacing and minimum rod sizes:
 - a. **NPS 3/4 (DN 20)**: Maximum span, **7 feet (2.1 m)**; minimum rod size, **3/8 inch (10 mm)**.
 - b. **NPS 1 (DN 25)**: Maximum span, **7 feet (2.1 m)**; minimum rod size, **3/8 inch (10 mm)**.
 - c. **NPS 1-1/4 (DN 32)**: Maximum span, **7 feet (2.1 m)**; minimum rod size, **3/8 inch (10 mm)**.
 - d. **NPS 1-1/2 (DN 40)**: Maximum span, **9 feet (2.7 m)**; minimum rod size, **3/8 inch (10 mm)**.
 - e. **NPS 2 (DN 50)**: Maximum span, **10 feet (3 m)**; minimum rod size, **3/8 inch (10 mm)**.
 - f. **NPS 2-1/2 (DN 65)**: Maximum span, **11 feet (3.4 m)**; minimum rod size, **1/2 inch (12 mm)**.
 - g. **NPS 3 (DN 80)**: Maximum span, **12 feet (3.7 m)**; minimum rod size, **1/2 inch (12 mm)**.
 - h. **NPS 3-1/2 (DN 90)**: Maximum span, **13 feet (4 m)**; minimum rod size, **1/2 inch (12 mm)**.
 - i. **NPS 4 (DN 100)**: Maximum span, **14 feet (4.3 m)**; minimum rod size, **5/8 inch (16 mm)**.
 - j. **NPS 5 (DN 125)**: Maximum span, **16 feet (4.9 m)**; minimum rod size, **5/8 inch (16 mm)**.
 - k. **NPS 6 (DN 150)**: Maximum span, **17 feet (5.2 m)**; minimum rod size, **3/4 inch (20 mm)**.
 - l. **NPS 8 (DN 200)**: Maximum span, **19 feet (5.8 m)**; minimum rod size, **3/4 inch (20 mm)**.
 - m. **NPS 10 (DN 250)**: Maximum span, **22 feet (6.7 m)**; minimum rod size, **7/8 inch (20 mm)**.
 - n. **NPS 12 (DN 300)**: Maximum span, **23 feet (7 m)**; minimum rod size, **7/8 inch (20 mm)**.
 - o. **NPS 14 (DN 350)**: Maximum span, **25 feet (7.6 m)**; minimum rod size, **1 inch (24 mm)**.
 - p. **NPS 16 (DN 400)**: Maximum span, **27 feet (8.2 m)**; minimum rod size, **1 inch (24 mm)**.
 - q. **NPS 18 (DN 450)**: Maximum span, **28 feet (8.5 m)**; minimum rod size, **1 inch (24 mm)**.
 - r. **NPS 20 (DN 500)**: Maximum span, **30 feet (9.1 m)**; minimum rod size, **1-1/4 inches (30 mm)**.
5. Install hangers for drawn-temper copper tubing with the following maximum spacing and minimum rod sizes:
 - a. **NPS 3/4 (DN 20)**: Maximum span, **5 feet (1.5 m)**; minimum rod size, **3/8 inch (10 mm)**.

- b. **NPS 1 (DN 25):** Maximum span, **6 feet (1.8 m)**; minimum rod size, **3/8 inch (10 mm)**.
 - c. **NPS 1-1/4 (DN 32):** Maximum span, **7 feet (2.1 m)**; minimum rod size, **3/8 inch (10 mm)**.
 - d. **NPS 1-1/2 (DN 40):** Maximum span, **8 feet (2.4 m)**; minimum rod size, **3/8 inch (10 mm)**.
 - e. **NPS 2 (DN 50):** Maximum span, **8 feet (2.4 m)**; minimum rod size, **3/8 inch (10 mm)**.
 - f. **NPS 2-1/2 (DN 65):** Maximum span, **9 feet (2.7 m)**; minimum rod size, **1/2 inch (12 mm)**.
 - g. **NPS 3 (DN 80):** Maximum span, **10 feet (3 m)**; minimum rod size, **1/2 inch (12 mm)**.
 6. **Plastic Piping Hanger Spacing:** Space hangers according to pipe manufacturer's written instructions for service conditions. Avoid point loading. Space and install hangers with the fewest practical rigid anchor points.
 7. **Fiberglass Piping Hanger Spacing:** Space hangers according to pipe manufacturer's written instructions for service conditions. Avoid point loading. Space and install hangers with the fewest practical rigid anchor points.
 8. Support vertical runs at roof, at each floor, and at **10-foot (3-m)** intervals between floors.
- E. **Pipe Joint Construction**
1. Join pipe and fittings according to the following requirements and Division 21 specifying piping systems.
 2. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
 3. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
 4. **Soldered Joints:** Apply ASTM B 813, water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook," using lead-free solder alloy complying with ASTM B 32.
 5. **Brazed Joints:** Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter, using copper-phosphorus brazing filler metal complying with AWS A5.8.
 6. **Threaded Joints:** Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
 - a. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
 - b. **Damaged Threads:** Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.
 7. **Welded Joints:** Construct joints according to AWS D10.12/D10.12M, using qualified processes and welding operators according to Part 1.1 "Quality Assurance" Article.
 8. **Flanged Joints:** Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.
 9. **Plastic Piping Solvent-Cemented Joints:** Clean and dry joining surfaces. Join pipe and fittings according to the following:
 - a. Comply with ASTM F 402 for safe-handling practice of cleaners, primers, and solvent cements.
 - b. **CPVC Piping:** Join according to ASTM D 2846/D 2846M Appendix.
 - c. **PVC Pressure Piping:** Join ASTM D 1785 schedule number, PVC pipe and PVC socket fittings according to ASTM D 2672. Join other-than-schedule number PVC pipe and socket fittings according to ASTM D 2855.
 - d. **PVC Nonpressure Piping:** Join according to ASTM D 2855.
 10. **Fiberglass Bonded Joints:** Prepare pipe ends and fittings, apply adhesive, and join according to pipe manufacturer's written instructions.
 11. **Grooved Joints:** Assemble joints with coupling and gasket, lubricant, and bolts. Cut or roll grooves in ends of pipe based on pipe and coupling manufacturer's written instructions for pipe wall thickness. Use grooved-end fittings and rigid, grooved-end-pipe couplings.
 12. **Mechanically Formed, Copper-Tube-Outlet Joints:** Use manufacturer-recommended tool and procedure, and brazed joints.
 13. **Pressure-Sealed Joints:** Use manufacturer-recommended tool and procedure. Leave insertion marks on pipe after assembly.
- F. **Hydronic Specialties Installation**

1. Install manual air vents at high points in piping, at heat-transfer coils, and elsewhere as required for system air venting.

OR

Install automatic air vents at high points of system piping in mechanical equipment rooms only. Manual vents at heat-transfer coils and elsewhere as required for air venting.

2. Install piping from boiler air outlet, air separator, or air purger to expansion tank with a 2 percent upward slope toward tank.
3. Install in-line air separators in pump suction. Install drain valve on air separators **NPS 2 (DN 50)** and larger.

OR

Install tangential air separator in pump suction. Install blowdown piping with gate or full-port ball valve; extend full size to nearest floor drain.

4. Install bypass chemical feeders in each hydronic system where indicated, in upright position with top of funnel not more than **48 inches (1200 mm)** above the floor. Install feeder in minimum **NPS 3/4 (DN 20)** bypass line, from main with full-size, full-port, ball valve in the main between bypass connections. Install **NPS 3/4 (DN 20)** pipe from chemical feeder drain, to nearest equipment drain and include a full-size, full-port, ball valve.
5. Install expansion tanks above the air separator. Install tank fitting in tank bottom and charge tank. Use manual vent for initial fill to establish proper water level in tank.
 - a. Install tank fittings that are shipped loose.
 - b. Support tank from floor or structure above with sufficient strength to carry weight of tank, piping connections, fittings, plus tank full of water. Do not overload building components and structural members.

OR

Install expansion tanks on the floor. Vent and purge air from hydronic system, and ensure tank is properly charged with air to suit system Project requirements.

G. Terminal Equipment Connections

1. Sizes for supply and return piping connections shall be the same as or larger than equipment connections.
2. Install control valves in accessible locations close to connected equipment.
3. Install bypass piping with globe valve around control valve. If parallel control valves are installed, only one bypass is required.
4. Install ports for pressure gages and thermometers at coil inlet and outlet connections according to Division 22 Section(s) "Meters And Gages For Plumbing Piping" OR Division 23 Section(s) "Meters And Gages For Hvac Piping".

H. Chemical Treatment

1. Perform an analysis of makeup water to determine type and quantities of chemical treatment needed to keep system free of scale, corrosion, and fouling, and to sustain the following water characteristics:
 - a. pH: 9.0 to 10.5.
 - b. "P" Alkalinity: 100 to 500 ppm.
 - c. Boron: 100 to 200 ppm.
 - d. Chemical Oxygen Demand: Maximum 100 ppm. Modify this value if closed system contains glycol.
 - e. Corrosion Inhibitor:
 - 1) Sodium Nitrate: 1000 to 1500 ppm.
 - 2) Molybdate: 200 to 300 ppm.
 - 3) Chromate: 200 to 300 ppm.
 - 4) Sodium Nitrate Plus Molybdate: 100 to 200 ppm each.
 - 5) Chromate Plus Molybdate: 50 to 100 ppm each.
 - f. Soluble Copper: Maximum 0.20 ppm.
 - g. Tolyriazole Copper and Yellow Metal Corrosion Inhibitor: Minimum 10 ppm.
 - h. Total Suspended Solids: Maximum 10 ppm.

- i. Ammonia: Maximum 20 ppm.
- j. Free Caustic Alkalinity: Maximum 20 ppm.
- k. Microbiological Limits:
 - 1) Total Aerobic Plate Count: Maximum 1000 organisms/ml.
 - 2) Total Anaerobic Plate Count: Maximum 100 organisms/ml.
 - 3) Nitrate Reducers: 100 organisms/ml.
 - 4) Sulfate Reducers: Maximum 0 organisms/ml.
 - 5) Iron Bacteria: Maximum 0 organisms/ml.
- 2. Fill system with fresh water and add liquid alkaline compound with emulsifying agents and detergents to remove grease and petroleum products from piping. Circulate solution for a minimum of 24 hours, drain, clean strainer screens, and refill with fresh water.
- 3. Add initial chemical treatment and maintain water quality in ranges noted above for the first year of operation.
- 4. Fill systems indicated to have antifreeze or glycol solutions with the following concentrations:
 - a. Hot-Water Heating Piping: Minimum percent ethylene, as directed by the Owner **OR** propylene, **as directed**, glycol.
 - b. Chilled-Water Piping: Minimum percent ethylene, as directed by the Owner **OR** propylene, **as directed**, glycol.
 - c. Dual-Temperature Heating and Cooling Water Piping: Minimum percent, as directed by the Owner ethylene **OR** propylene, **as directed**, glycol.
 - d. Glycol Cooling-Water Piping: Minimum percent ethylene, as directed by the Owner. **OR** propylene, **as directed**, glycol.
- I. Field Quality Control
 - 1. Prepare hydronic piping according to ASME B31.9 and as follows:
 - a. Leave joints, including welds, uninsulated and exposed for examination during test.
 - b. Provide temporary restraints for expansion joints that cannot sustain reactions due to test pressure. If temporary restraints are impractical, isolate expansion joints from testing.
 - c. Flush hydronic piping systems with clean water; then remove and clean or replace strainer screens.
 - d. Isolate equipment from piping. If a valve is used to isolate equipment, its closure shall be capable of sealing against test pressure without damage to valve. Install blinds in flanged joints to isolate equipment.
 - e. Install safety valve, set at a pressure no more than one-third higher than test pressure, to protect against damage by expanding liquid or other source of overpressure during test.
 - 2. Perform the following tests on hydronic piping:
 - a. Use ambient temperature water as a testing medium unless there is risk of damage due to freezing. Another liquid that is safe for workers and compatible with piping may be used.
 - b. While filling system, use vents installed at high points of system to release air. Use drains installed at low points for complete draining of test liquid.
 - c. Isolate expansion tanks and determine that hydronic system is full of water.
 - d. Subject piping system to hydrostatic test pressure that is not less than 1.5 times the system's working pressure. Test pressure shall not exceed maximum pressure for any vessel, pump, valve, or other component in system under test. Verify that stress due to pressure at bottom of vertical runs does not exceed 90 percent of specified minimum yield strength or 1.7 times "SE" value in Appendix A in ASME B31.9, "Building Services Piping."
 - e. After hydrostatic test pressure has been applied for at least 10 minutes, examine piping, joints, and connections for leakage. Eliminate leaks by tightening, repairing, or replacing components, and repeat hydrostatic test until there are no leaks.
 - f. Prepare written report of testing.
 - 3. Perform the following before operating the system:
 - a. Open manual valves fully.
 - b. Inspect pumps for proper rotation.
 - c. Set makeup pressure-reducing valves for required system pressure.
 - d. Inspect air vents at high points of system and determine if all are installed and operating freely (automatic type), or bleed air completely (manual type).

- e. Set temperature controls so all coils are calling for full flow.
- f. Inspect and set operating temperatures of hydronic equipment, such as boilers, chillers, cooling towers, to specified values.
- g. Verify lubrication of motors and bearings.

END OF SECTION 22 11 16 00c

NOT FOR BID

SECTION 22 11 16 00d - STEAM AND CONDENSATE PIPING

1.1 GENERAL

A. Description Of Work

1. This specification covers the furnishing and installation of materials for steam and condensate piping. Products shall be as follows or as directed by the Owner. Installation procedures shall be in accordance with the products manufacturer's recommendations. Demolition and removal of materials shall be as required to support the work.

B. Summary

1. This Section includes the following for LP and HP steam and condensate piping:
 - a. Pipe and fittings.
 - b. Strainers.
 - c. Flash tanks.
 - d. Safety valves.
 - e. Pressure-reducing valves.
 - f. Steam traps.
 - g. Thermostatic air vents and vacuum breakers.
 - h. Steam and condensate meters.

C. Definitions

1. HP Systems: High-pressure piping operating at more than **15 psig (104 kPa)** as required by ASME B31.1.
2. LP Systems: Low-pressure piping operating at **15 psig (104 kPa)** or less as required by ASME B31.9.
3. RTRF: Reinforced thermosetting resin (fiberglass) fittings.
4. RTRP: Reinforced thermosetting resin (fiberglass) pipe.

D. Performance Requirements

1. Components and installation shall be capable of withstanding the following minimum working pressures and temperatures:
 - a. HP Steam Piping: **<Insert psig (kPa).>**
 - b. LP Steam Piping: **<Insert psig (kPa).>**
 - c. Condensate Piping: **<Insert psig (kPa)> at 250 deg F (121 deg C).**
 - d. Makeup-Water Piping: **80 psig (552 kPa) at 150 deg F (66 deg C).**
 - e. Blowdown-Drain Piping: Equal to pressure of the piping system to which it is attached.
 - f. Air-Vent and Vacuum-Breaker Piping: Equal to pressure of the piping system to which it is attached.
 - g. Safety-Valve-Inlet and -Outlet Piping: Equal to pressure of the piping system to which it is attached.

E. Submittals

1. Product Data: For each type of the following:
 - a. RTRP and RTRF with adhesive.
 - b. Pressure-reducing and safety valve.
 - c. Steam trap.
 - d. Air vent and vacuum breaker.
 - e. Flash tank.
 - f. Meter.
2. Shop Drawings: Detail, **1/4 inch equals 1 foot (1:50)** scale, flash tank assemblies and fabrication of pipe anchors, hangers, pipe, multiple pipes, alignment guides, and expansion joints and loops and their attachment to the building structure. Detail locations of anchors, alignment guides, and expansion joints and loops.

3. Welding certificates.
4. Field quality-control test reports.
5. Operation and Maintenance Data: For valves, safety valves, pressure-reducing valves, steam traps, air vents, vacuum breakers, and meters to include in emergency, operation, and maintenance manuals.

F. Quality Assurance

1. Steel Support Welding: Qualify processes and operators according to AWS D1.1, "Structural Welding Code - Steel."
2. Pipe Welding: Qualify processes and operators according to the following:
 - a. Comply with provisions in ASME B31 Series, "Code for Pressure Piping."
 - b. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.
3. ASME Compliance: Comply with ASME B31.1, "Power Piping" **AND/OR** ASME B31.9, "Building Services Piping", **as directed**, for materials, products, and installation. Safety valves and pressure vessels shall bear the appropriate ASME label. Fabricate and stamp flash tanks to comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.

1.2 PRODUCTS

A. Copper Tube And Fittings

1. Drawn-Temper Copper Tubing: **ASTM B 88, Type L (ASTM B 88M, Type B) OR ASTM B 88, Type M (ASTM B 88M, Type C), as directed.**
2. Annealed-Temper Copper Tubing: **ASTM B 88, Type K (ASTM B 88M, Type A).**
3. Wrought-Copper Fittings and Unions: ASME B16.22.

B. Steel Pipe And Fittings

1. Steel Pipe: ASTM A 53/A 53M, black steel, plain ends, Type, Grade, and Schedule as indicated in Part 3 piping applications articles.
2. Cast-Iron Threaded Fittings: ASME B16.4; Classes 125, 150, and 300 as indicated in Part 3 piping applications articles.
3. Malleable-Iron Threaded Fittings: ASME B16.3; Classes 150 and 300 as indicated in Part 3 piping applications articles.
4. Malleable-Iron Unions: ASME B16.39; Classes 150, 250, and 300 as indicated in Part 3 piping applications articles.
5. Cast-Iron Threaded Flanges and Flanged Fittings: ASME B16.1, Classes 125 and 250 as indicated in Part 3 piping applications articles; raised ground face, and bolt holes spot faced.
6. Wrought-Steel Fittings: ASTM A 234/A 234M, wall thickness to match adjoining pipe.
7. Wrought-Steel Flanges and Flanged Fittings: ASME B16.5, including bolts, nuts, and gaskets of the following material group, end connections, and facings:
 - a. Material Group: 1.1.
 - b. End Connections: Butt welding.
 - c. Facings: Raised face.
8. Steel Pipe Nipples: ASTM A 733, made of ASTM A 53/A 53M, black steel of same Type, Grade, and Schedule as pipe in which installed.
9. Stainless-Steel Bellows, Flexible Connectors:
 - a. Body: Stainless-steel bellows with woven, flexible, bronze, wire-reinforced, protective jacket.
 - b. End Connections: Threaded or flanged to match equipment connected.
 - c. Performance: Capable of **3/4-inch (20-mm)** misalignment.
 - d. CWP Rating: **150-psig (1035-kPa).**
 - e. Maximum Operating Temperature: **250 deg F (121 deg C).**

C. Fiberglass Pipe And Fittings

1. RTRP: ASTM D 2996 filament-wound pipe with tapered bell and spigot ends for adhesive joints.
 2. RTRF: Compression or spray-up/contact molded fittings of same material, pressure class, and joining method as pipe.
 3. Flanges: ASTM D 4024 full-face gaskets suitable for the service, minimum **1/8 inch (3.2 mm)** thick, 60-70 durometer. ASTM A 307, Grade B, hex head bolts with washers.
 4. Bonding Adhesive for Fiberglass Piping: As recommended by fiberglass piping manufacturer.
- D. Joining Materials
1. Pipe-Flange Gasket Materials: Suitable for chemical and thermal conditions of piping system contents.
 - a. ASME B16.21, nonmetallic, flat, asbestos free, **1/8-inch (3.2-mm)** maximum thickness unless thickness or specific material is indicated.
 - 1) Full-Face Type: For flat-face, Class 125, cast-iron and cast-bronze flanges.
 - 2) Narrow-Face Type: For raised-face, Class 250, cast-iron and steel flanges.
 2. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated.
 3. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.
 4. Brazing Filler Metals: AWS A5.8, BCuP Series, copper-phosphorus alloys for joining copper with copper; or BA9-1, silver alloy for joining copper with bronze or steel.
 5. Welding Filler Metals: Comply with **AWS D10.12 (AWS D10.12M)** for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.
 6. Welding Materials: Comply with Section II, Part C, of ASME Boiler and Pressure Vessel Code for welding materials appropriate for wall thickness and for chemical analysis of pipe being welded.
- E. Dielectric Fittings
1. Description: Combination fitting of copper alloy and ferrous materials with threaded, solder-joint, plain, or weld-neck end connections that match piping system materials.
 2. Insulating Material: Suitable for system fluid, pressure, and temperature.
 3. Dielectric Unions:
 - a. Factory-fabricated union assembly, for **250-psig (1725-kPa)** minimum working pressure at **180 deg F (82 deg C)**.
 4. Dielectric Flanges:
 - a. Factory-fabricated companion-flange assembly, for **150- or 300-psig (1035- or 2070-kPa)** minimum working pressure as required to suit system pressures.
 5. Dielectric-Flange Kits:
 - a. Companion-flange assembly for field assembly. Include flanges, full-face- or ring-type neoprene or phenolic gasket, phenolic or polyethylene bolt sleeves, phenolic washers, and steel backing washers.
 - b. Separate companion flanges and steel bolts and nuts shall have **150- or 300-psig (1035- or 2070-kPa)** minimum working pressure as required to suit system pressures.
- F. Valves
1. Gate, Globe, Check, Ball, and Butterfly Valves: Comply with requirements specified in Division 23 Section "General-duty Valves For Hvac Piping".
 2. Stop-Check Valves:
 - a. Body and Bonnet: Malleable iron.
 - b. End Connections: Flanged.
 - c. Disc: Cylindrical with removable liner and machined seat.
 - d. Stem: Brass alloy.
 - e. Operator: Outside screw and yoke with cast-iron handwheel.
 - f. Packing: Polytetrafluoroethylene-impregnated packing with two-piece packing gland assembly.
 - g. Pressure Class: 250.
- G. Strainers
1. Y-Pattern Strainers:

- a. Body: ASTM A 126, Class B cast iron, with bolted cover and bottom drain connection.
 - b. End Connections: Threaded ends for strainers **NPS 2 (DN 50)** and smaller; flanged ends for strainers **NPS 2-1/2 (DN 65)** and larger.
 - c. Strainer Screen: Stainless-steel, 20 mesh strainer, and perforated stainless-steel basket with 50 percent free area.
 - d. Tapped blowoff plug.
 - e. CWP Rating: **250-psig (1725-kPa)** working steam pressure.
 2. Basket Strainers:
 - a. Body: ASTM A 126, Class B cast iron, with bolted cover and bottom drain connection.
 - b. End Connections: Threaded ends for strainers **NPS 2 (DN 50)** and smaller; flanged ends for strainers **NPS 2-1/2 (DN 65)** and larger.
 - c. Strainer Screen: Stainless-steel, 20 mesh strainer, and perforated stainless-steel basket with 50 percent free area.
 - d. CWP Rating: **250-psig (1725-kPa)** working steam pressure.
- H. Flash Tanks
1. Shop or factory fabricated of welded steel according to ASME Boiler and Pressure Vessel Code, for **150-psig (1035-kPa)** rating; and bearing ASME label. Fabricate with tappings for low-pressure steam and condensate outlets, high-pressure condensate inlet, air vent, safety valve, and legs.
- I. Safety Valves
1. Bronze **OR** Brass, **as directed**, Safety Valves:
 - a. Disc Material: Forged copper alloy.
 - b. End Connections: Threaded inlet and outlet.
 - c. Spring: Fully enclosed steel spring with adjustable pressure range and positive shutoff, factory set and sealed.
 - d. Pressure Class: 250.
 - e. Drip-Pan Elbow: Cast iron and having threaded inlet and outlet with threads complying with ASME B1.20.1.
 - f. Size and Capacity: As required for equipment according to ASME Boiler and Pressure Vessel Code.
 2. Cast-Iron Safety Valves:
 - a. Disc Material: Forged copper alloy with bronze nozzle.
 - b. End Connections: Raised-face flanged inlet and threaded or flanged outlet connections.
 - c. Spring: Fully enclosed cadmium-plated steel spring with adjustable pressure range and positive shutoff, factory set and sealed.
 - d. Pressure Class: 250.
 - e. Drip-Pan Elbow: Cast iron and having threaded inlet, outlet, and drain, with threads complying with ASME B1.20.1.
 - f. Exhaust Head: Cast iron and having threaded inlet and drain, with threads complying with ASME B1.20.1.
 - g. Size and Capacity: As required for equipment according to ASME Boiler and Pressure Vessel Code.
- J. Pressure-Reducing Valves
1. Size, Capacity, and Pressure Rating: Factory set for inlet and outlet pressures indicated.
 2. Description: Pilot-actuated, diaphragm type, with adjustable pressure range and positive shutoff.
 3. Body: Cast iron.
 4. End Connections: Threaded connections for valves **NPS 2 (DN 50)** and smaller and flanged connections for valves **NPS 2-1/2 (DN 65)** and larger.
 5. Trim: Hardened stainless steel.
 6. Head and Seat: Replaceable, main head stem guide fitted with flushing and pressure-arresting device cover over pilot diaphragm.
 7. Gaskets: Non-asbestos materials.

K. Steam Traps

1. Thermostatic Traps:
 - a. Body: Bronze angle-pattern body with integral union tailpiece and screw-in cap.
 - b. Trap Type: Balanced-pressure.
 - c. Bellows: Stainless steel or monel.
 - d. Head and Seat: Replaceable, hardened stainless steel.
 - e. Pressure Class: 125.
2. Thermodynamic Traps:
 - a. Body: Stainless steel with screw-in cap.
 - b. End Connections: Threaded.
 - c. Disc and Seat: Stainless steel.
 - d. Maximum Operating Pressure: 600 psig (4140 kPa).
3. Float and Thermostatic Traps:
 - a. Body and Bolted Cap: ASTM A 126, cast iron.
 - b. End Connections: Threaded.
 - c. Float Mechanism: Replaceable, stainless steel.
 - d. Head and Seat: Hardened stainless steel.
 - e. Trap Type: Balanced pressure.
 - f. Thermostatic Bellows: Stainless steel or monel.
 - g. Thermostatic air vent capable of withstanding 45 deg F (25 deg C) of superheat and resisting water hammer without sustaining damage.
 - h. Vacuum Breaker: Thermostatic with phosphor bronze bellows, and stainless steel cage, valve, and seat.
 - i. Maximum Operating Pressure: 125 psig (860 kPa).
4. Inverted Bucket Traps:
 - a. Body and Cap: Cast iron.
 - b. End Connections: Threaded.
 - c. Head and Seat: Stainless steel.
 - d. Valve Retainer, Lever, and Guide Pin Assembly: Stainless steel.
 - e. Bucket: Brass or stainless steel.
 - f. Strainer: Integral stainless-steel inlet strainer within the trap body.
 - g. Air Vent: Stainless-steel thermostatic vent.
 - h. Pressure Rating: 250 psig (1725 kPa).

L. Thermostatic Air Vents And Vacuum Breakers

1. Thermostatic Air Vents:
 - a. Body: Cast iron, bronze or stainless steel.
 - b. End Connections: Threaded.
 - c. Float, Valve, and Seat: Stainless steel.
 - d. Thermostatic Element: Phosphor bronze bellows in a stainless-steel cage.
 - e. Pressure Rating: 125 psig (861 kPa) OR 300 psig (2068 kPa), as directed.
 - f. Maximum Temperature Rating: 350 deg F (177 deg C).
2. Vacuum Breakers:
 - a. Body: Cast iron, bronze, or stainless steel.
 - b. End Connections: Threaded.
 - c. Sealing Ball, Retainer, Spring, and Screen: Stainless steel.
 - d. O-ring Seal: EPR.
 - e. Pressure Rating: 125 psig (861 kPa) OR 300 psig (2068 kPa), as directed.
 - f. Maximum Temperature Rating: 350 deg F (177 deg C).

M. Steam Meters

1. Meters shall have a microprocessor to display totalizer flow, flow rate, temperature, pressure, time, and date; alarms for high and low flow rate and temperature.
 - a. Computer shall have 4 to 20-mA or 2 to 10 volt output for temperature, pressure, and contact closure for flow increments.
 - b. Independent timers to store four peak flow rates and total flow.

- c. Interface compatible with central workstation described in Division 23 Section "Instrumentation And Control For Hvac".
- d. Microprocessor Enclosure: NEMA 250, Type 4.
- 2. Sensor:
 - a. Venturi, of stainless-steel **OR** carbon-steel, **as directed**, construction, for insertion in pipeline between flanges. At least 10:1 turndown with plus or minus 1 percent accuracy over full-flow range.
 - b. Vortex type with stainless-steel wetted parts and wafer **OR** flange, **as directed**, connections; and with a piezoelectric sensor removable and serviceable without shutting down the process. At least 10:1 turndown with plus or minus 1 percent accuracy over full-flow range.
 - c. Spring-loaded, variable-area flowmeter type; density compensated with stainless-steel wetted parts and wafer **OR** flange, **as directed**, connections. At least 10:1 turndown with plus or minus 2 percent accuracy over full-flow range.

N. Condensate Meters

- 1. Body: Cast iron, bronze, or brass.
- 2. Turbine: Copper, brass, or stainless steel.
- 3. Connections: Threaded for **NPS 2 (DN 50)** and smaller and flanged for **NPS 2-1/2 (DN 65)**.
- 4. Totalizer: Meters shall have a microprocessor to display flow, flow rate, time, and date; alarms for high and low flow rate, pressure, and temperature.
 - a. Computer shall have 4- to 20-mA or 2- to 10-volt output for temperature, pressure, and contact closure for flow increments.
 - b. Independent timers to store four peak flow rates and total flow.
 - c. Interface compatible with central workstation specified in Division 23 Section "Instrumentation And Control For Hvac".
 - d. Microprocessor Enclosure: NEMA 250, Type 4.
- 5. Pressure Rating: Atmospheric.
- 6. Maximum Temperature Rating: **250 deg F (121 deg C)**.

1.3 EXECUTION

A. LP Steam Piping Applications

- 1. LP Steam Piping, **NPS 2 (DN 50)** and Smaller: Schedule 40 **OR** 80, **as directed**, Type S, Grade B, steel pipe; Class 125 cast-iron fittings; and threaded joints.
- 2. LP Steam Piping, **NPS 2-1/2 through NPS 12 (DN 65 through DN 300)**: Schedule 40 **OR** 80, **as directed**, Type E, Grade B, steel pipe; Class 150 wrought-steel fittings, flanges, and flange fittings; and welded and flanged joints.
- 3. LP Steam Piping, **NPS 14 through NPS 18 (DN 350 through DN 450)**: Schedule 30, Type E, Grade B, steel pipe; Class 150 wrought-steel fittings, flanges, and flange fittings; and welded and flanged joints.
- 4. LP Steam Piping, **NPS 20 (DN 500)** and Larger: Schedule 20, Type E, Grade B, steel pipe; Class 150 wrought-steel fittings, flanges, and flange fittings; and welded and flanged joints.
- 5. Condensate piping above grade, **NPS 2 (DN 50)** and smaller, shall be either of the following, **as directed**:
 - a. Schedule 80, Type S, Grade B, steel pipe; Class 125 cast-iron fittings; and threaded joints.
 - b. RTRP and RTRF with adhesive or flanged joints.
- 6. Condensate piping above grade, **NPS 2-1/2 (DN 65)** and larger, shall be either of the following, **as directed**:
 - a. Schedule 80, Type E, Grade B, steel pipe; Class 150 wrought-steel fittings, flanges, and flange fittings; and welded and flanged joints.
 - b. RTRP and RTRF with adhesive or flanged joints.
- 7. Condensate piping below grade, **NPS 2 (DN 50)** and smaller, shall be either of the following, **as directed**:

- a. Schedule 80, Type S, Grade B, steel pipe; Class 125 cast-iron fittings; and threaded joints.
 - b. RTRP and RTRF with adhesive or flanged joints.
 8. Condensate piping below grade, **NPS 2-1/2 (DN 65)** and larger, shall be either of the following, **as directed**:
 - a. Schedule 80, Type E, Grade B, steel pipe; Class 150 wrought-steel fittings, flanges, and flange fittings; and welded and flanged joints.
 - b. RTRP and RTRF with adhesive or flanged joints.
- B. HP Steam Piping Applications
 1. HP Steam Piping, **NPS 2 (DN 50)** and Smaller: Schedule 40 **OR** 80, **as directed**, Type S, Grade B, steel pipe; Class 125 cast-iron fittings; and threaded joints.
 2. HP Steam Piping, **NPS 2-1/2 through NPS 12 (DN 65 through DN 300)**; Schedule 40 **OR** 80, **as directed**, Type E, Grade B, steel pipe; Class 150 wrought-steel fittings, flanges, and flange fittings; and welded and flanged joints.
 3. HP Steam Piping, **NPS 14 through NPS 18 (DN 350 through DN 450)**; Schedule 30, Type E, Grade B, steel pipe; Class 150 wrought-steel fittings, flanges, and flange fittings; and welded and flanged joints.
 4. HP Steam Piping, **NPS 20 (DN 500)** and Larger: Schedule 20, Type E, Grade B, steel pipe; Class 150 wrought-steel fittings, flanges, and flange fittings; and welded and flanged joints.
 5. Condensate piping above grade, **NPS 2 (DN 50)** and smaller, shall be either of the following, **as directed**:
 - a. Schedule 80, Type S, Grade B, steel pipe; Class 125 cast-iron fittings; and threaded joints.
 - b. RTRP and RTRF with adhesive or flanged joints.
 6. Condensate piping above grade, **NPS 2-1/2 (DN 65)** and larger, shall be either of the following, **as directed**:
 - a. Schedule 80, Type E, Grade B, steel pipe; Class 150 wrought-steel fittings, flanges, and flange fittings; and welded and flanged joints.
 - b. RTRP and RTRF with adhesive or flanged joints.
 7. Condensate piping below grade, **NPS 2 (DN 50)** and smaller, shall be either of the following, **as directed**:
 - a. Schedule 80, Type S, Grade B, steel pipe; Class 125 cast-iron fittings; and threaded joints.
 - b. RTRP and RTRF with adhesive or flanged joints.
 8. Condensate piping below grade, **NPS 2-1/2 (DN 65)** and larger, shall be either of the following, **as directed**:
 - a. Schedule 80, Type E, Grade B, steel pipe; Class 150 wrought-steel fittings, flanges, and flange fittings; and welded and flanged joints.
 - b. RTRP and RTRF with adhesive or flanged joints.
- C. Ancillary Piping Applications
 1. Makeup-water piping installed above grade shall be either of the following, **as directed**:
 - a. Drawn-temper copper tubing, wrought-copper fittings, and soldered **OR** brazed, **as directed**, joints.
 - b. Schedule 40 **OR** 80, **as directed**, CPVC plastic pipe and fittings, and solvent welded joints.
 2. Makeup-Water Piping Installed below Grade and within Slabs: Annealed-temper copper tubing, wrought-copper fittings, and soldered joints. Use the fewest possible joints.
 3. Blowdown-Drain Piping: Same materials and joining methods as for piping specified for the service in which blowdown drain is installed.
 4. Air-Vent Piping:
 - a. Inlet: Same as service where installed.
 - b. Outlet: Type **K (A)** annealed-temper copper tubing with soldered or flared joints.
 5. Vacuum-Breaker Piping: Outlet, same as service where installed.
 6. Safety-Valve-Inlet and -Outlet Piping: Same materials and joining methods as for piping specified for the service in which safety valve is installed.
- D. Valve Applications



1. Install shutoff duty valves at branch connections to steam supply mains, at steam supply connections to equipment, and at the outlet of steam traps.
2. Install safety valves on pressure-reducing stations and elsewhere as required by ASME Boiler and Pressure Vessel Code. Install safety-valve discharge piping, without valves, to nearest floor drain or as indicated on Drawings. Comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 1, for installation requirements.

E. Piping Installation

1. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Use indicated piping locations and arrangements if such were used to size pipe and calculate friction loss, expansion, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.
2. Install piping in concealed locations, unless otherwise indicated and except in equipment rooms and service areas.
3. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
4. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
5. Install piping to permit valve servicing.
6. Install piping free of sags and bends.
7. Install fittings for changes in direction and branch connections.
8. Install piping to allow application of insulation.
9. Select system components with pressure rating equal to or greater than system operating pressure.
10. Install groups of pipes parallel to each other, spaced to permit applying insulation and servicing of valves.
11. Install drains, consisting of a tee fitting, **NPS 3/4 (DN 20)** full port-ball valve, and short **NPS 3/4 (DN 20)** threaded nipple with cap, at low points in piping system mains and elsewhere as required for system drainage.
12. Install steam supply piping at a minimum uniform grade of 0.2 percent downward in direction of steam flow.
13. Install condensate return piping at a minimum uniform grade of 0.4 percent downward in direction of condensate flow.
14. Reduce pipe sizes using eccentric reducer fitting installed with level side down.
15. Install branch connections to mains using mechanically formed, **as directed**, tee fittings in main pipe, with the branch connected to top of main pipe.
16. Install valves according to Division 23 Section "General-duty Valves For Hvac Piping".
17. Install unions in piping, **NPS 2 (DN 50)** and smaller, adjacent to valves, at final connections of equipment, and elsewhere as indicated.
18. Install flanges in piping, **NPS 2-1/2 (DN 65)** and larger, at final connections of equipment and elsewhere as indicated.
19. Install strainers on supply side of control valves, pressure-reducing valves, traps, and elsewhere as indicated. Install **NPS 3/4 (DN 20)** nipple and full port ball valve in blowdown connection of strainers **NPS 2 (DN 50)** and larger. Match size of strainer blowoff connection for strainers smaller than **NPS 2 (DN 50)**.
20. Install expansion loops, expansion joints, anchors, and pipe alignment guides as specified in Division 23 Section "Expansion Fittings And Loops For Hvac Piping".
21. Identify piping as specified in Division 23 Section "Identification For Hvac Piping And Equipment".
22. Install drip legs at low points and natural drainage points such as ends of mains, bottoms of risers, and ahead of pressure regulators, and control valves.
 - a. On straight runs with no natural drainage points, install drip legs at intervals not exceeding **300 feet (90 m)**.
 - b. Size drip legs same size as main. In steam mains **NPS 6 (DN 150)** and larger, drip leg size can be reduced, but to no less than **NPS 4 (DN 100)**.
23. Flash Tank:

- a. Pitch condensate piping down toward flash tank.
 - b. If more than one condensate pipe discharges into flash tank, install a check valve in each line.
 - c. Install thermostatic air vent at tank top.
 - d. Install safety valve at tank top.
 - e. Install full-port ball valve, and swing check valve on condensate outlet.
 - f. Install inverted bucket or float and thermostatic trap at low-pressure condensate outlet, sized for three times the calculated heat load.
 - g. Install pressure gage on low-pressure steam outlet according to Division 23 Section "Meters And Gages For Hvac Piping".
- F. Steam-Trap Installation
1. Install steam traps in accessible locations as close as possible to connected equipment.
 2. Install full-port ball valve, strainer, and union upstream from trap; install union, check valve, and full-port ball valve downstream from trap unless otherwise indicated.
- G. Pressure-Reducing Valve Installation
1. Install pressure-reducing valves in accessible location for maintenance and inspection.
 2. Install bypass piping around pressure-reducing valves, with globe valve equal in size to area of pressure-reducing valve seat ring, unless otherwise indicated.
 3. Install gate valves on both sides of pressure-reducing valves.
 4. Install unions or flanges on both sides of pressure-reducing valves having threaded- or flanged-end connections respectively.
 5. Install pressure gages on low-pressure side of pressure-reducing valves after the bypass connection according to Division 23 Section "Meters And Gages For Hvac Piping".
 6. Install strainers upstream for pressure-reducing valve.
 7. Install safety valve downstream from pressure-reducing valve station.
- H. Steam Or Condensate Meter Installation
1. Install meters with lengths of straight pipe upstream and downstream according to steam meter manufacturer's instructions.
 2. Provide data acquisition wiring. Refer to Division 23 Section "Instrumentation And Control For Hvac".
- I. Safety Valve Installation
1. Install safety valves according to ASME B31.1, "Power Piping" **OR** ASME B31.9, "Building Services Piping," **as directed**
 2. Pipe safety-valve discharge without valves to atmosphere outside the building.
 3. Install drip-pan elbow fitting adjacent to safety valve and pipe drain connection to nearest floor drain.
 4. Install exhaust head with drain to waste, on vents equal to or larger than **NPS 2-1/2 (DN 65)**.
- J. Hangers And Supports
1. Install hangers and supports according to Division 23 Section "Hangers And Supports For Hvac Piping And Equipment". Comply with requirements below for maximum spacing.
 2. Seismic restraints are specified in Division 23 Section "Vibration And Seismic Controls For Hvac Piping And Equipment".
 3. Install the following pipe attachments:
 - a. Adjustable steel clevis hangers for individual horizontal piping less than **20 feet (6 m)** long.
 - b. Adjustable roller hangers and spring hangers for individual horizontal piping **20 feet (6 m)** or longer.
 - c. Pipe Roller: MSS SP-58, Type 44 for multiple horizontal piping **20 feet (6 m)** or longer, supported on a trapeze.
 - d. Spring hangers to support vertical runs.
 4. Install hangers with the following maximum spacing and minimum rod sizes:
 - a. **NPS 3/4 (DN 20)**: Maximum span, **9 feet (2.7 m)**; minimum rod size, **1/4 inch (6.4 mm)**.

- b. **NPS 1 (DN 25):** Maximum span, **9 feet (2.7 m)**; minimum rod size, **1/4 inch (6.4 mm)**.
 - c. **NPS 1-1/2 (DN 40):** Maximum span, **12 feet (3.7 m)**; minimum rod size, **3/8 inch (10 mm)**.
 - d. **NPS 2 (DN 50):** Maximum span, **13 feet (4 m)**; minimum rod size, **3/8 inch (10 mm)**.
 - e. **NPS 2-1/2 (DN 65):** Maximum span, **14 feet (4.3 m)**; minimum rod size, **3/8 inch (10 mm)**.
 - f. **NPS 3 (DN 80):** Maximum span, **15 feet (4.6 m)**; minimum rod size, **3/8 inch (10 mm)**.
 - g. **NPS 4 (DN 100):** Maximum span, **17 feet (5.2 m)**; minimum rod size, **1/2 inch (13 mm)**.
 - h. **NPS 6 (DN 150):** Maximum span, **21 feet (6.4 m)**; minimum rod size, **1/2 inch (13 mm)**.
 - i. **NPS 8 (DN 200):** Maximum span, **24 feet (7.3 m)**; minimum rod size, **5/8 inch (16 mm)**.
 - j. **NPS 10 (DN 250):** Maximum span, **26 feet (8 m)**; minimum rod size, **3/4 inch (19 mm)**.
 - k. **NPS 12 (DN 300):** Maximum span, **30 feet (9.1 m)**; minimum rod size, **7/8 inch (22 mm)**.
 - l. **NPS 14 (DN 350):** Maximum span, **32 feet (9.8 m)**; minimum rod size, **1 inch (25 mm)**.
 - m. **NPS 16 (DN 400):** Maximum span, **35 feet (10.7 m)**; minimum rod size, **1 inch (25 mm)**.
 - n. **NPS 18 (DN 450):** Maximum span, **37 feet (11.3 m)**; minimum rod size, **1-1/4 inches (32 mm)**.
 - o. **NPS 20 (DN 500):** Maximum span, **39 feet (11.9 m)**; minimum rod size, **1-1/4 inches (32 mm)**.
5. Install hangers for drawn-temper copper piping with the following maximum spacing and minimum rod sizes:
- a. **NPS 1/2 (DN 15):** Maximum span, **4 feet (1.2 m)**; minimum rod size, **1/4 inch (6.4 mm)**.
 - b. **NPS 3/4 (DN 20):** Maximum span, **5 feet (1.5 m)**; minimum rod size, **1/4 inch (6.4 mm)**.
 - c. **NPS 1 (DN 25):** Maximum span, **6 feet (1.8 m)**; minimum rod size, **1/4 inch (6.4 mm)**.
 - d. **NPS 1-1/2 (DN 40):** Maximum span, **8 feet (2.4 m)**; minimum rod size, **3/8 inch (10 mm)**.
 - e. **NPS 2 (DN 50):** Maximum span, **8 feet (2.4 m)**; minimum rod size, **3/8 inch (10 mm)**.
 - f. **NPS 2-1/2 (DN 65):** Maximum span, **9 feet (2.7 m)**; minimum rod size, **3/8 inch (10 mm)**.
 - g. **NPS 3 (DN 80):** Maximum span, **10 feet (3 m)**; minimum rod size, **3/8 inch (10 mm)**.
6. Support vertical runs at roof, at each floor, and at **10-foot (3-m)** intervals between floors.
7. Fiberglass Piping Hanger Spacing: Space hangers according to pipe manufacturer's written instructions for service conditions. Avoid point loading. Space and install hangers with the fewest practical rigid anchor points.

K. Pipe Joint Construction

1. Join pipe and fittings according to the following requirements and Division 21 specifying piping systems.
2. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
3. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
4. Soldered Joints: Apply ASTM B 813, water-flushable flux, unless otherwise indicated, to tube ends. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook," using lead-free solder alloy complying with ASTM B 32.
5. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" chapter, using copper-phosphorus brazing filler metal complying with AWS A5.8.
6. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
 - a. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
 - b. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.
7. Welded Joints: Construct joints according to **AWS D10.12 (AWS D10.12M)**, using qualified processes and welding operators according to Part 1 "Quality Assurance" Article.
8. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.
9. Fiberglass Bonded Joints: Prepare pipe ends and fittings, apply adhesive, and join according to pipe manufacturer's written instructions.

L. Terminal Equipment Connections

1. Size for supply and return piping connections shall be the same as or larger than equipment connections.
2. Install traps and control valves in accessible locations close to connected equipment.
3. Install bypass piping with globe valve around control valve. If parallel control valves are installed, only one bypass is required.
4. Install vacuum breakers downstream from control valve, close to coil inlet connection.
5. Install a drip leg at coil outlet.

M. Field Quality Control

1. Prepare steam and condensate piping according to ASME B31.1, "Power Piping" **AND/OR** ASME B31.9, "Building Services Piping," **as directed**, and as follows:
 - a. Leave joints, including welds, uninsulated and exposed for examination during test.
 - b. Provide temporary restraints for expansion joints that cannot sustain reactions due to test pressure. If temporary restraints are impractical, isolate expansion joints from testing.
 - c. Flush system with clean water. Clean strainers.
 - d. Isolate equipment from piping. If a valve is used to isolate equipment, its closure shall be capable of sealing against test pressure without damage to valve. Install blinds in flanged joints to isolate equipment.
2. Perform the following tests on steam and condensate piping:
 - a. Use ambient temperature water as a testing medium unless there is risk of damage due to freezing. Another liquid that is safe for workers and compatible with piping may be used.
 - b. Subject piping system to hydrostatic test pressure that is not less than 1.5 times the working pressure. Test pressure shall not exceed maximum pressure for any vessel, pump, valve, or other component in system under test. Verify that stress due to pressure at bottom of vertical runs does not exceed 90 percent of specified minimum yield strength.
 - c. After hydrostatic test pressure has been applied for at least 10 minutes, examine piping, joints, and connections for leakage. Eliminate leaks by tightening, repairing, or replacing components, and repeat hydrostatic test until there are no leaks.
3. Prepare written report of testing.

END OF SECTION 22 11 16 00d

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SECTION 22 11 16 00e - REFRIGERANT PIPING

1.1 GENERAL

A. Description Of Work

1. This specification covers the furnishing and installation of materials for refrigerant piping. Products shall be as follows or as directed by the Owner. Installation procedures shall be in accordance with the products manufacturer's recommendations. Demolition and removal of materials shall be as required to support the work.

B. Summary

1. This Section includes refrigerant piping used for air-conditioning applications.

C. Performance Requirements

1. Line Test Pressure for Refrigerant R-134a:
 - a. Suction Lines for Air-Conditioning Applications: **115 psig** (793 kPa).
 - b. Suction Lines for Heat-Pump Applications: **225 psig** (1551 kPa).
 - c. Hot-Gas and Liquid Lines: **225 psig** (1551 kPa).
2. Line Test Pressure for Refrigerant R-407C:
 - a. Suction Lines for Air-Conditioning Applications: **230 psig** (1586 kPa).
 - b. Suction Lines for Heat-Pump Applications: **380 psig** (2620 kPa).
 - c. Hot-Gas and Liquid Lines: **380 psig** (2620 kPa).
3. Line Test Pressure for Refrigerant R-410A:
 - a. Suction Lines for Air-Conditioning Applications: **300 psig** (2068 kPa).
 - b. Suction Lines for Heat-Pump Applications: **535 psig** (3689 kPa).
 - c. Hot-Gas and Liquid Lines: **535 psig** (3689 kPa).

D. Submittals

1. Product Data: For each type of valve and refrigerant piping specialty indicated. Include pressure drop, based on manufacturer's test data, for the following:
 - a. Thermostatic expansion valves.
 - b. Solenoid valves.
 - c. Hot-gas bypass valves.
 - d. Filter dryers.
 - e. Strainers.
 - f. Pressure-regulating valves.
2. Shop Drawings: Show layout of refrigerant piping and specialties, including pipe, tube, and fitting sizes, flow capacities, valve arrangements and locations, slopes of horizontal runs, oil traps, double risers, wall and floor penetrations, and equipment connection details. Show interface and spatial relationships between piping and equipment.
 - a. Shop Drawing Scale: **1/4 inch equals 1 foot** (1:50).
 - b. Refrigerant piping indicated on Drawings is schematic only. Size piping and design actual piping layout, including oil traps, double risers, specialties, and pipe and tube sizes to accommodate, as a minimum, equipment provided, elevation difference between compressor and evaporator, and length of piping to ensure proper operation and compliance with warranties of connected equipment.
3. Welding certificates.
4. Field quality-control test reports.
5. Operation and Maintenance Data: For refrigerant valves and piping specialties to include in maintenance manuals.

E. Quality Assurance

1. Welding: Qualify procedures and personnel according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."

2. Comply with ASHRAE 15, "Safety Code for Refrigeration Systems."
3. Comply with ASME B31.5, "Refrigeration Piping and Heat Transfer Components."

F. Product Storage And Handling

1. Store piping in a clean and protected area with end caps in place to ensure that piping interior and exterior are clean when installed.

1.2 PRODUCTS

A. Copper Tube And Fittings

1. Copper Tube: **ASTM B 88, Type K or L (ASTM B 88M, Type A or B) OR ASTM B 280, Type ACR, as directed.**
2. Wrought-Copper Fittings: ASME B16.22.
3. Wrought-Copper Unions: ASME B16.22.
4. Solder Filler Metals: ASTM B 32. Use 95-5 tin antimony or alloy HB solder to join copper socket fittings on copper pipe.
5. Brazing Filler Metals: AWS A5.8.
6. Flexible Connectors:
 - a. Body: Tin-bronze bellows with woven, flexible, tinned-bronze-wire-reinforced protective jacket.
 - b. End Connections: Socket ends.
 - c. Offset Performance: Capable of minimum **3/4-inch (20-mm)** misalignment in minimum **7-inch- (180-mm-)** long assembly.
 - d. Pressure Rating: Factory test at minimum **500 psig (3450 kPa).**
 - e. Maximum Operating Temperature: **250 deg F (121 deg C).**

B. Steel Pipe And Fittings

1. Steel Pipe: ASTM A 53/A 53M, black steel with plain ends; Type, Grade, and wall thickness as selected in Part 3 piping applications articles.
2. Wrought-Steel Fittings: ASTM A 234/A 234M, for welded joints.
3. Steel Flanges and Flanged Fittings: ASME B16.5, steel, including bolts, nuts, and gaskets, bevel-welded end connection, and raised face.
4. Welding Filler Metals: Comply with AWS D10.12/D10.12M for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.
5. Flanged Unions:
 - a. Body: Forged-steel flanges for **NPS 1 to NPS 1-1/2 (DN 25 to DN 40)** and ductile iron for **NPS 2 to NPS 3 (DN 50 to DN 80)**. Apply rust-resistant finish at factory.
 - b. Gasket: Fiber asbestos free.
 - c. Fasteners: Four plated-steel bolts, with silicon bronze nuts. Apply rust-resistant finish at factory.
 - d. End Connections: Brass tailpiece adapters for solder-end connections to copper tubing.
 - e. Offset Performance: Capable of minimum **3/4-inch (20-mm)** misalignment in minimum **7-inch- (180-mm-)** long assembly.
 - f. Pressure Rating: Factory test at minimum **400 psig (2760 kPa).**
 - g. Maximum Operating Temperature: **330 deg F (165 deg C).**
6. Flexible Connectors:
 - a. Body: Stainless-steel bellows with woven, flexible, stainless-steel-wire-reinforced protective jacket
 - b. End Connections:
 - 1) **NPS 2 (DN 50)** and Smaller: With threaded-end connections.
 - 2) **NPS 2-1/2 (DN 65)** and Larger: With flanged-end connections.
 - c. Offset Performance: Capable of minimum **3/4-inch (20-mm)** misalignment in minimum **7-inch- (180-mm-)** long assembly.
 - d. Pressure Rating: Factory test at minimum **500 psig (3450 kPa).**

- e. Maximum Operating Temperature: 250 deg F (121 deg C).

C. Valves And Specialties

1. Diaphragm Packless Valves:
 - a. Body and Bonnet: Forged brass or cast bronze; globe design with straight-through or angle pattern.
 - b. Diaphragm: Phosphor bronze and stainless steel with stainless-steel spring.
 - c. Operator: Rising stem and hand wheel.
 - d. Seat: Nylon.
 - e. End Connections: Socket, union, or flanged.
 - f. Working Pressure Rating: 500 psig (3450 kPa).
 - g. Maximum Operating Temperature: 275 deg F (135 deg C).
2. Packed-Angle Valves:
 - a. Body and Bonnet: Forged brass or cast bronze.
 - b. Packing: Molded stem, back seating, and replaceable under pressure.
 - c. Operator: Rising stem.
 - d. Seat: Nonrotating, self-aligning polytetrafluoroethylene.
 - e. Seal Cap: Forged-brass or valox hex cap.
 - f. End Connections: Socket, union, threaded, or flanged.
 - g. Working Pressure Rating: 500 psig (3450 kPa).
 - h. Maximum Operating Temperature: 275 deg F (135 deg C).
3. Check Valves:
 - a. Body: Ductile iron, forged brass, or cast bronze; globe pattern.
 - b. Bonnet: Bolted ductile iron, forged brass, or cast bronze; or brass hex plug.
 - c. Piston: Removable polytetrafluoroethylene seat.
 - d. Closing Spring: Stainless steel.
 - e. Manual Opening Stem: Seal cap, plated-steel stem, and graphite seal.
 - f. End Connections: Socket, union, threaded, or flanged.
 - g. Maximum Opening Pressure: 0.50 psig (3.4 kPa).
 - h. Working Pressure Rating: 500 psig (3450 kPa).
 - i. Maximum Operating Temperature: 275 deg F (135 deg C).
4. Service Valves:
 - a. Body: Forged brass with brass cap including key end to remove core.
 - b. Core: Removable ball-type check valve with stainless-steel spring.
 - c. Seat: Polytetrafluoroethylene.
 - d. End Connections: Copper spring.
 - e. Working Pressure Rating: 500 psig (3450 kPa).
5. Solenoid Valves: Comply with ARI 760 and UL 429; listed and labeled by an NRTL.
 - a. Body and Bonnet: Plated steel.
 - b. Solenoid Tube, Plunger, Closing Spring, and Seat Orifice: Stainless steel.
 - c. Seat: Polytetrafluoroethylene.
 - d. End Connections: Threaded.
 - e. Electrical: Molded, watertight coil in NEMA 250 enclosure of type required by location with 1/2-inch (16-GRC) conduit adapter, and 24 OR 115 OR 208, as directed, -V ac coil.
 - f. Working Pressure Rating: 400 psig (2760 kPa).
 - g. Maximum Operating Temperature: 240 deg F (116 deg C).
 - h. Manual operator.
6. Safety Relief Valves: Comply with ASME Boiler and Pressure Vessel Code; listed and labeled by an NRTL.
 - a. Body and Bonnet: Ductile iron and steel, with neoprene O-ring seal.
 - b. Piston, Closing Spring, and Seat Insert: Stainless steel.
 - c. Seat Disc: Polytetrafluoroethylene.
 - d. End Connections: Threaded.
 - e. Working Pressure Rating: 400 psig (2760 kPa).
 - f. Maximum Operating Temperature: 240 deg F (116 deg C).
7. Thermostatic Expansion Valves: Comply with ARI 750.

- a. Body, Bonnet, and Seal Cap: Forged brass or steel.
- b. Diaphragm, Piston, Closing Spring, and Seat Insert: Stainless steel.
- c. Packing and Gaskets: Non-asbestos.
- d. Capillary and Bulb: Copper tubing filled with refrigerant charge.
- e. Suction Temperature: **40 deg F (4.4 deg C)**.
- f. Superheat: Adjustable **OR** Nonadjustable, **as directed**.
- g. Reverse-flow option (for heat-pump applications).
- h. End Connections: Socket, flare, or threaded union.
- i. Working Pressure Rating: **700 psig (4820 kPa) OR 450 psig (3100 kPa), as directed**.
8. Hot-Gas Bypass Valves: Comply with UL 429; listed and labeled by an NRTL.
 - a. Body, Bonnet, and Seal Cap: Ductile iron or steel.
 - b. Diaphragm, Piston, Closing Spring, and Seat Insert: Stainless steel.
 - c. Packing and Gaskets: Non-asbestos.
 - d. Solenoid Tube, Plunger, Closing Spring, and Seat Orifice: Stainless steel.
 - e. Seat: Polytetrafluoroethylene.
 - f. Equalizer: Internal **OR** External, **as directed**.
 - g. Electrical: Molded, watertight coil in NEMA 250 enclosure of type required by location with **1/2-inch (16-GRC)** conduit adapter, and 24 **OR 115 OR 208, as directed**, -V ac coil.
 - h. End Connections: Socket.
 - i. Set Pressure: as directed by the Owner.
 - j. Throttling Range: Maximum **5 psig (34 kPa)**.
 - k. Working Pressure Rating: **500 psig (3450 kPa)**.
 - l. Maximum Operating Temperature: **240 deg F (116 deg C)**.
9. Straight-Type Strainers:
 - a. Body: Welded steel with corrosion-resistant coating.
 - b. Screen: 100-mesh stainless steel.
 - c. End Connections: Socket or flare.
 - d. Working Pressure Rating: **500 psig (3450 kPa)**.
 - e. Maximum Operating Temperature: **275 deg F (135 deg C)**.
10. Angle-Type Strainers:
 - a. Body: Forged brass or cast bronze.
 - b. Drain Plug: Brass hex plug.
 - c. Screen: 100-mesh monel.
 - d. End Connections: Socket or flare.
 - e. Working Pressure Rating: **500 psig (3450 kPa)**.
 - f. Maximum Operating Temperature: **275 deg F (135 deg C)**.
11. Moisture/Liquid Indicators:
 - a. Body: Forged brass.
 - b. Window: Replaceable, clear, fused glass window with indicating element protected by filter screen.
 - c. Indicator: Color coded to show moisture content in ppm.
 - d. Minimum Moisture Indicator Sensitivity: Indicate moisture above 60 ppm.
 - e. End Connections: Socket or flare.
 - f. Working Pressure Rating: **500 psig (3450 kPa)**.
 - g. Maximum Operating Temperature: **240 deg F (116 deg C)**.
12. Replaceable-Core Filter Dryers: Comply with ARI 730.
 - a. Body and Cover: Painted-steel shell with ductile-iron cover, stainless-steel screws, and neoprene gaskets.
 - b. Filter Media: 10 micron, pleated with integral end rings; stainless-steel support.
 - c. Desiccant Media: Activated alumina **OR** charcoal, **as directed**.
 - d. Designed for reverse flow (for heat-pump applications).
 - e. End Connections: Socket.
 - f. Access Ports: **NPS 1/4 (DN 8)** connections at entering and leaving sides for pressure differential measurement.
 - g. Maximum Pressure Loss: **2 psig (14 kPa)**.

- h. Rated Flow: as directed by the Owner.
- i. Working Pressure Rating: **500 psig (3450 kPa)**.
- j. Maximum Operating Temperature: **240 deg F (116 deg C)**.
- 13. Permanent Filter Dryers: Comply with ARI 730.
 - a. Body and Cover: Painted-steel shell.
 - b. Filter Media: 10 micron, pleated with integral end rings; stainless-steel support.
 - c. Desiccant Media: Activated alumina **OR** charcoal, **as directed**.
 - d. Designed for reverse flow (for heat-pump applications).
 - e. End Connections: Socket.
 - f. Access Ports: **NPS 1/4 (DN 8)** connections at entering and leaving sides for pressure differential measurement.
 - g. Maximum Pressure Loss: **2 psig (14 kPa)**.
 - h. Rated Flow: as directed by the Owner.
 - i. Working Pressure Rating: **500 psig (3450 kPa)**.
 - j. Maximum Operating Temperature: **240 deg F (116 deg C)**.
- 14. Mufflers:
 - a. Body: Welded steel with corrosion-resistant coating.
 - b. End Connections: Socket or flare.
 - c. Working Pressure Rating: **500 psig (3450 kPa)**.
 - d. Maximum Operating Temperature: **275 deg F (135 deg C)**.
- 15. Receivers: Comply with ARI 495.
 - a. Comply with ASME Boiler and Pressure Vessel Code; listed and labeled by an NRTL.
 - b. Comply with UL 207; listed and labeled by an NRTL.
 - c. Body: Welded steel with corrosion-resistant coating.
 - d. Tappings: Inlet, outlet, liquid level indicator, and safety relief valve.
 - e. End Connections: Socket or threaded.
 - f. Working Pressure Rating: **500 psig (3450 kPa)**.
 - g. Maximum Operating Temperature: **275 deg F (135 deg C)**.
- 16. Liquid Accumulators: Comply with ARI 495.
 - a. Body: Welded steel with corrosion-resistant coating.
 - b. End Connections: Socket or threaded.
 - c. Working Pressure Rating: **500 psig (3450 kPa)**.
 - d. Maximum Operating Temperature: **275 deg F (135 deg C)**.

D. Refrigerants

- 1. ASHRAE 34, R-134a: Tetrafluoroethane.
- 2. ASHRAE 34, R-407C: Difluoromethane/Pentafluoroethane/1,1,1,2-Tetrafluoroethane.
- 3. ASHRAE 34, R-410A: Pentafluoroethane/Difluoromethane.

1.3 EXECUTION

A. Piping Applications For Refrigerant R-134a

- 1. Suction Lines **NPS 1-1/2 (DN 40)** and Smaller for Conventional Air-Conditioning Applications: Copper, Type ACR, annealed-temper tubing and wrought-copper fittings with brazed **OR** soldered, **as directed**, joints.
OR
Suction Lines **NPS 4 (DN 100)** and Smaller **OR NPS 2 to NPS 4 (DN 50 to DN 100)**, **as directed**, for Conventional Air-Conditioning Applications: Copper, Type ACR **OR L (B)**, **as directed**, drawn-temper tubing and wrought-copper fittings with brazed **OR** soldered, **as directed**, joints.
- 2. Hot-Gas and Liquid Lines, and Suction Lines for Heat-Pump Applications, **as directed**: Copper, Type ACR, annealed-temper tubing and wrought-copper fittings with brazed **OR** soldered, **as directed**, joints.
OR

Hot-Gas and Liquid Lines, and Suction Lines for Heat-Pump Applications, **as directed**: Copper, Type ACR **OR K (A) OR L (B)**, **as directed**, drawn-temper tubing and wrought-copper fittings with soldered joints.

OR

Hot-Gas and Liquid Lines, and Suction Lines for Heat-Pump Applications, **as directed**:

- a. **NPS 1-1/2 (DN 40)** and Smaller: Copper, Type ACR, annealed-temper tubing and wrought-copper fittings with brazed **OR** soldered, **as directed**, joints.

OR

NPS 1-1/2 (DN 40) and Smaller: Copper, Type ACR **OR K (A) OR L (B)**, **as directed**, drawn-temper tubing and wrought-copper fittings with brazed **OR** soldered, **as directed**, joints.

- b. **NPS 4 (DN 100)**: Copper, Type ACR **OR K (A) OR L (B)**, **as directed**, drawn-temper tubing and wrought-copper fittings with brazed **OR** soldered, **as directed**, joints.

3. Safety-Relief-Valve Discharge Piping: Schedule 40, black-steel and wrought-steel fittings with welded joints.

OR

Safety-Relief-Valve Discharge Piping: Copper, Type ACR **OR K (A) OR L (B)**, **as directed**, drawn-temper tubing and wrought-copper fittings with soldered joints.

OR

Safety-Relief-Valve Discharge Piping:

- a. **NPS 1-1/2 (DN 40)** and Smaller: Copper, Type ACR, annealed-temper tubing and wrought-copper fittings with brazed **OR** soldered, **as directed**, joints.

OR

NPS 1-1/2 (DN 40) and Smaller: Copper, Type ACR **OR L (B)**, **as directed**, drawn-temper tubing and wrought-copper fittings with brazed **OR** soldered, **as directed**, joints.

- b. **NPS 4 (DN 100)**: Copper, Type ACR **OR K (A) OR L (B)**, **as directed**, drawn-temper tubing and wrought-copper fittings with brazed **OR** soldered, **as directed**, joints.

B. Piping Applications For Refrigerant R-407c

1. Suction Lines **NPS 1-1/2 (DN 40)** and Smaller for Conventional Air-Conditioning Applications: Copper, Type ACR, annealed-temper tubing and wrought-copper fittings

OR

Suction Lines **NPS 4 (DN 100)** and Smaller **OR NPS 2 to NPS 4 (DN 50 to DN 100)**, **as directed**, for Conventional Air-Conditioning Applications: Copper, Type ACR **OR L (B)**, **as directed**, drawn-temper tubing and wrought-copper fittings with brazed **OR** soldered, **as directed**, joints.

2. Hot-Gas and Liquid Lines, and Suction Lines for Heat-Pump Applications, **as directed**: Copper, Type ACR, annealed-temper tubing and wrought-copper fittings with brazed **OR** soldered, **as directed**, joints.

OR

Hot-Gas and Liquid Lines, and Suction Lines for Heat-Pump Applications, **as directed**: Copper, Type ACR **OR K (A) OR L (B)**, **as directed**, drawn-temper tubing and wrought-copper fittings with soldered joints.

OR

Hot-Gas and Liquid Lines, and Suction Lines for Heat-Pump Applications, **as directed**:

- a. **NPS 1 (DN 25)** and Smaller: Copper, Type ACR, annealed-temper tubing and wrought-copper fittings with brazed **OR** soldered, **as directed**, joints.

OR

NPS 1 (DN 25) and Smaller: Copper, Type ACR **OR L (B)**, **as directed**, drawn-temper tubing and wrought-copper fittings with brazed **OR** soldered, **as directed**, joints.

- b. **NPS 1-1/4 to NPS 2 (DN 32 to DN 50)**: Copper, Type **K (A)**, annealed- or drawn-temper tubing and wrought-copper fittings with brazed **OR** soldered, **as directed**, joints.

- c. **NPS 4 (DN 100)**: Copper, Type ACR **OR K (A) OR L (B)**, **as directed**, drawn-temper tubing and wrought-copper fittings with soldered joints.

3. Safety-Relief-Valve Discharge Piping: Schedule 40, black-steel and wrought-steel fittings with welded joints.

OR

Safety-Relief-Valve Discharge Piping: Copper, Type ACR **OR K (A) OR L (B)**, **as directed**, drawn-temper tubing and wrought-copper fittings with soldered joints.

OR

Safety-Relief-Valve Discharge Piping:

- a. **NPS 1 (DN 25)** and Smaller: Copper, Type ACR, annealed-temper tubing and wrought-copper fittings with brazed **OR** soldered joints.

OR

NPS 1 (DN 25) and Smaller: Copper, Type ACR **OR L (B)**, **as directed**, drawn-temper tubing and wrought-copper fittings with brazed **OR** soldered, **as directed**, joints.

- b. **NPS 1-1/4 to NPS 2 (DN 32 to DN 50)**: Copper, Type **K (A)**, annealed- or drawn-temper tubing and wrought-copper fittings with brazed **OR** soldered, **as directed**, joints.
- c. **NPS 4 (DN 100)**: Copper, Type ACR **OR K (A) OR L (B)**, **as directed**, drawn-temper tubing and wrought-copper fittings with soldered joints.

C. Piping Applications For Refrigerant R-410a

1. Suction Lines **NPS 1-1/2 (DN 40)** and Smaller for Conventional Air-Conditioning Applications: Copper, Type ACR, annealed-temper tubing and wrought-copper fittings with brazed **OR** soldered, **as directed**, joints.

OR

Suction Lines **NPS 3-1/2 (DN 90)** and Smaller **OR NPS 2 to NPS 3-1/2 (DN 50 to DN 90)**, **as directed**, for Conventional Air-Conditioning Applications: Copper, Type ACR **OR L (B)**, **as directed**, drawn-temper tubing and wrought-copper fittings with brazed **OR** soldered, **as directed**, joints.

OR

Suction Lines **NPS 4 (DN 100)** and Smaller for Conventional Air-Conditioning Applications: Copper, Type ACR **OR K (A) OR L (B)**, **as directed**, drawn-temper tubing and wrought-copper fittings with soldered joints.

2. Hot-Gas and Liquid Lines, and Suction Lines for Heat-Pump Applications, **as directed**: Copper, Type ACR **OR L (B)**, **as directed**, annealed- or drawn-temper tubing and wrought-copper fittings with brazed **OR** soldered, **as directed**, joints.

OR

Hot-Gas and Liquid Lines, and Suction Lines for Heat-Pump Applications, **as directed** Copper, Type **K (A)**, annealed- or drawn-temper tubing and wrought-copper fittings with brazed **OR** soldered, **as directed**, joints.

OR

Hot-Gas and Liquid Lines, and Suction Lines for Heat-Pump Applications, **as directed**: Copper, Type ACR **OR K (A) OR L (B)**, **as directed**, drawn-temper tubing and wrought-copper fittings with 95-5 tin-antimony soldered joints.

OR

Hot-Gas and Liquid Lines, and Suction Lines for Heat-Pump Applications, **as directed**: Copper, Type ACR **OR K (A) OR L (B)**, **as directed**, drawn-temper tubing and wrought-copper fittings with Alloy HB soldered joints.

OR

Hot-Gas and Liquid Lines, and Suction Lines for Heat-Pump Applications, **as directed**:

- a. **NPS 5/8 (DN 18)** and Smaller: Copper, Type ACR **OR L (B)**, **as directed**, annealed- or drawn-temper tubing and wrought-copper fittings with brazed **OR** soldered, **as directed**, joints.
- b. **NPS 3/4 to NPS 1 (DN 20 to DN 25)** and Smaller: Copper, Type **K (A)**, annealed- or drawn-temper tubing and wrought-copper fittings with brazed **OR** soldered, **as directed**, joints.
- c. **NPS 1-1/4 (DN 32)** and Smaller: Copper, Type ACR **OR K (A) OR L (B)**, **as directed**, drawn-temper tubing and wrought-copper fittings with 95-5 tin-antimony soldered joints.
- d. **NPS 1-1/2 to NPS 2 (DN 40 to DN 50)**: Copper, Type ACR **OR K (A) OR L (B)**, **as directed**, drawn-temper tubing and wrought-copper fittings with Alloy HB soldered joints.

OR

Hot-Gas and Liquid Lines, and Suction Lines for Heat-Pump Applications, **as directed**, **NPS 2 to NPS 4 (DN 50 to DN 100)**: Schedule 40, black-steel and wrought-steel fittings with welded joints.

3. Safety-Relief-Valve Discharge Piping: Copper, Type ACR **OR L (B)**, **as directed**, annealed- or drawn-temper tubing and wrought-copper fittings with brazed **OR** soldered, **as directed**, joints.

OR

Safety-Relief-Valve Discharge Piping: Copper, Type **K (A)**, annealed- or drawn-temper tubing and wrought-copper fittings with brazed **OR** soldered, **as directed**, joints.

OR

Safety-Relief-Valve Discharge Piping: Copper, Type ACR **OR K (A) OR L (B)**, **as directed**, drawn-temper tubing and wrought-copper fittings with 95-5 tin-antimony soldered joints.

OR

Safety-Relief-Valve Discharge Piping: Copper, Type ACR **OR K (A) OR L (B)**, **as directed**, drawn-temper tubing and wrought-copper fittings with Alloy HB soldered joints.

OR

Safety-Relief-Valve Discharge Piping:

- a. **NPS 5/8 (DN 18)** and Smaller: Copper, Type ACR **OR L (B)**, **as directed**, annealed- or drawn-temper tubing and wrought-copper fittings with brazed **OR** soldered, **as directed**, joints.
- b. **NPS 3/4 to NPS 1 (DN 20 to DN 25)** and Smaller: Copper, Type **K (A)**, annealed- or drawn-temper tubing and wrought-copper fittings with brazed **OR** soldered, **as directed**, joints.
- c. **NPS 1-1/4 (DN 32)** and Smaller: Copper, Type ACR **OR K (A) OR L (B)**, **as directed**, drawn-temper tubing and wrought-copper fittings with 95-5 tin-antimony soldered joints.
- d. **NPS 1-1/2 to NPS 2 (DN 40 to DN 50)**: Copper, Type ACR **OR K (A) OR L (B)**, **as directed**, drawn-temper tubing and wrought-copper fittings with Alloy HB soldered joints.

OR

Safety-Relief-Valve Discharge Piping **NPS 2 to NPS 4 (DN 50 to DN 100)**: Schedule 40, black-steel and wrought-steel fittings with welded joints.

D. Valve And Specialty Applications

1. Install diaphragm packless **OR** packed-angle, **as directed**, valves in suction and discharge lines of compressor.
2. Install service valves for gage taps at inlet and outlet of hot-gas bypass valves and strainers if they are not an integral part of valves and strainers.
3. Install a check valve at the compressor discharge and a liquid accumulator at the compressor suction connection.
4. Except as otherwise indicated, install diaphragm packless **OR** packed-angle, **as directed**, valves on inlet and outlet side of filter dryers.
5. Install a full-sized, three-valve bypass around filter dryers.
6. Install solenoid valves upstream from each expansion valve and hot-gas bypass valve. Install solenoid valves in horizontal lines with coil at top.
7. Install thermostatic expansion valves as close as possible to distributors on evaporators.
 - a. Install valve so diaphragm case is warmer than bulb.
 - b. Secure bulb to clean, straight, horizontal section of suction line using two bulb straps. Do not mount bulb in a trap or at bottom of the line.
 - c. If external equalizer lines are required, make connection where it will reflect suction-line pressure at bulb location.
8. Install safety relief valves where required by ASME Boiler and Pressure Vessel Code. Pipe safety-relief-valve discharge line to outside according to ASHRAE 15.
9. Install moisture/liquid indicators in liquid line at the inlet of the thermostatic expansion valve or at the inlet of the evaporator coil capillary tube.
10. Install strainers upstream from and adjacent to the following unless they are furnished as an integral assembly for device being protected:
 - a. Solenoid valves.
 - b. Thermostatic expansion valves.

- c. Hot-gas bypass valves.
- d. Compressor.
- 11. Install filter dryers in liquid line between compressor and thermostatic expansion valve, and in the suction line at the compressor, **as directed**.
- 12. Install receivers sized to accommodate pump-down charge.
- 13. Install flexible connectors at compressors.

E. Piping Installation

- 1. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems; indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Shop Drawings.
- 2. Install refrigerant piping according to ASHRAE 15.
- 3. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.
- 4. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- 5. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
- 6. Install piping adjacent to machines to allow service and maintenance.
- 7. Install piping free of sags and bends.
- 8. Install fittings for changes in direction and branch connections.
- 9. Select system components with pressure rating equal to or greater than system operating pressure.
- 10. Refer to Division 23 Section(s) "Instrumentation And Control For Hvac" AND "Sequence Of Operations For Hvac Controls" for solenoid valve controllers, control wiring, and sequence of operation.
- 11. Install piping as short and direct as possible, with a minimum number of joints, elbows, and fittings.
- 12. Arrange piping to allow inspection and service of refrigeration equipment. Install valves and specialties in accessible locations to allow for service and inspection. Install access doors or panels as specified in Division 08 Section "Access Doors And Frames" if valves or equipment requiring maintenance is concealed behind finished surfaces.
- 13. Install refrigerant piping in protective conduit where installed belowground.
- 14. Install refrigerant piping in rigid or flexible conduit in locations where exposed to mechanical injury.
- 15. Slope refrigerant piping as follows:
 - a. Install horizontal hot-gas discharge piping with a uniform slope downward away from compressor.
 - b. Install horizontal suction lines with a uniform slope downward to compressor.
 - c. Install traps and double risers to entrain oil in vertical runs.
 - d. Liquid lines may be installed level.
- 16. When brazing or soldering, remove solenoid-valve coils and sight glasses; also remove valve stems, seats, and packing, and accessible internal parts of refrigerant specialties. Do not apply heat near expansion-valve bulb.
- 17. Before installation of steel refrigerant piping, clean pipe and fittings using the following procedures:
 - a. Shot blast the interior of piping.
 - b. Remove coarse particles of dirt and dust by drawing a clean, lintless cloth through tubing by means of a wire or electrician's tape.
 - c. Draw a clean, lintless cloth saturated with trichloroethylene through the tube or pipe. Continue this procedure until cloth is not discolored by dirt.
 - d. Draw a clean, lintless cloth, saturated with compressor oil, squeezed dry, through the tube or pipe to remove remaining lint. Inspect tube or pipe visually for remaining dirt and lint.
 - e. Finally, draw a clean, dry, lintless cloth through the tube or pipe.

- f. Safety-relief-valve discharge piping is not required to be cleaned but is required to be open to allow unrestricted flow.
- 18. Install pipe sleeves at penetrations in exterior walls and floor assemblies.
- 19. Seal penetrations through fire and smoke barriers according to Division 07 Section "Penetration Firestopping".
- 20. Install piping with adequate clearance between pipe and adjacent walls and hangers or between pipes for insulation installation.
- 21. Install sleeves through floors, walls, or ceilings, sized to permit installation of full-thickness insulation.
- 22. Seal pipe penetrations through exterior walls according to Division 07 Section "Joint Sealants" for materials and methods.
- 23. Identify refrigerant piping and valves according to Division 23 Section "Identification For Hvac Piping And Equipment".

F. Pipe Joint Construction

- 1. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- 2. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
- 3. Fill pipe and fittings with an inert gas (nitrogen or carbon dioxide), during brazing or welding, to prevent scale formation.
- 4. Soldered Joints: Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook."
- 5. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," Chapter "Pipe and Tube."
 - a. Use Type BcuP, copper-phosphorus alloy for joining copper socket fittings with copper pipe.
 - b. Use Type BAg, cadmium-free silver alloy for joining copper with bronze or steel.
- 6. Threaded Joints: Thread steel pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
 - a. Apply appropriate tape or thread compound to external pipe threads unless dry-seal threading is specified.
 - b. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.
- 7. Steel pipe can be threaded, but threaded joints must be seal brazed or seal welded.
- 8. Welded Joints: Construct joints according to AWS D10.12/D10.12M.
- 9. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.

G. Hangers And Supports

- 1. Hanger, support, and anchor products are specified in Division 23 Section "Hangers And Supports For Hvac Piping And Equipment".
- 2. Install the following pipe attachments:
 - a. Adjustable steel clevis hangers for individual horizontal runs less than 20 feet (6 m) long.
 - b. Roller hangers and spring hangers for individual horizontal runs 20 feet (6 m) or longer.
 - c. Pipe Roller: MSS SP-58, Type 44 for multiple horizontal piping 20 feet (6 m) or longer, supported on a trapeze.
 - d. Spring hangers to support vertical runs.
 - e. Copper-clad hangers and supports for hangers and supports in direct contact with copper pipe.
- 3. Install hangers for copper tubing with the following maximum spacing and minimum rod sizes:
 - a. NPS 1/2 (DN 15): Maximum span, 60 inches (1500 mm); minimum rod size, 1/4 inch (6.4 mm).
 - b. NPS 5/8 (DN 18): Maximum span, 60 inches (1500 mm); minimum rod size, 1/4 inch (6.4 mm).
 - c. NPS 1 (DN 25): Maximum span, 72 inches (1800 mm); minimum rod size, 1/4 inch (6.4 mm).

- d. **NPS 1-1/4 (DN 32):** Maximum span, **96 inches (2400 mm)**; minimum rod size, **3/8 inch (9.5 mm)**.
 - e. **NPS 1-1/2 (DN 40):** Maximum span, **96 inches (2400 mm)**; minimum rod size, **3/8 inch (9.5 mm)**.
 - f. **NPS 2 (DN 50):** Maximum span, **96 inches (2400 mm)**; minimum rod size, **3/8 inch (9.5 mm)**.
 - g. **NPS 2-1/2 (DN 65):** Maximum span, **108 inches (2700 mm)**; minimum rod size, **3/8 inch (9.5 mm)**.
 - h. **NPS 3 (DN 80):** Maximum span, **10 feet (3 m)**; minimum rod size, **3/8 inch (9.5 mm)**.
 - i. **NPS 4 (DN 100):** Maximum span, **12 feet (3.7 m)**; minimum rod size, **1/2 inch (13 mm)**.
 4. Install hangers for steel piping with the following maximum spacing and minimum rod sizes:
 - a. **NPS 2 (DN 50):** Maximum span, **10 feet (3 m)**; minimum rod size, **3/8 inch (9.5 mm)**.
 - b. **NPS 2-1/2 (DN 65):** Maximum span, **11 feet (3.4 m)**; minimum rod size, **3/8 inch (9.5 mm)**.
 - c. **NPS 3 (DN 80):** Maximum span, **12 feet (3.7 m)**; minimum rod size, **3/8 inch (9.5 mm)**.
 - d. **NPS 4 (DN 100):** Maximum span, **14 feet (4.3 m)**; minimum rod size, **1/2 inch (13 mm)**.
 5. Support multifloor vertical runs at least at each floor.
- H. Field Quality Control
1. Perform tests and inspections and prepare test reports.
 2. Tests and Inspections:
 - a. Comply with ASME B31.5, Chapter VI.
 - b. Test refrigerant piping, specialties, and receivers. Isolate compressor, condenser, evaporator, and safety devices from test pressure if they are not rated above the test pressure.
 - c. Test high- and low-pressure side piping of each system separately at not less than the pressures indicated in Part 1 "Performance Requirements" Article.
 - 1) Fill system with nitrogen to the required test pressure.
 - 2) System shall maintain test pressure at the manifold gage throughout duration of test.
 - 3) Test joints and fittings with electronic leak detector or by brushing a small amount of soap and glycerin solution over joints.
 - 4) Remake leaking joints using new materials, and retest until satisfactory results are achieved.
- I. System Charging
1. Charge system using the following procedures:
 - a. Install core in filter dryers after leak test but before evacuation.
 - b. Evacuate entire refrigerant system with a vacuum pump to **500 micrometers (67 Pa)**. If vacuum holds for 12 hours, system is ready for charging.
 - c. Break vacuum with refrigerant gas, allowing pressure to build up to **2 psig (14 kPa)**.
 - d. Charge system with a new filter-dryer core in charging line.
- J. Adjusting
1. Adjust thermostatic expansion valve to obtain proper evaporator superheat.
 2. Adjust high- and low-pressure switch settings to avoid short cycling in response to fluctuating suction pressure.
 3. Adjust set-point temperature of air-conditioning or chilled-water controllers to the system design temperature.
 4. Perform the following adjustments before operating the refrigeration system, according to manufacturer's written instructions:
 - a. Open shutoff valves in condenser water circuit.
 - b. Verify that compressor oil level is correct.
 - c. Open compressor suction and discharge valves.
 - d. Open refrigerant valves except bypass valves that are used for other purposes.
 - e. Check open compressor-motor alignment and verify lubrication for motors and bearings.
 5. Replace core of replaceable filter dryer after system has been adjusted and after design flow rates and pressures are established.

END OF SECTION 22 11 16 00e

NOT FOR BID

SECTION 22 11 16 00f - GENERAL-SERVICE COMPRESSED-AIR PIPING

1.1 GENERAL

A. Description Of Work:

1. This specification covers the furnishing and installation of materials for general-service compressed-air piping. Products shall be as follows or as directed by the Owner. Installation procedures shall be in accordance with the product manufacturer's recommendations. Demolition and removal of materials shall be as required to support the work.

B. Summary

1. This Section includes piping and related specialties for general-service compressed-air systems operating at **200 psig (1380 kPa)** or less.

C. Definitions

1. ABS: Acrylonitrile-butadiene-styrene plastic.
2. CR: Chlorosulfonated polyethylene synthetic rubber.
3. EPDM: Ethylene-propylene-diene terpolymer rubber.
4. HDPE: High-density polyethylene plastic.
5. NBR: Acrylonitrile-butadiene rubber.
6. PE: Polyethylene plastic.
7. PVC: Polyvinyl chloride plastic.
8. High-Pressure Compressed-Air Piping: System of compressed-air piping and specialties operating at pressures between **150 and 200 psig (1035 and 1380 kPa)**.
9. Low-Pressure Compressed-Air Piping: System of compressed-air piping and specialties operating at pressures of **150 psig (1035 kPa)** or less.

D. Performance Requirements

1. Seismic Performance: Compressed-air piping and support and installation shall withstand effects of seismic events determined according to SEI/ASCE 7, "Minimum Design Loads for Buildings and Other Structures."

E. Submittals

1. Product Data: For the following:
 - a. Plastic pipes, fittings, and valves.
 - b. Dielectric fittings.
 - c. Flexible pipe connectors.
 - d. Safety valves.
 - e. Pressure regulators. Include rated capacities and operating characteristics.
 - f. Automatic drain valves.
 - g. Filters. Include rated capacities and operating characteristics.
 - h. Lubricators. Include rated capacities and operating characteristics.
 - i. Quick couplings.
 - j. Hose assemblies.
2. Brazing **OR** Welding, **as directed**, certificates.
3. Field quality-control test reports.
4. Operation and maintenance data.

F. Quality Assurance

1. Brazing: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications," or to AWS B2.2, "Standard for Brazing Procedure and Performance Qualification."
2. Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX.



3. ASME Compliance:
 - a. Comply with ASME B31.1, "Power Piping," for high-pressure compressed-air piping.
 - b. Comply with ASME B31.9, "Building Services Piping," for low-pressure compressed-air piping.

G. Project Conditions

1. Interruption of Existing Compressed-Air Service: Do not interrupt compressed-air service to facilities occupied by the Owner or others unless permitted under the following conditions and then only after arranging to provide temporary compressed-air service according to requirements indicated:
 - a. Notify the Owner no fewer than two days in advance of proposed interruption of compressed-air service.
 - b. Do not proceed with interruption of compressed-air service without the Owner's written permission.

1.2 PRODUCTS

A. Pipes, Tubes, And Fittings

1. Schedule 40, Steel Pipe: ASTM A 53/A 53M, Type E or S, Grade B, black or hot-dip zinc coated with ends threaded according to ASME B1.20.1.
 - a. Steel Nipples: ASTM A 733, made of ASTM A 53/A 53M or ASTM A 106, Schedule 40, galvanized seamless steel pipe. Include ends matching joining method.
 - b. Malleable-Iron Fittings: ASME B16.3, Class 150 or 300, threaded.
 - c. Malleable-Iron Unions: ASME B16.39, Class 150 or 300, threaded.
 - d. Steel Flanges: ASME B16.5, Class 150 or 300, carbon steel, threaded.
 - e. Wrought-Steel Butt-Welding Fittings: ASME B16.9, Schedule 40.
 - f. Steel Flanges: ASME B16.5, Class 150 or 300, carbon steel.
 - g. Grooved-End Fittings and Couplings:
 - 1) Grooved-End Fittings: ASTM A 47/A 47M, malleable-iron castings or ASTM A 536, ductile-iron casting; with grooves according to AWWA C606 and dimensions matching steel pipe.
 - 2) Couplings: AWWA C606 or UL 213, for steel-pipe dimensions and rated for **300-psig (2070-kPa)** minimum working pressure. Include ferrous housing sections, gasket suitable for compressed air, and bolts and nuts. Provide EDPM gaskets for oil-free compressed air. Provide NBR gaskets if compressed air contains oil or oil vapor.
2. Schedule 5, Steel Pipe: ASTM A 135, carbon steel with plain ends and zinc-plated finish.
 - a. Pressure-Seal Fittings: Listed and labeled by a qualified testing agency and FMG-approved, carbon-steel, pressure-seal housing with O-ring end seals suitable for compressed-air piping and rated for **300-psig (2070-kPa)** minimum working pressure. Provide EDPM seals for oil-free compressed air. Provide NBR seals if compressed air contains oil or oil vapor.
3. Copper Tube: **ASTM B 88, Type K or L (ASTM B 88M, Type A or B)** and **ASTM B 88, Type M (ASTM B 88M, Type C)** seamless, drawn-temper, water tube.
 - a. Wrought-Copper Fittings: ASME B16.22, solder-joint pressure type or MSS SP-73, wrought copper with dimensions for brazed joints.
 - b. Cast-Copper-Alloy Flanges: ASME B16.24, Class 150 or 300.
 - c. Copper Unions: ASME B16.22 or MSS SP-123.
 - d. Press-Type Fittings, **NPS 2 (DN 50)** and Smaller: Wrought-copper fitting with EPDM O-ring seal in each end.
 - e. Press-Type Fittings, **NPS 2-1/2 to NPS 4 (DN 65 to DN 100)**: Bronze fitting with stainless-steel grip ring and EPDM O-ring seal in each end.
 - f. Extruded-Tee Outlets: Procedure for making branch outlets in copper tube according to ASTM F 2014.

- g. Grooved-End Fittings and Couplings:
 - 1) Grooved-End Fittings: **ASTM B 75 (ASTM B 75M)**, copper tube or ASTM B 584, bronze castings.
 - 2) Couplings: Copper-tube dimensions and design similar to AWWA C606. Include ferrous housing sections, gasket suitable for compressed air, and bolts and nuts. Provide EDPM gasket for oil-free compressed air. Provide NBR gasket if compressed air contains oil or oil vapor.
4. Transition Couplings for Metal Piping: Metal coupling or other manufactured fitting same size as, with pressure rating at least equal to and ends compatible with, piping to be joined.
5. PVC Pipe: ASTM D 1785, Schedule 40.
 - a. PVC Fittings: ASTM D 2466, Schedule 40, socket type.
6. Blue ABS Piping System: Made of ASTM D 3965, ABS-resin modified to provide shatter-resistant pipe for compressed-air service. Pipe and fittings are light blue and sizes are in millimeters.
 - a. Transition Fittings, 20 to 63 mm: Composite union with ABS socket end, CR O-ring, and malleable-iron union nut and threaded end; with construction similar to MSS SP-107, transition union.
 - b. Transition Fittings, 90 to 110 mm: Flange assembly with ABS flange, CR gasket, and metal flange of material matching piping to be connected.
 - c. Valves, 20 to 63 mm: ABS union ball valve with socket ends.
 - d. Valves, 90 to 110 mm: ABS butterfly valve with lever handle.
7. Green ABS Piping System: Made of ASTM D 3965, ABS-resin modified to provide shatter-resistant pipe for compressed-air service. Pipe and fittings are dark green with SDR of 9.0 and same OD as ASTM A 53/A 53M, steel pipe.
 - a. Transition Fittings, **NPS 1/2 to NPS 2 (DN 15 to DN 50)**: Composite union with ABS socket end, CR O-ring, ABS union nut, and brass solder-joint end; with construction similar to MSS SP-107, transition union.
 - b. Transition Fittings, **NPS 2-1/2 to NPS 4 (DN 65 to DN 100)**: ABS flange, CR gasket, and metal flange of material matching piping to be connected.
 - c. Valves, **NPS 1/2 to NPS 2 (DN 15 to DN 50)**: Union ball valve with socket ends.
 - d. Valves, **NPS 2-1/2 to NPS 4 (DN 65 to DN 100)**: Union ball valve with flanged ends. Include safety exhaust feature in Part 3 "Valve Applications" Article if required.
8. HDPE Piping System: Made of ASTM D 1248, HDPE resin to provide shatter-resistant pipe for compressed-air service. Pipe and fittings are dark blue with pipe dimensions about the same OD as ASTM D 3035, PE pipe.
 - a. Transition Fittings, **NPS 1/2 to NPS 2 (DN 15 to DN 50)**: HDPE adapter with one socket end and one end with threaded brass insert.
 - b. Transition Fittings, **NPS 2-1/2 to NPS 4 (DN 65 to DN 100)**: HDPE flange, CR gasket, and metal flange of material matching piping to be connected.
 - c. Valves, **NPS 1/2 to NPS 3 (DN 15 to DN 80)**: HDPE union ball valve with socket ends.

B. Joining Materials

1. Pipe-Flange Gasket Materials: Suitable for compressed-air piping system contents.
 - a. ASME B16.21, nonmetallic, flat, asbestos free, **1/8-inch (3.2-mm)** maximum thickness unless thickness or specific material is indicated.
 - 1) Full-Face Type: For flat-face, Class 125, cast-iron and cast-bronze flanges.
 - 2) Narrow-Face Type: For raised-face, Class 250, cast-iron and steel flanges.
2. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated.
3. Plastic Pipe-Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer, unless otherwise indicated.
4. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.
5. Brazing Filler Metals: AWS A5.8/A5.8M, BCuP Series, copper-phosphorus alloys for general-duty brazing, unless otherwise indicated.
6. Welding Filler Metals: Comply with AWS D10.12/D10.12M for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.
7. Solvent Cements for Joining Plastic Piping:



- a. ABS Piping: ASTM D 2235.
 - b. PVC Piping: ASTM D 2564. Include primer complying with ASTM F 656.
- C. Valves
 1. Metal Ball, Butterfly, Check, Gate, and Globe Valves: Comply with requirements in Division 22 Section "General-duty Valves For Plumbing Piping".
- D. Dielectric Fittings
 1. General Requirements for Dielectric Fittings: Combination fitting of copper alloy and ferrous materials with insulating material; suitable for system fluid, pressure, and temperature. Include threaded, solder-joint, plain, or weld-neck end connections that match piping system materials.
 2. Dielectric Unions: Factory-fabricated union assembly, for 250-psig (1725-kPa) minimum working pressure at 180 deg F (82 deg C).
 3. Dielectric Flanges: Factory-fabricated companion-flange assembly, for 150- or 300-psig (1035- or 2070-kPa) minimum working pressure as required to suit system pressures.
 4. Dielectric-Flange Kits: Companion-flange assembly for field assembly. Include flanges, full-face- or ring-type neoprene or phenolic gasket, phenolic or polyethylene bolt sleeves, phenolic washers, and steel backing washers.
 - a. Separate companion flanges and steel bolts and nuts shall have 150- or 300-psig (1035- or 2070-kPa) minimum working pressure where required to suit system pressures.
- E. Flexible Pipe Connectors
 1. Bronze-Hose Flexible Pipe Connectors: Corrugated-bronze tubing with bronze wire-braid covering and ends brazed to inner tubing.
 - a. Working-Pressure Rating: 200 psig (1380 kPa) OR 250 psig (1725 kPa), as directed, minimum.
 - b. End Connections, NPS 2 (DN 50) and Smaller: Threaded copper pipe or plain-end copper tube.
 - c. End Connections, NPS 2-1/2 (DN 65) and Larger: Flanged copper alloy.
 2. Stainless-Steel-Hose Flexible Pipe Connectors: Corrugated-stainless-steel tubing with stainless-steel wire-braid covering and ends welded to inner tubing.
 - a. Working-Pressure Rating: 200 psig (1380 kPa) OR 250 psig (1725 kPa), as directed, minimum.
 - b. End Connections, NPS 2 (DN 50) and Smaller: Threaded steel pipe nipple.
 - c. End Connections, NPS 2-1/2 (DN 65) and Larger: Flanged steel nipple.
- F. Sleeves
 1. Galvanized-Steel Sheet: 0.0239-inch (0.6-mm) minimum thickness; round tube closed with welded longitudinal joint.
 2. Stack Sleeve Fittings: Manufactured, cast-iron sleeve with integral clamping flange. Include clamping ring and bolts and nuts for membrane flashing.
 - a. Underdeck Clamp: Clamping ring with set screws.
- G. Escutcheons
 1. General Requirements: Manufactured wall and ceiling escutcheons and floor plates, with ID to closely fit around pipe and tube and OD that completely covers opening.
 2. One-Piece, Deep-Pattern Escutcheons: Deep-drawn, box-shaped brass with polished chrome-plated finish.
 3. One-Piece, Cast-Brass Escutcheons: With set screw.
 - a. Finish: Polished chrome-plated OR Rough brass, as directed.
 4. Split-Casting, Cast-Brass Escutcheons: With concealed hinge and set screw.
 - a. Finish: Polished chrome-plated OR Rough brass, as directed.
 5. One-Piece, Stamped-Steel Escutcheons: With set screw OR spring clips, as directed, and chrome-plated finish.

6. Split-Plate, Stamped-Steel Escutcheons: With concealed **OR** exposed-rivet, **as directed**, hinge, set screw **OR** spring clips, **as directed**, and chrome-plated finish.
7. One-Piece, Floor-Plate Escutcheons: Cast iron.
8. Split-Casting, Floor-Plate Escutcheons: Cast brass with concealed hinge and set screw.

H. Specialties

1. Safety Valves: ASME Boiler and Pressure Vessel Code: Section VIII, "Pressure Vessels," construction; National Board certified, labeled, and factory sealed; constructed of bronze body with poppet-type safety valve for compressed-air service.
 - a. Pressure Settings: Higher than discharge pressure and same or lower than receiver pressure rating.
2. Air-Main Pressure Regulators: Bronze body, direct acting, spring-loaded manual pressure-setting adjustment, and rated for **250-psig (1725-kPa)** inlet pressure, unless otherwise indicated.
 - a. Type: Pilot operated.
3. Air-Line Pressure Regulators: Diaphragm **OR** Pilot, **as directed**, operated, bronze body, direct acting, spring-loaded manual pressure-setting adjustment, and rated for **200-psig (1380-kPa)** minimum inlet pressure, unless otherwise indicated.

OR

Air-Line Pressure Regulators: Diaphragm operated, aluminum alloy or plastic body, direct acting, spring-loaded manual pressure-setting adjustment, and rated for **200-psig (1380-kPa)** minimum inlet pressure, unless otherwise indicated.
4. Automatic Drain Valves: Stainless-steel body and internal parts, rated for **200-psig (1380-kPa)** minimum working pressure, capable of automatic discharge of collected condensate. Include mounting bracket if wall mounting is indicated, **as directed**.
5. Coalescing Filters: Coalescing type with activated carbon capable of removing water and oil aerosols; with color-change dye to indicate when carbon is saturated and warning light to indicate when selected maximum pressure drop has been exceeded. Include mounting bracket if wall mounting is indicated, **as directed**.
6. Mechanical Filters: Two-stage, mechanical-separation-type, air-line filters. Equip with deflector plates, resin-impregnated-ribbon-type filters with edge filtration, and drain cock. Include mounting bracket if wall mounting is indicated, **as directed**.
7. Air-Line Lubricators: With drip chamber and sight dome for observing oil drop entering air stream; with oil-feed adjustment screw and quick-release collar for easy bowl removal. Include mounting bracket if wall mounting is indicated, **as directed**.
 - a. Provide with automatic feed device for supplying oil to lubricator.

I. Quick Couplings

1. General Requirements for Quick Couplings: Assembly with locking-mechanism feature for quick connection and disconnection of compressed-air hose.
2. Automatic-Shutoff Quick Couplings: Straight-through brass body with O-ring or gasket seal and stainless-steel or nickel-plated-steel operating parts.
 - a. Socket End: With one-way valve and threaded inlet for connection to piping or threaded hose fitting.
 - b. Plug End: Flow-sensor-bleeder, check-valve **OR** Straight-through, **as directed**, type with barbed outlet for attaching hose.
3. Valveless Quick Couplings: Straight-through brass body with stainless-steel or nickel-plated-steel operating parts.
 - a. Socket End: With O-ring or gasket seal, without valve, and with barbed inlet for attaching hose.
 - b. Plug End: With barbed outlet for attaching hose.

J. Hose Assemblies

1. Description: Compatible hose, clamps, couplings, and splicers suitable for compressed-air service, of nominal diameter indicated, and rated for **300-psig (2070-kPa)** minimum working pressure, unless otherwise indicated.

- a. Hose: Reinforced single **OR** double, **as directed**, -wire-braid, CR-covered hose for compressed-air service.
- b. Hose Clamps: Stainless-steel clamps or bands.
- c. Hose Couplings: Two-piece, straight-through, threaded brass or stainless-steel O-ring or gasket-seal swivel coupling with barbed ends for connecting two sections of hose.
- d. Hose Splicers: One-piece, straight-through brass or stainless-steel fitting with barbed ends for connecting two sections of hose.

K. Grout

- 1. Description: ASTM C 1107, Grade B, nonshrink and nonmetallic, dry hydraulic-cement grout.
 - a. Characteristics: Post-hardening, volume adjusting, nonstaining, noncorrosive, nongaseous, and recommended for interior and exterior applications.
 - b. Design Mix: **5000-psi (34.5-MPa)**, 28-day compressive strength.
 - c. Packaging: Premixed and factory packaged.

1.3 EXECUTION

A. Piping Applications

- 1. Compressed-Air Piping between Air Compressors and Receivers: Use one of the following piping materials for each size range:
 - a. **NPS 2 (DN 50)** and Smaller: Schedule 40, black **OR** galvanized, **as directed**, -steel pipe; threaded, malleable-iron fittings; and threaded joints.
 - b. **NPS 2 (DN 50)** and Smaller: Schedule 5, galvanized-steel pipe; pressure-seal fittings; and pressure-sealed joints.
 - c. **NPS 2 (DN 50)** and Smaller: Schedule 40, black-steel pipe; wrought-steel fittings; and welded joints.
 - d. **NPS 2 (DN 50)** and Smaller: **Type K or L (Type A or B)**, copper tube; wrought-copper fittings; and brazed joints.
 - e. **NPS 2-1/2 to NPS 4 (DN 65 to DN 100)**: Schedule 40, black **OR** galvanized, **as directed**, -steel pipe; threaded, malleable-iron fittings; and threaded joints.
 - f. **NPS 2-1/2 to NPS 4 (DN 65 to DN 100)**: Schedule 40, black **OR** galvanized, **as directed**, -steel pipe; grooved-end fittings; couplings; and grooved joints.
 - g. **NPS 2-1/2 to NPS 4 (DN 65 to DN 100)**: Schedule 40, black-steel pipe; wrought-steel fittings; and welded joints.
 - h. **NPS 2-1/2 to NPS 4 (DN 65 to DN 100)**: **Type K or L (Type A or B)**, copper tube; wrought-copper fittings; and brazed joints.
 - i. **NPS 2-1/2 to NPS 4 (DN 65 to DN 100)**: **Type K or L (Type A or B)**, copper tube; grooved-end copper fittings; couplings; and grooved joints.
 - j. **NPS 5 (DN 125)** and Larger: Schedule 40, black **OR** galvanized, **as directed**, -steel pipe; threaded, malleable-iron fittings; and threaded joints.
 - k. **NPS 5 (DN 125)** and Larger: Schedule 40, black **OR** galvanized, **as directed**, -steel pipe; grooved-end fittings; couplings; and grooved joints.
 - l. **NPS 5 (DN 125)** and Larger: Schedule 40, black-steel pipe; wrought-steel fittings; and welded joints.
 - m. **NPS 5 (DN 125)** and Larger: Grooved-end, **Type K or L (ASTM B 88M Type A or B)**, copper tube; grooved-end copper fittings; couplings; and grooved joints.
- 2. Low-Pressure Compressed-Air Distribution Piping: Use one of the following piping materials for each size range:
 - a. **NPS 2 (DN 50)** and Smaller: Schedule 40, black **OR** galvanized, **as directed**, -steel pipe; threaded, malleable-iron fittings; and threaded joints.
 - b. **NPS 2 (DN 50)** and Smaller: Schedule 5, galvanized-steel pipe; pressure-seal fittings; and pressure-sealed joints.
 - c. **NPS 2 (DN 50)** and Smaller: **Type K or L (Type A or B)**, copper tube; wrought-copper fittings; and brazed **OR** soldered, **as directed**, joints.

- d. **NPS 2 (DN 50)** and Smaller: **Type K or L (Type A or B)**, copper tube; press-type fittings; and pressure-sealed joints.
- e. **NPS 2 (DN 50)** and Smaller: 63-mm and smaller, blue ABS pipe and fittings; transition fittings; valves; and solvent-cemented joints.
- f. **NPS 2 (DN 50)** and Smaller: Green ABS pipe and fittings, transition fittings, and valves; and solvent-cemented joints.
- g. **NPS 2 (DN 50)** and Smaller: HDPE pipe, fittings, and valves; and heat-fusion joints.
- h. **NPS 2-1/2 to NPS 4 (DN 65 to DN 100)**: Schedule 40, black **OR** galvanized, **as directed**, -steel pipe; threaded, malleable-iron fittings; and threaded joints.
- i. **NPS 2-1/2 to NPS 4 (DN 65 to DN 100)**: Schedule 40, black **OR** galvanized, **as directed**, -steel pipe; grooved-end fittings; couplings; and grooved joints.
- j. **NPS 2-1/2 to NPS 4 (DN 65 to DN 100)**: **Type K or L (Type A or B)**, copper tube; wrought-copper fittings; and brazed **OR** soldered, **as directed**, joints.
- k. **NPS 2-1/2 to NPS 4 (DN 65 to DN 100)**: **Type K or L (Type A or B)**, copper tube; grooved-end copper fittings; couplings; and grooved joints.
- l. **NPS 2-1/2 to NPS 4 (DN 65 to DN 100)**: **Type K or L (Type A or B)**, copper tube; press-type fittings; and pressure-sealed joints.
- m. **NPS 2-1/2 to NPS 4 (DN 65 to DN 100)**: 90- and 110-mm, blue ABS pipe and fittings; transition fittings; and solvent-cemented joints. Include butterfly valves and flanged joints.
- n. **NPS 2-1/2 to NPS 4 (DN 65 to DN 100)**: **NPS 3 and NPS 4 (DN 80 and DN 100)**, green ABS pipe and fittings; transition fittings; and solvent-cemented joints. Include ball valves and flanged joints.
- o. **NPS 2-1/2 to NPS 4 (DN 65 to DN 100)**: **NPS 3 and NPS 4 (DN 80 and DN 100)**, HDPE pipe and fittings; valves; and heat-fusion joints.
- p. **NPS 5 and NPS 6 (DN 125 and DN 150)**: Schedule 40, black **OR** galvanized, **as directed**, -steel pipe; threaded, malleable-iron fittings; and threaded joints.
- q. **NPS 5 (DN 125)** and Larger: Schedule 40, black **OR** galvanized, **as directed**, -steel pipe; grooved-end fittings; couplings; and grooved joints.
- r. **NPS 5 to NPS 8 (DN 125 to DN 200)**: **Type K or L (Type A or B)**, copper tube; grooved-end copper fittings; couplings; and grooved joints.
3. High-Pressure Compressed-Air Distribution Piping: Use one of the following piping materials for each size range:
 - a. **NPS 2 (DN 50)** and Smaller: Schedule 40, black **OR** galvanized, **as directed**, -steel pipe; threaded, malleable-iron fittings; and threaded joints.
 - b. **NPS 2 (DN 50)** and Smaller: Schedule 5, galvanized-steel pipe; pressure-seal fittings; and pressure-sealed joints.
 - c. **NPS 2 (DN 50)** and Smaller: Schedule 40, black-steel pipe; wrought-steel fittings; and welded joints.
 - d. **NPS 2 (DN 50)** and Smaller: **Type K or L (Type A or B)**, copper tube; wrought-copper fittings; and brazed **OR** soldered, **as directed**, joints.
 - e. **NPS 2-1/2 to NPS 6 (DN 65 to DN 150)**: Schedule 40, black **OR** galvanized, **as directed**, -steel pipe; threaded, malleable-iron fittings; and threaded joints.
 - f. **NPS 2-1/2 to NPS 6 (DN 65 to DN 150)**: Schedule 40, black **OR** galvanized, **as directed**, -steel pipe; grooved-end fittings; couplings; and grooved joints.
 - g. **NPS 2-1/2 to NPS 6 (DN 65 to DN 150)**: Schedule 40, black-steel pipe; wrought-steel fittings; and welded joints.
 - h. **NPS 2-1/2 to NPS 4 (DN 65 to DN 100)**: **Type K or L (Type A or B)**, copper tube; wrought-copper fittings; and brazed **OR** soldered, **as directed**, joints.
 - i. **NPS 2-1/2 to NPS 6 (DN 65 to DN 150)**: **Type K or L (Type A or B)**, copper tube; wrought-copper fittings; and brazed joints.
 - j. **NPS 2-1/2 to NPS 6 (DN 65 to DN 150)**: **Type K or L (Type A or B)**, copper tube; grooved-end copper fittings; couplings; and grooved joints.
 - k. **NPS 8 (DN 200)** and Larger: Schedule 40, black **OR** galvanized, **as directed**, -steel pipe; grooved-end fittings; couplings; and grooved joints.
 - l. **NPS 8 (DN 200)** and Larger: Schedule 40, black-steel pipe; wrought-steel fittings; and welded joints.



- m. **NPS 8 (DN 200): Type K or L (Type A or B)**, copper tube; grooved-end copper fittings; couplings; and grooved joints.
 - 4. Drain Piping: Use one of the following piping materials:
 - a. **NPS 2 (DN 50) and Smaller: Type M (Type C)** copper tube; wrought-copper fittings; and brazed or soldered joints.
 - b. **NPS 2 (DN 50) and Smaller:** PVC pipe and fittings; and solvent-cemented joints.
- B. Valve Applications
 - 1. General-Duty Valves: Comply with requirements in Division 22 Section "General-duty Valves For Plumbing Piping" for metal general-duty valves. Use metal valves, unless otherwise indicated.
 - a. Metal General-Duty Valves: Use valve types specified in "Valve Applications" Article in Division 22 Section "General-duty Valves For Plumbing Piping" according to the following:
 - 1) Low-Pressure Compressed Air: Valve types specified for low-pressure compressed air.
 - 2) High-Pressure Compressed Air: Valve types specified for medium-pressure compressed air.
 - 3) Equipment Isolation **NPS 2 (DN 50) and Smaller:** Safety-exhaust, copper-alloy ball valve with exhaust vent and pressure rating at least as great as piping system operating pressure.
 - 4) Grooved-end valves may be used with grooved-end piping and grooved joints.
 - b. Plastic General-Duty Valves: Provide valves, made by piping manufacturer, that are compatible with piping. Do not use plastic valves between air compressors and receivers.
 - 1) Blue ABS Piping System: Ball and butterfly valves.
 - 2) Green ABS Piping System: Ball valves.
 - 3) HDPE Piping System: Ball valves.
- C. Piping Installation
 - 1. Drawing plans, schematics, and diagrams indicate general location and arrangement of compressed-air piping. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, air-compressor sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.
 - 2. Install piping concealed from view and protected from physical contact by building occupants, unless otherwise indicated and except in equipment rooms and service areas.
 - 3. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited, unless otherwise indicated.
 - 4. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal and to coordinate with other services occupying that space.
 - 5. Install piping adjacent to equipment and machines to allow service and maintenance.
 - 6. Install air and drain piping with 1 percent slope downward in direction of flow.
 - 7. Install nipples, flanges, unions, transition and special fittings, and valves with pressure ratings same as or higher than system pressure rating, unless otherwise indicated.
 - 8. Equipment and Specialty Flanged Connections:
 - a. Use steel companion flange with gasket for connection to steel pipe.
 - b. Use cast-copper-alloy companion flange with gasket and brazed **OR** soldered, **as directed**, joint for connection to copper tube. Do not use soldered joints for connection to air compressors or to equipment or machines producing shock or vibration.
 - 9. Flanged joints may be used instead of specified joint for any piping or tubing system.
 - 10. Extended-tee outlets with brazed branch connection may be used for copper tubing, within extruded-tee connection diameter to run tube diameter ratio for tube type, according to Extruded Tee Connections Sizes and Wall Thickness for Copper Tube (Inches) Table in ASTM F 2014.
 - 11. Install eccentric reducers where compressed-air piping is reduced in direction of flow, with bottoms of both pipes and reducer fitting flush.
 - 12. Install branch connections to compressed-air mains from top of main. Provide drain leg and drain trap at end of each main and branch and at low points.

13. Install thermometer and pressure gage on discharge piping from each air compressor and on each receiver. Comply with requirements in Division 22 Section "Meters And Gages For Plumbing Piping".
14. Install piping to permit valve servicing.
15. Install piping free of sags and bends.
16. Install fittings for changes in direction and branch connections.
17. Install seismic restraints on piping. Seismic-restraint devices are specified in Division 22 Section "Vibration And Seismic Controls For Plumbing Piping And Equipment".

D. Joint Construction

1. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
2. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
3. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
 - a. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
 - b. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.
4. Welded Joints for Steel Piping: Join according to AWS D10.12/D10.12M.
5. Brazed Joints for Copper Tubing: Join according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter.
6. Soldered Joints: Apply ASTM B 813, water-flushable flux, unless otherwise indicated, to tube end. Join according to ASTM B 828 or CDA's "Copper Tube Handbook."
7. Extruded-Tee Outlets for Copper Tubing: Form branches according to ASTM F 2014, with tools recommended by procedure manufacturer, and using operators qualified according to Part 1 "Quality Assurance" Article.
8. Flanged Joints: Use asbestos-free, nonmetallic gasket suitable for compressed air. Join flanges with gasket and bolts according to ASME B31.9 for bolting procedure.
9. Grooved Joints: Assemble couplings with housing, gasket, lubricant, and bolts. Join according to AWWA C606 for grooved joints. Do not apply lubricant to prelubricated gaskets.
10. Heat-Fusion Joints for PE Piping: Clean and dry joining surfaces by wiping with clean cloth or paper towels. Join according to ASTM D 2657 for socket-fusion joints.
11. Pressure-Sealed Joints: Join with tools recommended by fitting manufacturer, using operators qualified according to Part 1 "Quality Assurance" Article.
12. Solvent-Cemented Joints for ABS Piping: Clean and dry joining surfaces. Join according to the following:
 - a. Comply with ASTM F 402 for safe-handling practice of cleaners, primers, and solvent cements.
 - b. Join according to ASME B31.9 for solvent-cemented joints and to ASTM D 2235 Appendix.
13. Solvent-Cemented Joints for PVC Piping: Clean and dry joining surfaces. Join according to the following:
 - a. Comply with ASTM F 402 for safe-handling practice of cleaners, primers, and solvent cements.
 - b. Apply primer and join according to ASME B31.9 for solvent-cemented joints and to ASTM D 2672.
14. Dissimilar Metal Piping Material Joints: Use dielectric fittings.

E. Valve Installation

1. General-Duty Valves: Comply with requirements in Division 22 Section "General-duty Valves For Plumbing Piping".
2. Install shutoff valves and unions or flanged joints at compressed-air piping to air compressors.
3. Install shutoff valve at inlet to each automatic drain valve, filter, lubricator, and pressure regulator.
4. Install check valves to maintain correct direction of compressed-air flow to and from compressed-air piping specialties and equipment.

F. Dielectric Fitting Installation

1. Install dielectric fittings in piping at connections of dissimilar metal piping and tubing.
2. **NPS 2 (DN 50)** and Smaller: Use dielectric unions.
3. **NPS 2-1/2 to NPS 4 (DN 65 to DN 100)**: Use dielectric flanges.
4. **NPS 5 (DN 125)** and Larger: Use dielectric flange kits.

G. Flexible Pipe Connector Installation

1. Install flexible pipe connectors in discharge piping and in inlet air piping from remote air-inlet filter, **as directed**, of each air compressor.
2. Install bronze-hose flexible pipe connectors in copper compressed-air tubing.
3. Install stainless-steel-hose flexible pipe connectors in steel compressed-air piping.

H. Specialty Installation

1. Install safety valves on receivers in quantity and size to relieve at least the capacity of connected air compressors.
2. Install air-main pressure regulators in compressed-air piping at or near air compressors.
3. Install air-line pressure regulators in branch piping to equipment and tools, **as directed**.
4. Install automatic drain valves on aftercoolers, receivers, and dryers. Discharge condensate onto nearest floor drain.
5. Install coalescing filters in compressed-air piping at or near air compressors and upstream from mechanical filters. Mount on wall at locations indicated, **as directed**.
6. Install mechanical filters in compressed-air piping at or near air compressors and downstream from coalescing filters. Mount on wall at locations indicated, **as directed**.
7. Install air-line lubricators in branch piping to machine tools. Mount on wall at locations indicated, **as directed**.
8. Install quick couplings at piping terminals for hose connections.
9. Install hose assemblies at hose connections.

I. Connections

1. Install unions, in piping **NPS 2 (DN 50)** and smaller, adjacent to each valve and at final connection to each piece of equipment and machine.
2. Install flanges, in piping **NPS 2-1/2 (DN 65)** and larger, adjacent to flanged valves and at final connection to each piece of equipment and machine.

J. Sleeve Installation

1. Sleeves are not required for core-drilled holes.
2. Permanent sleeves are not required for holes formed by removable PE sleeves.
3. Install sleeves for pipes passing through concrete and masonry walls and concrete floor and roof slabs using galvanized-steel pipe **OR** galvanized-steel sheet **OR** stack sleeve fittings **OR** PVC pipe, **as directed**.
OR
Install sleeves for pipes passing through concrete and masonry walls, gypsum board partitions, and concrete floor and roof slabs.
 - a. Wall Penetrations: Cut sleeves to length for mounting flush with both surfaces.
 - b. Floor Penetrations: Extend sleeves installed in floors of mechanical equipment areas or other wet areas **2 inches (50 mm)** above finished floor level. Extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified.
4. Install sleeves in new walls and slabs as new walls and slabs are constructed.
5. Install sleeves that are large enough to provide **1/4-inch (6.4-mm)** annular clear space between sleeve and pipe or pipe insulation. Use the following sleeve materials:
 - a. PVC **OR** Steel, **as directed**, Pipe Sleeves: For pipes smaller than **NPS 6 (DN 150)**.
 - b. Steel Sheet Sleeves: For pipes **NPS 6 (DN 150)** and larger, penetrating gypsum board partitions.
 - c. Stack Sleeve Fittings: For pipes penetrating floors with membrane waterproofing. Secure flashing between clamping flanges. Install section of cast-iron soil pipe to extend sleeve to

2 inches (50 mm) above finished floor level. Comply with requirements in Division 07 Section "Sheet Metal Flashing And Trim" for flashing.

- 1) Seal space outside of sleeve fittings with grout.
6. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Comply with requirements in Division 07 Section "Penetration Firestopping".

K. Escutcheon Installation

1. Install escutcheons for penetrations of walls, ceilings, and floors according to the following:
 - a. New Piping:
 - 1) Piping with Fitting or Sleeve Protruding from Wall: One piece, deep pattern.
 - 2) Bare Piping at Wall and Floor Penetrations in Finished Spaces: One piece, cast brass with polished chrome-plated finish **OR** stamped steel with set screw **OR** stamped steel with set screw or spring clips **OR** stamped steel with spring clips, **as directed**.
 - 3) Bare Piping at Ceiling Penetrations in Finished Spaces: One piece, cast brass with polished chrome-plated finish **OR** One piece or split-casting, cast brass with polished chrome-plated finish **OR** Split casting, cast brass with polished chrome-plated finish **OR** One piece, stamped steel with set screw **OR** One piece or split plate, stamped steel with set screw **OR** Split plate, stamped steel with set screw, **as directed**.
 - 4) Bare Piping in Unfinished Service Spaces: One piece, cast brass with polished chrome-plated finish **OR** cast brass with rough-brass finish **OR** stamped steel with set screw **OR** stamped steel with spring clips **OR** stamped steel with set screw or spring clips, **as directed**.
 - 5) Bare Piping in Equipment Rooms: One piece, cast brass **OR** stamped steel with set screw **OR** stamped steel with spring clips **OR** stamped steel with set screw or spring clips, **as directed**.
 - 6) Bare Piping at Floor Penetrations in Equipment Rooms: One-piece floor plate.
 - b. Existing Piping:
 - 1) Chrome-Plated Piping: Split-casting, cast brass with chrome-plated finish.
 - 2) Insulated Piping: Split-plate, stamped steel with concealed **OR** exposed-rivet, **as directed**, hinge and spring clips.
 - 3) Bare Piping at Wall and Floor Penetrations in Finished Spaces: Split casting, cast brass with chrome-plated finish **OR** plate, stamped steel with concealed hinge and spring clips, **as directed**.
 - 4) Bare Piping at Ceiling Penetrations in Finished Spaces: Split casting, cast brass with chrome-plated finish **OR** plate, stamped steel with concealed hinge and set screw, **as directed**.
 - 5) Bare Piping in Unfinished Service Spaces: Split casting, cast brass with polished chrome-plated finish **OR** casting, cast brass with rough-brass finish **OR** plate, stamped steel with concealed hinge and set screw or spring clips **OR** plate, stamped steel with concealed or exposed-rivet hinge and set screw or spring clips **OR** plate, stamped steel with exposed-rivet hinge and set screw or spring clips, **as directed**.
 - 6) Bare Piping in Equipment Rooms: Split casting, cast brass **OR** plate, stamped steel with set screw or spring clips, **as directed**.
 - 7) Bare Piping at Floor Penetrations in Equipment Rooms: Split-casting floor plate.

L. Hanger And Support Installation

1. Comply with requirements in Division 22 Section "Vibration And Seismic Controls For Plumbing Piping And Equipment" for seismic-restraint devices.
2. Comply with requirements in Division 22 Section "Hangers And Supports For Plumbing Piping And Equipment" for pipe hanger and support devices.
3. Vertical Piping: MSS Type 8 or 42, clamps.
4. Individual, Straight, Horizontal Piping Runs:
 - a. **100 Feet (30 m)** or Less: MSS Type 1, adjustable, steel clevis hangers.

- b. Longer Than **100 Feet (30 m)**: MSS Type 43, adjustable roller hangers.
5. Multiple, Straight, Horizontal Piping Runs **100 Feet (30 m)** or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
6. Base of Vertical Piping: MSS Type 52, spring hangers.
7. Support horizontal piping within **12 inches (300 mm)** of each fitting and coupling.
8. Rod diameter may be reduced 1 size for double-rod hangers, with **3/8-inch (10-mm)** minimum rods.
9. Install hangers for Schedule 40, steel piping with the following maximum horizontal spacing and minimum rod diameters:
 - a. **NPS 1/4 to NPS 1/2 (DN 8 to DN 15)**: **96 inches (2400 mm)** with **3/8-inch (10-mm)** rod.
 - b. **NPS 3/4 to NPS 1-1/4 (DN 20 to DN 32)**: **84 inches (2100 mm)** with **3/8-inch (10-mm)** rod.
 - c. **NPS 1-1/2 (DN 40)**: **12 feet (3.7 m)** with **3/8-inch (10-mm)** rod.
 - d. **NPS 2 (DN 50)**: **13 feet (4 m)** with **3/8-inch (10-mm)** rod.
 - e. **NPS 2-1/2 (DN 65)**: **14 feet (4.3 m)** with **1/2-inch (13-mm)** rod.
 - f. **NPS 3 (DN 80)**: **15 feet (4.6 m)** with **1/2-inch (13-mm)** rod.
 - g. **NPS 3-1/2 (DN 90)**: **16 feet (4.9 m)** with **1/2-inch (13-mm)** rod.
 - h. **NPS 4 (DN 100)**: **17 feet (5.2 m)** with **5/8-inch (16-mm)** rod.
 - i. **NPS 5 (DN 125)**: **19 feet (5.8 m)** with **5/8-inch (16-mm)** rod.
 - j. **NPS 6 (DN 150)**: **21 feet (6.4 m)** with **3/4-inch (19-mm)** rod.
 - k. **NPS 8 (DN 200)**: **24 feet (7.3 m)** with **3/4-inch (19-mm)** rod.
 - l. **NPS 10 (DN 250)**: **26 feet (7.9 m)** with **7/8-inch (22-mm)** rod.
 - m. **NPS 12 (DN 300)**: **30 feet (9.1 m)** with **7/8-inch (22-mm)** rod.
10. Install supports for vertical, Schedule 40, steel piping every **15 feet (4.6 m)**.
11. Install hangers for Schedule 5, steel piping with the following maximum horizontal spacing and minimum rod diameters:
 - a. **NPS 1/2 (DN 15)**: **72 inches (1800 mm)** with **3/8-inch (10-mm)** rod.
 - b. **NPS 3/4 (DN 20)**: **84 inches (2100 mm)** with **3/8-inch (10-mm)** rod.
 - c. **NPS 1 (DN 25)**: **96 inches (2400 mm)** with **3/8-inch (10-mm)** rod.
 - d. **NPS 1-1/4 (DN 32)**: **108 inches (2700 mm)** with **3/8-inch (10-mm)** rod.
 - e. **NPS 1-1/2 (DN 40)**: **10 feet (3 m)** with **3/8-inch (10-mm)** rod.
 - f. **NPS 2 (DN 50)**: **11 feet (3.4 m)** with **3/8-inch (10-mm)** rod.
12. Install supports for vertical, Schedule 5, steel piping every **10 feet (3 m)**.
13. Install hangers for copper tubing with the following maximum horizontal spacing and minimum rod diameters:
 - a. **NPS 1/4 (DN 8)**: **60 inches (1500 mm)** with **3/8-inch (10-mm)** rod.
 - b. **NPS 3/8 and NPS 1/2 (DN 10 and DN 15)**: **72 inches (1800 mm)** with **3/8-inch (10-mm)** rod.
 - c. **NPS 3/4 (DN 20)**: **84 inches (2100 mm)** with **3/8-inch (10-mm)** rod.
 - d. **NPS 1 (DN 25)**: **96 inches (2400 mm)** with **3/8-inch (10-mm)** rod.
 - e. **NPS 1-1/4 (DN 32)**: **108 inches (2700 mm)** with **3/8-inch (10-mm)** rod.
 - f. **NPS 1-1/2 (DN 40)**: **10 feet (3 m)** with **3/8-inch (10-mm)** rod.
 - g. **NPS 2 (DN 50)**: **11 feet (3.4 m)** with **3/8-inch (10-mm)** rod.
 - h. **NPS 2-1/2 (DN 65)**: **13 feet (4 m)** with **1/2-inch (13-mm)** rod.
 - i. **NPS 3 (DN 80)**: **14 feet (4.3 m)** with **1/2-inch (13-mm)** rod.
 - j. **NPS 3-1/2 (DN 90)**: **15 feet (4.6 m)** with **1/2-inch (13-mm)** rod.
 - k. **NPS 4 (DN 100)**: **16 feet (4.9 m)** with **1/2-inch (13-mm)** rod.
 - l. **NPS 5 (DN 125)**: **18 feet (5.5 m)** with **1/2-inch (13-mm)** rod.
 - m. **NPS 6 (DN 150)**: **20 feet (6 m)** with **5/8-inch (16-mm)** rod.
 - n. **NPS 8 (DN 200)**: **23 feet (7 m)** with **3/4-inch (19-mm)** rod.
14. Install supports for vertical copper tubing every **10 feet (3 m)**.
15. Install vinyl-coated hangers for ABS piping with the following maximum horizontal spacing and minimum rod diameters:
 - a. All Sizes: Install continuous support for piping with compressed air at normal operating temperature above **100 deg F (38 deg C)**.
 - b. **NPS 3/8 and NPS 1/2 (DN 10 and DN 15)**: **30 inches (760 mm)** with **3/8-inch (10-mm)** rod.

- c. NPS 3/4 (DN 20): 38 inches (975 mm) with 3/8-inch (10-mm) rod.
 - d. NPS 1 (DN 25): 40 inches (1015 mm) with 3/8-inch (10-mm) rod.
 - e. NPS 1-1/4 (DN 32): 45 inches (1140 mm) with 3/8-inch (10-mm) rod.
 - f. NPS 1-1/2 (DN 40): 52 inches (1330 mm) with 3/8-inch (10-mm) rod.
 - g. NPS 2 (DN 50): 58 inches (1470 mm) with 3/8-inch (10-mm) rod.
 - h. NPS 3 (DN 80): 68 inches (1730 mm) with 1/2-inch (13-mm) rod.
 - i. NPS 4 (DN 100): 76 inches (1900 mm) with 1/2-inch (13-mm) rod.
16. Install supports for vertical ABS piping every 48 inches (1220 mm).
 17. Install vinyl-coated hangers for HDPE piping with the following maximum horizontal spacing and minimum rod diameters:
 - a. All Sizes: Install continuous support for piping with compressed air at normal operating temperature above 100 deg F (38 deg C).
 - b. NPS 1/2 (DN 15): 30 inches (760 mm) with 3/8-inch (10-mm) rod.
 - c. NPS 3/4 (DN 20): 35 inches (890 mm) with 3/8-inch (10-mm) rod.
 - d. NPS 1 (DN 25): 40 inches (1015 mm) with 3/8-inch (10-mm) rod.
 - e. NPS 1-1/4 (DN 32): 43 inches (1090 mm) with 3/8-inch (10-mm) rod.
 - f. NPS 1-1/2 (DN 40): 49 inches (1245 mm) with 3/8-inch (10-mm) rod.
 - g. NPS 2 (DN 50): 55 inches (1400 mm) with 3/8-inch (10-mm) rod.
 - h. NPS 3 and NPS 4 (DN 80 and DN 100): 96 inches (2440 mm) with 1/2-inch (13-mm) rod.
 18. Install supports for vertical HDPE piping every 48 inches (1220 mm).
- M. Labeling And Identification
1. Install identifying labels and devices for general-service compressed-air piping, valves, and specialties. Comply with requirements in Division 22 Section "Identification For Plumbing Piping And Equipment".
- N. Field Quality Control
1. Perform field tests and inspections.
 2. Tests and Inspections:
 - a. Piping Leak Tests for Metal Compressed-Air Piping: Test new and modified parts of existing piping. Cap and fill general-service compressed-air piping with oil-free dry air or gaseous nitrogen to pressure of 50 psig (345 kPa) above system operating pressure, but not less than 150 psig (1035 kPa). Isolate test source and let stand for four hours to equalize temperature. Refill system, if required, to test pressure; hold for two hours with no drop in pressure.
 - b. Piping Leak Tests for ABS Compressed-Air Piping: Test new and modified parts of existing piping. Cap and fill general-service compressed-air piping with oil-free dry air or gaseous nitrogen, at temperature of 110 deg F (43 deg C) or less, to pressure of 40 psig (275 kPa) above system operating pressure, but not less than 80 psig (550 kPa) OR 100 psig (690 kPa), as directed, or more than 120 psig (825 kPa). Isolate test source and let stand for four hours to equalize temperature. Refill system, if required, to test pressure; hold for two hours with no drop in pressure.
 - c. Piping Leak Tests for HDPE Compressed-Air Piping: Test new and modified parts of existing piping. Cap and fill general-service compressed-air piping with oil-free dry air or gaseous nitrogen, at temperature of 100 deg F (38 deg C) or less, to pressure of 40 psig (275 kPa) above system operating pressure, but not less than 100 psig (690 kPa) OR 125 psig (860 kPa) OR 150 psig (1035 kPa), as directed, or more than 180 psig (1240 kPa). Isolate test source and let stand for four hours to equalize temperature. Refill system, if required, to test pressure; hold for two hours with no drop in pressure.
 - d. Repair leaks and retest until no leaks exist.
 - e. Inspect filters, lubricators, and pressure regulators for proper operation.
 3. Prepare test reports.

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SECTION 22 11 16 00g - COMPRESSED-AIR PIPING FOR LABORATORY AND HEALTHCARE FACILITIES

1.1 GENERAL

A. Description Of Work

1. This specification covers the furnishing and installation of materials for compressed-air piping for laboratory and healthcare facilities. Products shall be as follows or as directed by the Owner. Installation procedures shall be in accordance with the products manufacturer's recommendations. Demolition and removal of materials shall be as required to support the work.

B. Summary

1. This Section includes the following:
 - a. Compressed-air piping and specialties for nonmedical laboratory facilities, designated "laboratory air," operating at **50 psig (345 kPa) OR 100 psig (690 kPa) OR 125 psig (860 kPa), as directed.**
 - b. Medical air piping and specialties, designated "medical air," operating at **50 to 55 psig (345 to 380 kPa).**
 - c. Dental air piping and specialties, designated "dental air," operating at **80 to 100 psig (550 to 690 kPa).**
 - d. Gas-powered-tool air piping and specialties, designated "instrument air," operating at **175 psig (1200 kPa).**
 - e. Healthcare laboratory air piping and specialties, designated "medical laboratory air," operating at **100 psig (690 kPa).**

C. Definitions

1. D.I.S.S.: Diameter-index safety system.
2. Low Voltage: As defined in NFPA 70 for circuits and equipment operating at less than 50 V or for remote-control, signaling power-limited circuits.
3. Medical Compressed-Air Piping Systems: Include medical air, dental air, instrument air, and medical laboratory air piping systems.

D. Submittals

1. Product Data: For the following:
 - a. Compressed-air tubes and fittings.
 - b. Compressed-air valves and valve boxes.
 - c. Medical compressed-air service connections.
 - d. Medical compressed-air pressure control panels.
 - e. Medical compressed-air manifolds.
 - f. Medical compressed-air alarm system components.
2. Shop Drawings: Diagram power, signal, and control wiring.
3. Piping Material Certification: Signed by Installer certifying that medical compressed-air piping materials comply with NFPA 99 requirements.
4. Brazing certificates.
5. Field quality-control test reports.
6. Operation and maintenance data.

E. Quality Assurance

1. Installer Qualifications:
 - a. Medical Compressed-Air Piping Systems for Healthcare Facilities: Qualify installers according to ASSE Standard #6010.
 - b. Pressure-Seal Joining Procedure for Copper Tubing: Qualify operators according to training provided by Viega; Plumbing and Heating Systems.



2. Testing Agency Qualifications: An independent testing agency, with the experience and capability to conduct the vacuum piping testing indicated, that is a member of the Medical Gas Professional Healthcare Organization **OR** is an NRTL, **as directed**, and that is acceptable to authorities having jurisdiction.
 - a. Qualify testing personnel according to ASSE Standard #6020 for inspectors and ASSE Standard #6030 for verifiers.
3. Source Limitations: Obtain compressed-air service connections of same type and from same manufacturer as service connections provided for in Division 22 Section "Gas Piping For Laboratory And Healthcare Facilities".
4. Brazing: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications," or AWS B2.2, "Standard for Brazing Procedure and Performance Qualification."
5. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
6. ASME Compliance:
 - a. Comply with ASME B31.1, "Power Piping," for laboratory compressed-air piping operating at more than **150 psig (1035 kPa)**.
 - b. Comply with ASME B31.9, "Building Services Piping," for laboratory compressed-air piping operating at **150 psig (1035 kPa)** or less.
7. Comply with NFPA 99, "Health Care Facilities," for medical compressed-air system materials and installation in healthcare facilities.

F. Project Conditions

1. Interruption of Existing Laboratory and Medical Compressed-Air Service(s): Do not interrupt laboratory or medical compressed-air service to facilities occupied by the Owner or others unless permitted under the following conditions and then only after arranging to provide temporary service according to requirements indicated:
 - a. Notify the Owner no fewer than two days in advance of proposed interruption of laboratory and medical compressed-air service(s).
 - b. Do not proceed with interruption of laboratory and medical compressed-air service(s) without the Owner's written permission.

1.2 PRODUCTS

A. Pipes, Tubes, And Fittings

1. Copper Medical Gas Tube: ASTM B 819, Type K **OR** Type L, **as directed**, seamless, drawn temper, that has been manufacturer cleaned, purged, and sealed for medical gas service or according to CGA G-4.1 for oxygen service. Include standard color marking "OXY," "MED," "OXY/MED," "OXY/ACR," or "ACR/MED" in green for Type K tube and in blue for Type L tube.
 - a. General Requirements for Copper Fittings: Manufacturer cleaned, purged, and bagged for oxygen service according to CGA G-4.1.
 - b. Wrought-Copper Fittings: ASME B16.22, solder-joint pressure type or MSS SP-73, with dimensions for brazed joints.
 - c. Copper Unions: ASME B16.22 or MSS SP-123, wrought copper or cast-copper alloy.
 - d. Press-Type Fittings:
 - 1) **NPS 2 (DN 50)** and Smaller: Wrought-copper fitting with EPDM O-ring seal in each end.
 - 2) **NPS 2-1/2 to NPS 4 (DN 65 to DN 100)**: Bronze fitting with stainless-steel grip ring and EPDM O-ring seal in each end.
2. Memory-Metal Couplings: Cryogenic compression fitting made of ASTM F 2063, nickel-titanium, shape-memory alloy, and that has been manufacturer cleaned, purged, and sealed for oxygen service according to CGA G-4.1.

3. Copper Water Tube: **ASTM B 88, Type M (ASTM B 88M, Type C)**, seamless, drawn temper.
 - a. Copper Fittings: ASME B16.18, cast-copper or ASME B16.22, wrought-copper, solder-joint pressure type.
 - b. Press-Type Fittings:
 - 1) **NPS 2 (DN 50)** and Smaller: Wrought-copper fitting with EPDM O-ring seal in each end.
 - 2) **NPS 2-1/2 to NPS 4 (DN 65 to DN 100)**: Bronze fitting with stainless-steel grip ring and EPDM O-ring seal in each end.
 4. PVC Pipe: ASTM D 1785, Schedule 40.
 - a. PVC Fittings: ASTM D 2466, Schedule 40, socket type.
- B. Joining Materials
1. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.
 2. Brazing Filler Metals: AWS A5.8/A5.8M, BCuP Series, copper-phosphorus alloys for general-duty brazing unless otherwise indicated.
 3. Threaded-Joint Tape: PTFE.
 4. Solvent Cement for Joining PVC Piping: ASTM D 2564. Include primer complying with ASTM F 656.
- C. Valves
1. General Requirements for Valves: Manufacturer cleaned, purged, and bagged according to CGA G-4.1 for oxygen service.
 2. Ball Valves: MSS SP-110, 3-piece body, brass or bronze.
 - a. Pressure Rating: **300 psig (2070 kPa)** minimum.
 - b. Ball: Full-port, chrome-plated brass.
 - c. Seats: PTFE or TFE.
 - d. Handle: Lever type with locking device, **as directed**.
 - e. Stem: Blowout proof with PTFE or TFE seal.
 - f. Ends: Manufacturer-installed ASTM B 819, copper-tube extensions.
 3. Check Valves: In-line pattern, bronze.
 - a. Pressure Rating: **300 psig (2070 kPa)** minimum.
 - b. Operation: Spring loaded.
 - c. Ends: Manufacturer-installed ASTM B 819, copper-tube extensions.
 4. Zone Valves: MSS SP-110, 3-piece-body, brass or bronze ball valve with gage.
 - a. Pressure Rating: **300 psig (2070 kPa)** minimum.
 - b. Ball: Full-port, chrome-plated brass.
 - c. Seats: PTFE or TFE.
 - d. Handle: Lever type with locking device, **as directed**.
 - e. Stem: Blowout proof with PTFE or TFE seal.
 - f. Ends: Manufacturer-installed ASTM B 819, copper-tube extensions.
 - g. Pressure Gage: Manufacturer installed on one copper-tube extension.
 5. Zone Valve Boxes: Formed steel with anchors for recessed mounting, holes with grommets in box sides for tubing extension protection, and of size for single or multiple valves with pressure gages and in sizes required to permit manual operation of valves.
 - a. Interior Finish: Factory-applied white enamel.
 - b. Cover Plate: Aluminum or extruded-anodized aluminum **OR** Satin-chrome finish steel **OR** Stainless steel with NAAMM AMP 503, No. 4 finish, **as directed**, with frangible or removable windows.
 - c. Valve-Box Windows: Clear or tinted transparent plastic with labeling that includes rooms served, according to NFPA 99.
- OR**
- Zone Valve Boxes: Formed or extruded aluminum with anchors for recessed mounting, holes with grommets in box sides for tubing extension protection, and of size for single or multiple valves with pressure gages and in sizes required to permit manual operation of valves.

- a. Interior Finish: Factory-applied white enamel.
 - b. Cover Plate: Aluminum or extruded-anodized aluminum **OR** Stainless steel with NAAMM AMP 503, No. 4 finish, **as directed**, with frangible or removable windows.
 - c. Valve-Box Windows: Clear or tinted transparent plastic with labeling that includes rooms served, according to NFPA 99.
 6. Safety Valves: Bronze-body, ASME-construction, poppet, pressure-relief type with settings to match system requirements.
 7. Pressure Regulators: Bronze body and trim; spring-loaded, diaphragm-operated relieving type; manual pressure-setting adjustment; rated for **250-psig (1725-kPa)** minimum inlet pressure; and capable of controlling delivered air pressure within **0.5 psig for each 10-psig (5.0 kPa for each 100-kPa)** inlet pressure.
 8. Automatic Drain Valves: Stainless-steel body and internal parts, rated for **200-psig (1380-kPa)** minimum working pressure, capable of automatic discharge of collected condensate. Include mounting bracket where wall mounting is indicated, **as directed**.
- D. Medical Compressed-Air Service Connections
1. Connection Devices: For specific medical compressed-air pressure and service listed. Include roughing-in assemblies, finishing assemblies, and cover plates. Individual cover plates are not required if service connection is in multiple unit or assembly with cover plate. Furnish recessed-type units made for concealed piping unless otherwise indicated.
 - a. Roughing-in Assembly:
 - 1) Steel outlet box for recessed mounting and concealed piping.
 - 2) Brass-body outlet block with secondary check valve that will prevent gas flow when primary valve is removed.
 - 3) Double seals that will prevent air leakage.
 - 4) ASTM B 819, **NPS 3/8 (DN 10)** copper outlet tube brazed to valve with service marking and tube-end dust cap.
 - b. Finishing Assembly:
 - 1) Brass housing with primary check valve.
 - 2) Double seals that will prevent air leakage.
 - 3) Cover plate with gas-service label.
 - c. Quick-Coupler Service Connections: Pressure outlet with noninterchangeable keyed indexing to prevent interchange between services, constructed to permit one-handed connection and removal of equipment, and with positive-locking ring that retains equipment stem in valve during use.
 - d. D.I.S.S. Service Connections: Pressure outlets, complying with CGA V-5, with threaded indexing to prevent interchange between services, constructed to permit one-handed connection and removal of equipment.
 - 1) Medical Air Service Connections: CGA V-5, D.I.S.S. No. 1160.
 - 2) Instrument Air Service Connections: CGA V-5, D.I.S.S. No. 1160.
 - e. Cover Plates: One piece, stainless steel, with NAAMM AMP 503, No. 4 finish **OR** metal, with chrome-plated finish **OR** anodized aluminum, **as directed**, and permanent, color-coded, identifying label matching corresponding service.
- E. Medical Compressed-Air Pressure Control Panels
1. Description: Steel box and support brackets for recessed roughing in with stainless-steel or anodized-aluminum cover plate with printed operating instructions. Include manifold assembly consisting of inlet supply valve, inlet supply pressure gage, line-pressure control regulator, outlet supply pressure gage, D.I.S.S. service connection, and piping outlet for remote service connection.
 - a. Minimum Working Pressure: **200 psig (1380 kPa)**.
 - b. Line-Pressure Control Regulator: Self-relieving diaphragm type with precision manual adjustment.
 - c. Pressure Gages: **0- to 300-psig (0- to 2070-kPa)** range.

- d. Service Connection: CGA V-5, D.I.S.S. No. 1160, instrument air outlet.
- e. Before final assembly, provide temporary dust shield and U-tube for testing.
- f. Label cover plate "Air Pressure Control."

F. Medical Compressed-Air Manifolds

1. General Requirements for Medical Compressed-Air Manifolds: Comply with NFPA 99, Ch. 5, "Manifolds for Gas Cylinders without Reserve Supply."
2. Central Control Panel Unit: Weatherproof cabinet, supply and delivery pressure gages, electrical alarm system connections and transformer, indicator lights or devices, manifold connection, pressure changeover switch, line-pressure regulator, shutoff valves, and safety valve.
3. Manifold and Headers: Duplex, nonferrous-metal header for number of cylinders indicated, divided into two equal banks. Units include design for **2000-psig (13.8-MPa)** minimum inlet pressure. Include cylinder bank headers with inlet (pigtail) connections complying with CGA V-1, individual inlet check valves, shutoff valve, pressure regulator, check valve, and pressure gage.
4. Compressed-Air Cylinders: Will be furnished by the Owner **OR** Number and type of compressed-air cylinders required for complete manifold systems, **as directed**.
5. Operation: Automatic, pressure-switch-activated changeover from one cylinder bank to the other when first bank becomes exhausted, without line-pressure fluctuation or resetting of regulators and without supply interruption by shutoff of either cylinder bank header.
6. Mounting: Wall with mounting brackets for manifold control cabinet and headers **OR** Floor with support legs for manifold control cabinet, **as directed**.
7. Label manifold control unit with permanent label identifying compressed air and system operating pressure.
8. Medical Air Manifolds: For 4 cylinders and **1250-cu. ft./h (9.85-L/s)** **OR** 8 cylinders and **2500-cu. ft./h (19.7-L/s)**, **as directed**, capacity at **55-psig (380-kPa)** line pressure.
9. Instrument Air Manifolds: For 8 cylinders and **2000-cu. ft./h (15.7-L/s)** **OR** 12 cylinders and **3000-cu. ft./h (23.6-L/s)**, **as directed**, capacity at **200-psig (1380-kPa)** minimum line pressure.

G. Medical Compressed-Air-Piping Alarm Systems

1. Panels for medical compressed-air piping systems may be combined in single panels with medical vacuum and medical gas piping systems.
2. Components: Designed for continuous service and to operate on power supplied from 120 **OR** 240 **OR** 277, **as directed**, -V ac power source to alarm panels and with connections for low-voltage wiring to remote sensing devices. Include step-down transformers if required.
3. Dew Point Monitors: Continuous line monitoring, having panel with gage or digital display, pipeline sensing element, electrical connections for alarm system, factory- or field-installed valved bypass, and visual and cancelable audio signal for dryer site and master alarm panels. Alarm signals when pressure dew point rises above **39 deg F (4 deg C)** at **55 psig (380 kPa)**.
 - a. Operation: Chilled-mirror method **OR** Chilled-mirror method or hygrometer moisture analyzer with sensor probe **OR** Hygrometer moisture analyzer with sensor probe, **as directed**.
4. Pressure Switches or Transducer Sensors: Continuous line monitoring with electrical connections for alarm system.
 - a. Low-Pressure Operating Range: **0- to 100-psig (0- to 690-kPa)**.
 - b. High-Pressure Operating Range: Up to **250-psig (1725-kPa)**.
5. Carbon Monoxide Monitors: Panel with gage or digital display, pipeline sensing element, electrical connections for alarm system, and factory- or field-installed valved bypass. Alarm signals when carbon monoxide level rises above 10 ppm.
6. General Requirements for Medical Compressed-Air Alarm Panels: Factory wired with audible and color-coded visible signals to indicate specified functions.
 - a. Mounting: Exposed, surface **OR** Recessed, **as directed**, installation.
 - b. Enclosures: Fabricated from minimum **0.047-inch- (1.2-mm-)** thick steel or minimum **0.05-inch- (1.27-mm-)** thick aluminum, with knockouts for electrical and piping connections.
7. Master Alarm Panels: Separate trouble alarm signals, pressure gages, and indicators for medical compressed-air piping systems.

- a. Include alarm signals when the following conditions exist:
 - 1) Medical Air: Pressure drops below 40 psig (275 kPa) or rises above 60 psig (415 kPa), backup air compressor is in operation, pressure drop across filter assembly increases more than 2 psig (13.8 kPa), dew point rises above 39 deg F (4 deg C) at 55 psig (380 kPa), carbon monoxide level rises above 10 ppm, and high water level is reached in receiver for liquid-ring, medical air compressor systems.
 - 2) Dental Air: Pressure drops below 65 psig (450 kPa) or rises above 110 psig (760 kPa), backup air compressor is in operation, pressure drop across filter assembly increases more than 2 psig (13.8 kPa), dew point rises above 50 deg F (10 deg C) at 125 psig (860 kPa), and carbon monoxide level rises above 10 ppm.
 - 3) Instrument Air: Pressure drops below 165 psig (1140 kPa) or rises above 185 psig (1275 kPa).
 - 4) Medical Laboratory Air: Pressure drops below 90 psig (630 kPa) or rises above 110 psig (760 kPa).
8. Anesthetizing-Area Alarm Panels: Separate trouble alarm signals, pressure gages, and indicators for medical compressed-air piping systems.
 - a. Include alarm signals when the following conditions exist:
 - 1) Medical Air: Pressure drops below 40 psig (275 kPa) or rises above 60 psig (415 kPa).
 - 2) Instrument Air: Pressure drops below 165 psig (1140 kPa) or rises above 185 psig (1275 kPa).
9. Area Alarm Panels: Separate trouble alarm signals, pressure gages, and indicators for medical compressed-air piping systems.
 - a. Include alarm signals when the following condition exists:
 - 1) Medical Air: Pressure drops below 40 psig (275 kPa) or rises above 60 psig (415 kPa).
10. Dental-Area Alarm Panels: Separate trouble alarm signals, pressure gages, and indicators for medical compressed-air piping systems.
 - a. Include alarm signals when the following conditions exist:
 - 1) Dental Air: Pressure drops below 65 psig (450 kPa) or rises above 110 psig (760 kPa), backup air compressor is in operation, pressure drop across filter assembly increases more than 2 psig (13.8 kPa), dew point rises above 50 deg F (10 deg C) at 125 psig (860 kPa), and carbon monoxide level rises above 10 ppm.
 - 2) Instrument Air: Pressure drops below 165 psig (1140 kPa) or rises above 185 psig (1275 kPa).
11. Medical Laboratory Area Alarm Panels: Separate trouble alarm signals, pressure gages,; and indicators for medical compressed-air piping systems.
 - a. Include alarm signals when the following condition exists:
 - 1) Medical Laboratory Air: Pressure drops below 90 psig (630 kPa) or rises above 110 psig (760 kPa).
- H. Computer Interface Cabinet
 1. Description: Wall-mounting, welded-steel control cabinet with gasketed door, mounting brackets, grounding device, and white-enamel finish for connection of medical compressed-air- piping-system alarms to facility computer. Include factory-installed signal circuit boards, power transformer, circuit breaker, wiring terminal board, and internal wiring capable of interfacing 20, **as directed**, alarm signals.
- I. Compressed-Air-Cylinder Storage Racks
 1. Wall Storage Racks: Fabricate racks with chain restraints for upright cylinders as indicated or provide equivalent manufactured wall racks.
 2. Freestanding Storage Racks: Fabricate racks as indicated or provide equivalent manufactured storage racks.

J. Flexible Pipe Connectors

1. Description: Corrugated-bronze tubing with bronze wire-braid covering and ends brazed to inner tubing.
 - a. Working-Pressure Rating: **200 psig (1380 kPa) OR 250 psig (1725 kPa), as directed,** minimum.
 - b. End Connections: Threaded copper pipe or plain-end copper tube.

K. Sleeves

1. Galvanized-Steel Sheet: **0.0239-inch (0.6-mm)** minimum thickness; round tube closed with welded longitudinal joint.
2. Stack Sleeve Fittings: Manufactured, cast-iron sleeve with integral clamping flange. Include clamping ring and bolts and nuts for membrane flashing.
 - a. Underdeck Clamp: Clamping ring with set screws.

L. Escutcheons

1. General Requirements for Escutcheons: Manufactured wall and ceiling escutcheons and floor plates, with ID to closely fit around pipe and tube and OD that completely covers opening.
2. One-Piece, Deep-Pattern Escutcheons: Deep-drawn, box-shaped brass with polished chrome-plated finish.
3. One-Piece, Cast-Brass Escutcheons: With set screw.
 - a. Finish: Polished chrome-plated **OR** Rough brass, **as directed**.
4. Split-Casting, Cast-Brass Escutcheons: With concealed hinge and set screw.
 - a. Finish: Polished chrome-plated **OR** Rough brass, **as directed**.
5. One-Piece, Stamped-Steel Escutcheons: With set screw **OR** spring clips, **as directed**, and chrome-plated finish.
6. Split-Plate, Stamped-Steel Escutcheons: With concealed **OR** exposed-rivet, **as directed**, hinge, set screw **OR** spring clips, **as directed**, and chrome-plated finish.
7. One-Piece, Floor-Plate Escutcheons: Cast iron.
8. Split-Casting, Floor-Plate Escutcheons: Cast brass with concealed hinge and set screw.

M. Grout

1. Description: ASTM C 1107, Grade B, nonshrink and nonmetallic, dry hydraulic-cement grout.
 - a. Characteristics: Post-hardening, volume adjusting, nonstaining, noncorrosive, nongaseous, and recommended for interior and exterior applications.
 - b. Design Mix: **5000-psi (34.5-MPa)**, 28-day compressive strength.
 - c. Packaging: Premixed and factory packaged.

N. Nitrogen

1. Description: Comply with USP 28 - NF 23 for oil-free dry nitrogen.

1.3 EXECUTION

A. Piping Applications

1. Connect new tubing to existing tubing with memory-metal couplings.
2. Laboratory Air Piping: Use one of the following piping materials for each size range:
 - a. **NPS 4 (DN 100)** and Smaller: Type L, copper medical gas tube; wrought-copper fittings; and brazed joints.
 - b. **NPS 4 (DN 100)** and Smaller: Type L, copper medical gas tube; press-type fittings; and pressure-sealed joints.
 - c. **NPS 5 to NPS 8 (DN 125 to DN 200)**: Type L, copper medical gas tube; wrought-copper fittings; and brazed joints.
3. Medical Air Piping: Use Type L, copper medical gas tube; wrought-copper fittings; and brazed joints.

4. Dental Air Piping: Use Type L, copper medical gas tube; wrought-copper fittings; and brazed joints.
5. Instrument Air Piping:
 - a. **NPS 3 (DN 80)** and Smaller: Use Type K **OR** Type L, **as directed**, copper medical gas tube; wrought-copper fittings; and brazed joints.
 - b. **NPS 3-1/2 (DN 90)** and Larger: Use Type K, copper medical gas tube; wrought-copper fittings; and brazed joints.
6. Medical Laboratory Air Piping: Use Type L, copper medical gas tube; wrought-copper fittings; and brazed joints.
7. Drain Piping: Use one of the following piping materials:
 - a. Copper water tube, cast- or wrought-copper fittings, and soldered **OR** press-type fittings, and pressure-sealed, **as directed**, joints.
 - b. PVC pipe, PVC fittings, and solvent-cemented joints.

B. Piping Installation

1. Drawing plans, schematics, and diagrams indicate general location and arrangement of compressed-air piping. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, air-compressor sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.
2. Comply with ASSE Standard #6010 for installation of compressed-air piping.
3. Install piping concealed from view and protected from physical contact by building occupants unless otherwise indicated and except in equipment rooms and service areas.
4. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
5. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal and coordinate with other services occupying that space.
6. Install piping adjacent to equipment and specialties to allow service and maintenance.
7. Install air and drain piping with 1 percent slope downward in direction of flow.
8. Install nipples, unions, special fittings, and valves with pressure ratings same as or higher than system pressure rating used in applications below unless otherwise indicated.
9. Install eccentric reducers, if available, where compressed-air piping is reduced in direction of flow, with bottoms of both pipes and reducer fitting flush.
10. Install branch connections to compressed-air mains from top of main. Provide drain leg and drain trap at end of each main and branch and at low points.
11. Install thermometer and pressure gage on discharge piping from each air compressor and on each receiver. Comply with requirements in Division 22 Section "Meters And Gages For Plumbing Piping".
12. Install piping to permit valve servicing.
13. Install piping free of sags and bends.
14. Install fittings for changes in direction and branch connections.
15. Install medical compressed-air piping to medical compressed-air service connections specified in this Section, to medical compressed-air service connections in equipment specified in Division 22 Section "Gas Piping For Laboratory And Healthcare Facilities", and to equipment specified in other Sections requiring medical compressed-air service.
16. Install seismic restraints on compressed-air piping. Seismic-restraint devices are specified in Division 22 Section "Vibration And Seismic Controls For Plumbing Piping And Equipment".
17. Install compressed-air service connections recessed in walls. Attach roughing-in assembly to substrate; attach finishing assembly to roughing-in assembly.
18. Connect compressed-air piping to air compressors and to compressed-air outlets and equipment requiring compressed-air service.
19. Install unions in copper compressed-air tubing adjacent to each valve and at final connection to each piece of equipment, machine, and specialty.

C. Valve Installation

1. Install shutoff valve at each connection to and from compressed-air equipment and specialties.
2. Install check valves to maintain correct direction of compressed-air flow from compressed-air equipment.
3. Install valve boxes recessed in wall and anchored to substrate. Single boxes may be used for multiple valves that serve same area or function.
4. Install zone valves and gages in valve boxes. Rotate valves to angle that prevents closure of cover when valve is in closed position.
5. Install safety valves on compressed-air receivers where required by NFPA 99 and where recommended by specialty manufacturers.
6. Install pressure regulators on compressed-air piping where reduced pressure is required.
7. Install automatic drain valves on equipment, specialties, and piping with drain connection. Run drain piping to floor drain so contents spill over or into it.
8. Install flexible pipe connectors in discharge piping and in inlet air piping from remote air-inlet filter, **as directed**, of each air compressor.

D. Joint Construction

1. Ream ends of PVC pipes and remove burrs.
2. Remove scale, slag, dirt, and debris from outside of cleaned tubing and fittings before assembly.
3. Threaded Joints: Apply appropriate tape to external pipe threads.
4. Brazed Joints: Join copper tube and fittings according to CDA's "Copper Tube Handbook," "Brazed Joints" Chapter. Continuously purge joint with oil-free dry nitrogen during brazing.
5. Soldered Joints: Apply ASTM B 813, water-flushable flux to tube end. Join copper tube and fittings according to ASTM B 828.
6. Pressure-Sealed Joints: Join copper tube and press-type fittings with tools recommended by fitting manufacturer.
7. Memory-Metal Coupling Joints: Join new copper tube to existing tube according to procedures developed by fitting manufacturer for installation of memory-metal coupling joints.
8. Solvent-Cemented Joints: Clean and dry joining surfaces. Join PVC pipe and fittings according to the following:
 - a. Comply with ASTM F 402 for safe-handling practice of cleaners, primers, and solvent cements.
 - b. Apply primer and join according to ASME B31.9 for solvent-cemented joints, and ASTM D 2672.

E. Compressed-Air Service Component Installation

1. Install compressed-air pressure control panel in walls. Attach to substrate.
2. Install compressed-air manifolds on concrete base, **as directed**, anchored to substrate.
3. Install compressed-air cylinders and connect to manifold piping.
4. Install compressed-air manifolds with seismic restraints as indicated.
5. Install compressed-air-cylinder wall storage racks attached to substrate.

F. Medical Compressed-Air-Piping Alarm System Installation

1. Alarm panels for medical compressed-air piping systems may be combined in single panels with medical vacuum piping systems and medical gas piping systems.
2. Install alarm system components for medical compressed-air-piping according to and in locations required by NFPA 99.
3. Install area and master alarm panels for medical compressed-air piping system where indicated.
4. Install computer interface cabinet with connection to medical compressed-air-piping alarm system and to facility computer.

G. Sleeve Installation

1. Sleeves are not required for core-drilled holes.
2. Permanent sleeves are not required for holes formed by removable PE sleeves.

3. Install sleeves for pipes passing through concrete and masonry walls and concrete floor and roof slabs using galvanized-steel pipe **OR** galvanized-steel sheet **OR** stack sleeve fittings **OR** PVC pipe, **as directed**.
 - a. Wall Penetrations: Cut sleeves to length for mounting flush with both surfaces.
 - b. Floor Penetrations: Extend sleeves installed in floors of mechanical equipment areas or other wet areas **2 inches (50 mm)** above finished floor level. Extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified.
- OR**
Install sleeves in new walls and slabs as new walls and slabs are constructed.
4. Install sleeves that are large enough to provide **1/4-inch (6.4-mm)** annular clear space between sleeve and pipe or pipe insulation. Use the following sleeve materials:
 - a. PVC **OR** Steel, **as directed**, Pipe Sleeves: For pipes smaller than **NPS 6 (DN 150)**.
 - b. Steel Sheet Sleeves: For pipes **NPS 6 (DN 150)** and larger penetrating gypsum board partitions.
 - c. Stack Sleeve Fittings: For pipes penetrating floors with membrane waterproofing. Secure flashing between clamping flanges. Install section of cast-iron soil pipe to extend sleeve to **2 inches (50 mm)** above finished floor level. Comply with requirements in Division 07 Section "Sheet Metal Flashing And Trim" for flashing.
 - 1) Seal space outside of sleeve fittings with grout.
5. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Comply with requirements in Division 07 Section "Penetration Firestopping".

H. Escutcheon Installation

1. Install escutcheons for penetrations of walls, ceilings, and floors according to the following:
 - a. New Piping:
 - 1) Piping with Fitting or Sleeve Protruding from Wall: One piece, deep pattern.
 - 2) Bare Piping at Wall and Floor Penetrations in Finished Spaces: One piece, cast brass with polished chrome-plated finish **OR** stamped steel with set screw **OR** stamped steel with set screw or spring clips **OR** stamped steel with spring clips, **as directed**.
 - 3) Bare Piping at Ceiling Penetrations in Finished Spaces: One piece, cast brass with polished chrome-plated finish **OR** One piece or split casting, cast brass with polished chrome-plated finish **OR** Split casting, cast brass with polished chrome-plated finish **OR** One piece, stamped steel with set screw **OR** One piece or split plate, stamped steel with set screw **OR** Split plate, stamped steel with set screw, **as directed**.
 - 4) Bare Piping in Unfinished Service Spaces: One piece, cast brass with polished chrome-plated finish **OR** cast brass with rough-brass finish **OR** stamped steel with set screw **OR** stamped steel with spring clips **OR** stamped steel with set screw or spring clips, **as directed**.
 - 5) Bare Piping in Equipment Rooms: One piece, cast brass **OR** stamped steel with set screw **OR** stamped steel with spring clips **OR** stamped steel with set screw or spring clips, **as directed**.
 - 6) Bare Piping at Floor Penetrations in Equipment Rooms: One-piece floor plate.
 - b. Existing Piping:
 - 1) Chrome-Plated Piping: Split casting, cast brass with chrome-plated finish.
 - 2) Insulated Piping: Split plate, stamped steel with concealed **OR** exposed-rivet, **as directed**, hinge and spring clips.
 - 3) Bare Piping at Wall and Floor Penetrations in Finished Spaces: Split casting, cast brass with chrome-plated finish **OR** plate, stamped steel with concealed hinge and spring clips, **as directed**.

- 4) Bare Piping at Ceiling Penetrations in Finished Spaces: Split casting, cast brass with chrome-plated finish **OR** plate, stamped steel with concealed hinge and set screw, **as directed**.
- 5) Bare Piping in Unfinished Service Spaces: Split casting, cast brass with polished chrome-plated finish **OR** casting, cast brass with rough-brass finish **OR** plate, stamped steel with concealed hinge and set screw or spring clips **OR** plate, stamped steel with concealed or exposed-rivet hinge and set screw or spring clips **OR** plate, stamped steel with exposed-rivet hinge and set screw or spring clips, **as directed**.
- 6) Bare Piping in Equipment Rooms: Split casting, cast brass **OR** plate, stamped steel with set screw or spring clips, **as directed**.
- 7) Bare Piping at Floor Penetrations in Equipment Rooms: Split-casting floor plate.

I. Hanger And Support Installation

1. Comply with requirements in Division 22 Section "Vibration And Seismic Controls For Plumbing Piping And Equipment" for seismic-restraint devices.
2. Comply with requirements in Division 22 Section "Hangers And Supports For Plumbing Piping And Equipment" for pipe hanger and support devices.
3. Vertical Piping: MSS Type 8 or 42, clamps.
4. Individual, Straight, Horizontal Piping Runs:
 - a. 100 Feet (30 m) and Less: MSS Type 1, adjustable, steel, clevis hangers.
 - b. Longer Than 100 Feet (30 m): MSS Type 43, adjustable, roller hangers.
5. Multiple, Straight, Horizontal Piping Runs 100 Feet (30 m) or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze. Comply with requirements in Division 22 Section "Hangers And Supports For Plumbing Piping And Equipment" for trapeze hangers.
6. Base of Vertical Piping: MSS Type 52, spring hangers.
7. Support horizontal piping within 12 inches (300 mm) of each fitting and coupling.
8. Rod diameter may be reduced 1 size for double-rod hangers, with 3/8-inch (10-mm) minimum rods.
9. Install hangers for copper tubing with the following maximum horizontal spacing and minimum rod diameters:
 - a. NPS 1/4 (DN 8): 60 inches (1500 mm) with 3/8-inch (10-mm) rod.
 - b. NPS 3/8 and NPS 1/2 (DN 10 and DN 15): 72 inches (1800 mm) with 3/8-inch (10-mm) rod.
 - c. NPS 3/4 (DN 20): 84 inches (2100 mm) with 3/8-inch (10-mm) rod.
 - d. NPS 1 (DN 25): 96 inches (2400 mm) with 3/8-inch (10-mm) rod.
 - e. NPS 1-1/4 (DN 32): 108 inches (2700 mm) with 3/8-inch (10-mm) rod.
 - f. NPS 1-1/2 (DN 40): 10 feet (3 m) with 3/8-inch (10-mm) rod.
 - g. NPS 2 (DN 50): 11 feet (3.4 m) with 3/8-inch (10-mm) rod.
 - h. NPS 2-1/2 (DN 65): 13 feet (4 m) with 1/2-inch (13-mm) rod.
 - i. NPS 3 (DN 80): 14 feet (4.3 m) with 1/2-inch (13-mm) rod.
 - j. NPS 3-1/2 (DN 90): 15 feet (4.6 m) with 1/2-inch (13-mm) rod.
 - k. NPS 4 (DN 100): 16 feet (4.9 m) with 1/2-inch (13-mm) rod.
 - l. NPS 5 (DN 125): 18 feet (5.5 m) with 1/2-inch (13-mm) rod.
 - m. NPS 6 (DN 150): 20 feet (6 m) with 5/8-inch (16-mm) rod.
 - n. NPS 8 (DN 200): 23 feet (7 m) with 3/4-inch (19-mm) rod.
10. Install supports for vertical copper tubing every 10 feet (3 m).

J. Labeling And Identification

1. Install identifying labels and devices for nonmedical laboratory compressed-air piping, valves, and specialties. Comply with requirements in Division 22 Section "Identification For Plumbing Piping And Equipment".
2. Install identifying labels and devices for medical compressed-air piping systems according to NFPA 99. Use the following or similar captions and color-coding for piping products where required by NFPA 99:
 - a. Medical Air: Black letters on yellow background.

- b. Dental Air: Black letters on yellow-and-white diagonal stripe background.
 - c. Instrument Air: White letters on red background.
 - d. Medical Laboratory Air: Black letters on yellow-and-white checkerboard background.
- K. Field Quality Control For Compressed-Air Piping In Nonmedical Laboratory Facilities
 - 1. Perform tests and inspections of compressed-air piping in nonmedical laboratory facilities and prepare test reports.
 - 2. Tests and Inspections:
 - a. Piping Leak Tests for Compressed-Air Piping: Test new and modified parts of existing piping. Cap and fill general-service compressed-air piping with oil-free dry nitrogen to pressure of **50 psig (345 kPa)** above system operating pressure, but not less than **150 psig (1035 kPa)**. Isolate test source and let stand for four hours to equalize temperature. Refill system, if required, to test pressure; hold for two hours with no drop in pressure.
 - b. Repair leaks and retest until no leaks exist.
 - c. Inspect filters and pressure regulators for proper operation.
- L. Field Quality Control For Medical Compressed-Air Piping In Healthcare Facilities
 - 1. Perform tests and inspections of medical compressed-air piping systems in healthcare facilities and prepare test reports.
 - 2. Tests and Inspections:
 - a. Medical Compressed-Air Testing Coordination: Perform tests, inspections, verifications, and certification of medical compressed-air piping systems concurrently with tests, inspections, and certification of medical vacuum piping and medical gas piping systems.
 - b. Preparation: Perform the following Installer tests according to requirements in NFPA 99 and ASSE Standard #6010:
 - 1) Initial blowdown.
 - 2) Initial pressure test.
 - 3) Cross-connection test.
 - 4) Piping purge test.
 - 5) Standing pressure test for positive-pressure medical compressed-air piping.
 - 6) Repair leaks and retest until no leaks exist.
 - c. System Verification: Comply with requirements in NFPA 99, ASSE Standard #6020, and ASSE Standard #6030 for verification of medical compressed-air piping systems and perform the following tests and inspections:
 - 1) Standing pressure test.
 - 2) Individual-pressurization **OR** Individual-pressurization or pressure-differential **OR** Pressure-differential, **as directed**, cross-connection test.
 - 3) Valve test.
 - 4) Master and area alarm tests.
 - 5) Piping purge test.
 - 6) Piping particulate test.
 - 7) Piping purity test.
 - 8) Final tie-in test.
 - 9) Operational pressure test.
 - 10) Medical air purity test.
 - 11) Verify correct labeling of equipment and components.
 - d. Testing Certification: Certify that specified tests, inspections, and procedures have been performed and certify report results. Include the following:
 - 1) Inspections performed.
 - 2) Procedures, materials, and gases used.
 - 3) Test methods used.
 - 4) Results of tests.
 - 3. Remove and replace components that do not pass tests and inspections and retest as specified above.



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SECTION 22 11 16 00h - VACUUM PIPING FOR LABORATORY AND HEALTHCARE FACILITIES

1.1 GENERAL

A. Description Of Work

1. This specification covers the furnishing and installation of materials for vacuum piping for laboratory and healthcare facilities. Products shall be as follows or as directed by the Owner. Installation procedures shall be in accordance with the products manufacturer's recommendations. Demolition and removal of materials shall be as required to support the work.

B. Summary

1. This Section includes the following:
 - a. Laboratory low-vacuum piping and specialties, designated "laboratory low vacuum" operating at **12 inches mercury** (40.6 kPa vacuum) **OR 20 inches mercury** (67.7 kPa vacuum), **as directed**.
 - b. Laboratory high-vacuum piping and specialties, designated "laboratory high vacuum" operating at **24 inches mercury** (81.3 kPa vacuum) **OR 29 inches mercury** (98.2 kPa vacuum), **as directed**.
 - c. Medical surgical vacuum piping and specialties, designated "medical vacuum" operating at **15 inches mercury** (380 mm mercury or 50.7 kPa vacuum) **OR 20 inches mercury** (510 mm mercury or 67.7 kPa vacuum) **OR 30 inches mercury** (760 mm mercury or 101.4 kPa vacuum), **as directed**.
 - d. Waste anesthetic gas disposal piping and specialties, designated "WAGD evacuation" operating at **14 inches mercury** (355 mm mercury or 47.2 kPa vacuum) **OR 15 inches mercury** (380 mm mercury or 50.7 kPa vacuum), **as directed**.
 - e. Dental vacuum piping and specialties, designated "dental vacuum" operating at **10 inches mercury** (255 mm mercury or 33.8 kPa vacuum) **OR 12 inches mercury** (305 mm mercury or 40.6 kPa vacuum), **as directed**.
 - f. Oral-evacuation piping and specialties, designated "HVE" operating at **5 inches mercury** (127 mm mercury or 16.9 kPa vacuum) **OR 8 inches mercury** (203 mm mercury or 27.0 kPa vacuum), **as directed**.
 - g. Healthcare laboratory vacuum piping and specialties, designated "medical laboratory vacuum" operating at **12 inches mercury** (40.6 kPa vacuum) **OR 20 inches mercury** (67.7 kPa vacuum) **OR 24 inches mercury** (81.3 kPa vacuum), **as directed**.

C. Definitions

1. D.I.S.S.: Diameter-index safety system.
2. HVE: High-volume (oral) evacuation.
3. Low Voltage: As defined in NFPA 70 for circuits and equipment operating at less than 50 V or for remote-control, signaling power-limited circuits.
4. WAGD: Waste anesthetic gas disposal.
5. Medical vacuum piping systems include medical vacuum, WAGD evacuation, dental vacuum, HVE, and medical laboratory vacuum piping systems.

D. Submittals

1. Product Data: For the following:
 - a. Vacuum pipes **OR** tubes, **as directed**, and fittings.
 - b. Vacuum valves and valve boxes.
 - c. Medical vacuum service connections and vacuum-bottle brackets.
2. LEED Submittal:
 - a. Product Data for Credit EQ 4.1: For solvent cements and adhesive primers, including printed statement of VOC content.
3. Shop Drawings: Diagram power, signal, and control wiring.

4. Piping Material Certification: Signed by Installer certifying that medical vacuum piping materials comply with NFPA 99 requirements.
5. Qualification Data: For Installer and testing agency.
6. Brazing certificates.
7. Field quality-control test reports.
8. Operation and maintenance data.

E. Quality Assurance

1. Installer Qualifications:
 - a. Medical Vacuum Piping Systems for Healthcare Facilities: Qualify installers according to ASSE Standard #6010.
 - b. Extruded-Tee Outlet Procedure: Qualify operators according to training provided by T-DRILL Industries Inc., for making branch outlets.
 - c. Pressure-Seal Joining Procedure for Copper Tubing: Qualify operators according to training provided by Viega; Plumbing and Heating Systems.
2. Testing Agency Qualifications: An independent testing agency, with the experience and capability to conduct the vacuum piping testing indicated, that is a member of the Medical Gas Professional Healthcare Organization or is an NRTL, and that is acceptable to authorities having jurisdiction.
 - a. Qualify testing personnel according to ASSE Standard #6020 for inspectors and ASSE Standard #6030 for verifiers.
3. Source Limitations: Obtain vacuum service connections of same type and from same manufacture as service connections provided for in Division 22 Section "Gas Piping For Laboratory And Healthcare Facilities".
4. Brazing: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications," or AWS B2.2, "Standard for Brazing Procedure and Performance Qualification."
5. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
6. Comply with ASME B31.9, "Building Services Piping," for vacuum piping in laboratory facilities.
7. NFPA Compliance: Comply with NFPA 99, "Health Care Facilities," for medical vacuum system materials and installation in healthcare facilities.

F. Project Conditions

1. Interruption of Existing Laboratory or Medical Vacuum Service(s): Do not interrupt laboratory or medical vacuum service to facilities occupied by the Owner or others unless permitted under the following conditions and then only after arranging to provide temporary service according to requirements indicated:
 - a. Notify the Owner no fewer than two days in advance of proposed interruption of laboratory or medical vacuum service(s).
 - b. Do not proceed with interruption of laboratory or medical vacuum service(s) without the Owner's written permission.

1.2 PRODUCTS

A. Pipes, Tubes, And Fittings

1. Copper Medical Gas Tube: ASTM B 819, Type L, seamless, drawn temper that has been manufacturer cleaned, purged, and sealed for medical gas service or according to CGA G-4.1 for oxygen service. Include standard color marking "OXY," "MED," "OXY/MED," "OXY/ACR," or "ACR/MED" in blue.
 - a. General Requirements for Copper Fittings: Manufacturer cleaned, purged, and bagged for oxygen service according to CGA G-4.1.

- b. Wrought-Copper Fittings: ASME B16.22, solder-joint pressure type or MSS SP-73, with dimensions for brazed joints.
 - c. Copper Unions: ASME B16.22 or MSS SP-123, wrought copper or cast-copper alloy.
 - d. Press-Type Fittings:
 - 1) **NPS 2 (DN 50)** and Smaller: Wrought-copper fitting with EPDM O-ring seal in each end.
 - 2) **NPS 2-1/2 to NPS 4 (DN 65 to DN 100)**: Bronze fitting with stainless-steel grip ring and EPDM O-ring seal in each end.
 2. Copper Water Tube: **ASTM B 88, Type M (ASTM B 88M, Type C)**, seamless, drawn temper.
 - a. Cast-Copper Fittings: ASME B16.18, solder-joint pressure type.
 - b. Wrought-Copper Fittings: ASME B16.22, solder-joint pressure type.
 - c. Cast-Copper-Alloy Flanges: ASME B16.24, Class 150.
 - d. Copper Unions: ASME B16.22 or MSS SP-123, wrought copper or cast-copper alloy.
 - e. Press-Type Fittings:
 - 1) **NPS 2 (DN 50)** and Smaller: Wrought-copper fitting with EPDM O-ring seal in each end.
 - 2) **NPS 2-1/2 to NPS 4 (DN 65 to DN 100)**: Bronze fitting with stainless-steel grip ring and EPDM O-ring seal in each end.
 3. Extruded-Tee Outlets: ASTM F 2014 procedure for making branch outlets in copper tube.
 4. Memory-Metal Couplings: Cryogenic compression fitting made of ASTM F 2063, nickel-titanium, shape-memory alloy, and that has been manufacturer cleaned, purged, and sealed for oxygen service according to CGA G-4.1.
 5. PVC Pipe: ASTM D 1785, Schedule 40 and Schedule 80.
 - a. PVC Pressure Fittings: ASTM D 2466, Schedule 40 and ASTM D 2467, Schedule 80; socket type.
- B. Joining Materials
 1. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.
 2. Brazing Filler Metals: AWS A5.8/A5.8M, BCuP Series, copper-phosphorus alloys for general-duty brazing unless otherwise indicated.
 3. Threaded-Joint Tape: PTFE.
 4. Pipe-Flange Gasket Materials: ASME B16.21, nonmetallic, flat, asbestos-free, **1/8-inch (3.2-mm)** maximum thickness, full-face type.
 5. Flange Bolts and Nuts: ASME B18.2.1, carbon steel.
 6. Solvent Cement for Joining PVC Piping: ASTM D 2564. Include primer complying with ASTM F 656.
 - a. Use PVC solvent cement that has a VOC content of 510 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 - b. Use adhesive primer that has a VOC content of 550 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- C. Valves
 1. General Requirements for Valves: Manufacturer cleaned, purged, and bagged according to CGA G-4.1 for oxygen service.
 - a. Exception: Factory cleaning and bagging are not required for valves for WAGD service.
 2. Copper-Alloy Ball Valves: MSS SP-110, 3-piece body, brass or bronze.
 - a. Pressure Rating: **300 psig (2070 kPa)** minimum.
 - b. Ball: Full-port, chrome-plated brass.
 - c. Seats: PTFE or TFE.
 - d. Handle: Lever type with locking device, **as directed**.
 - e. Stem: Blowout proof with PTFE or TFE seal.
 - f. Ends: Manufacturer-installed ASTM B 819, copper-tube extensions.
 3. Bronze Check Valves: In-line pattern.
 - a. Pressure Rating: **300 psig (2070 kPa)** minimum.
 - b. Operation: Spring loaded.

- c. Ends: Manufacturer-installed ASTM B 819, copper-tube extensions.
 4. Zone Valves: MSS SP-110, 3-piece-body, brass or bronze ball valve with gage.
 - a. Pressure Rating: **300 psig (2070 kPa)** minimum.
 - b. Ball: Full-port, chrome-plated brass.
 - c. Seats: PTFE or TFE.
 - d. Handle: Lever type with locking device, **as directed**.
 - e. Stem: Blowout proof with PTFE or TFE seal.
 - f. Ends: Manufacturer-installed ASTM B 819, copper-tube extensions.
 - g. Vacuum Gage: Manufacturer installed on one copper-tube extension.
 5. Zone Valve Boxes: Formed steel with anchors for recessed mounting, holes with grommets in box sides for tubing extension protection, and of size for single or multiple valves with vacuum gages and in sizes required to permit manual operation of valves.
 - a. Interior Finish: Factory-applied white enamel.
 - b. Cover Plate: Aluminum or extruded-anodized aluminum **OR** Satin-chrome finish steel **OR** Stainless steel with NAAMM AMP 503, No. 4 finish, **as directed**, with frangible or removable windows.
 - c. Valve-Box Windows: Clear or tinted transparent plastic with labeling that includes rooms served, according to NFPA 99.
 6. Zone Valve Boxes: Formed or extruded aluminum with anchors for recessed mounting, holes with grommets in box sides for tubing extension protection, and of size for single or multiple valves with vacuum gages and in sizes required to permit manual operation of valves.
 - a. Interior Finish: Factory-applied white enamel.
 - b. Cover Plate: Aluminum or extruded-anodized aluminum **OR** Stainless steel with NAAMM AMP 503, No. 4 finish, **as directed**, with frangible or removable windows.
 - c. Valve-Box Windows: Clear or tinted transparent plastic with labeling that includes rooms served, according to NFPA 99.
 7. PVC Ball Valves: MSS SP-122, with union ends and **150-psig (1035-kPa)** minimum working-pressure rating and suitable for vacuum service.
 8. PVC Butterfly Valves: Lug type with lever handle and **150-psig (1035-kPa)** minimum working-pressure rating and suitable for vacuum service.
 9. PVC Check Valves: Ball-, in-line-, piston-, or swing-check design with flanged or union ends and **70-psig (480-kPa) OR 100-psig (690-kPa)**, **as directed**, minimum working-pressure rating and suitable for vacuum service.
 10. Safety Valves: Bronze-body, ASME-construction, pressure-relief type with settings to match system requirements.
 11. Automatic Drain Valves: Stainless-steel body and internal parts, rated for **200-psig (1380-kPa)** minimum working pressure, capable of automatic discharge of collected condensate. Include mounting bracket where wall mounting is indicated.
- D. Medical Vacuum Service Connections
1. Connection Devices: For specific medical vacuum service listed. Include roughing-in assemblies, finishing assemblies, and cover plates. Individual cover plates are not required if service connection is in multiple unit or assembly with cover plate. Furnish recessed-type units made for concealed piping unless otherwise indicated.
 - a. Roughing-in Assembly:
 - 1) Steel outlet box for recessed mounting and concealed piping.
 - 2) Brass-body inlet block.
 - 3) Seals that will prevent vacuum leakage.
 - 4) ASTM B 819, **NPS 3/8 (DN 10)** copper outlet tube brazed to valve with service marking and tube-end dust cap.
 - b. Finishing Assembly:
 - 1) Brass housing with primary check valve.
 - 2) Seals that will prevent vacuum leakage.
 - 3) Cover plate with gas-service label.

- c. Quick-Coupler Service Connections: Suction inlets for medical vacuum **OR** medical vacuum and WAGD evacuation **OR** WAGD evacuation, **as directed**, service outlets with noninterchangeable keyed indexing to prevent interchange between services, constructed to permit one-handed connection and removal of equipment, and with positive-locking ring that retains equipment stem in valve during use.
 - d. D.I.S.S. Service Connections: Suction inlets, complying with CGA V-5, with threaded indexing to prevent interchange between services, constructed to permit one-handed connection and removal of equipment.
 - 1) Medical Vacuum Service Connections: CGA V-5, D.I.S.S. No. 1220.
 - 2) WAGD Evacuation Service Connections: CGA V-5, D.I.S.S. No. 2220.
 - e. Vacuum Bottle Brackets: One piece, with pattern and finish matching corresponding service cover plate.
 - f. Cover Plates: One piece, stainless steel, with NAAMM AMP 503, No. 4 finish **OR** metal, with chrome-plated finish **OR** anodized aluminum, **as directed**, and permanent, color-coded, identifying label matching corresponding service.
- E. Medical Vacuum Piping Alarm Systems
1. Panels for medical vacuum piping systems may be combined in single panels with medical compressed-air and medical gas piping systems.
 2. Components: Designed for continuous service and to operate on power supplied from 120-V **OR** 240-V **OR** 277-V, **as directed**, ac power source to alarm panels and with connections for low-voltage wiring to remote sensing devices. Include step-down transformers if required.
 3. Vacuum Switches or Transducer Sensors: Continuous line monitoring with electrical connections for alarm system.
 - a. Vacuum Operating Range: **0- to 30-in. Hg (0- to 101-kPa vacuum)**.
 4. General Requirements for Medical Vacuum Alarm Panels: Factory wired with audible and color-coded visible signals to indicate specified functions.
 - a. Mounting: Exposed, surface **OR** Recessed, **as directed**, installation.
 - b. Enclosures: Fabricated from minimum **0.047-inch- (1.2-mm-)** thick steel or minimum **0.05-inch- (1.27-mm-)** thick aluminum, with knockouts for electrical and piping connections.
 5. Master Alarm Panels: With separate trouble alarm signals, vacuum gages, and indicators for medical vacuum piping systems.
 - a. Include alarm signals when the following conditions exist:
 - 1) Medical Vacuum: Vacuum drops below **12-in. Hg (40 kPa vacuum)** and backup vacuum pump is in operation.
 - 2) WAGD Evacuation: Vacuum drops below **12-in. Hg (40 kPa vacuum)**.
 - 3) Dental Vacuum: Vacuum drops below **6-in. Hg (20 kPa vacuum)** and backup vacuum producer is in operation.
 - 4) HVE: **4-in. Hg (13 kPa vacuum)** and backup vacuum producer is in operation.
 - 5) Medical Laboratory Vacuum: Vacuum drops below **10-in. Hg (34 kPa vacuum)**.
 6. Anesthetizing-Area Alarm Panels: Separate trouble alarm signals; vacuum gages; and indicators for medical vacuum piping systems.
 - a. Include alarm signals when the following conditions exist:
 - 1) Medical Vacuum: Vacuum drops below **12-in. Hg (40 kPa vacuum)**.
 - 2) WAGD Evacuation: Vacuum drops below **12-in. Hg (40 kPa vacuum)**.
 7. Area Alarm Panels: Separate trouble alarm signals; vacuum gages; and indicators for medical vacuum piping systems.
 - a. Include alarm signals when the following condition exists:
 - 1) Medical Vacuum: Vacuum drops below **12-in. Hg (40 kPa vacuum)**.
 8. Dental Area Alarm Panels: Separate trouble alarm signals; vacuum gages; and indicators for medical vacuum piping systems.
 - a. Include alarm signals when the following conditions exist:
 - 1) Dental Vacuum: Vacuum drops below **6-in. Hg (20 kPa vacuum)** and backup vacuum producer is in operation.
 - 2) HVE: **4-in. Hg (13 kPa vacuum)** and backup vacuum producer is in operation.



9. Medical Laboratory Area Alarm Panels: Separate trouble alarm signals; vacuum gages; and indicators for medical vacuum piping systems.
 - a. Include alarm signals when the following condition exists:
 - 1) Medical Vacuum: Vacuum drops below **12-in. Hg (40 kPa vacuum)**.
- F. Computer Interface Cabinet
 1. Description: Wall-mounting, welded-steel, control cabinet with gasketed door, mounting brackets, grounding device, and white-enamel finish for connection of medical vacuum piping system alarms to facility computer. Include factory-installed signal circuit boards, power transformer, circuit breaker, wiring terminal board, and internal wiring capable of interfacing 20 alarm signals.
- G. Flexible Pipe Connectors
 1. Description: Corrugated-bronze tubing with bronze wire-braid covering and ends brazed to inner tubing.
 - a. Working-Pressure Rating: **200 psig (1380 kPa) OR 250 psig (1725 kPa), as directed**, minimum.
 - b. End Connections: Threaded copper pipe or plain-end copper tube.
- H. Sleeves
 1. Galvanized-Steel Sheet: **0.0239-inch (0.6-mm)** minimum thickness; round tube closed with welded longitudinal joint.
 2. Stack Sleeve Fittings: Manufactured, cast-iron sleeve with integral clamping flange. Include clamping ring and bolts and nuts for membrane flashing.
 - a. Underdeck Clamp: Clamping ring with set screws.
- I. Escutcheons
 1. General Requirements for Escutcheons: Manufactured wall and ceiling escutcheons and floor plates, with ID to closely fit around pipe and tube and OD that completely covers opening.
 2. One-Piece, Deep-Pattern Escutcheons: Deep-drawn, box-shaped brass with polished chrome-plated finish.
 3. One-Piece, Cast-Brass Escutcheons: With set screw.
 - a. Finish: Polished chrome-plated **OR** Rough brass **OR** Polished chrome-plated and rough brass, **as directed**.
 4. Split-Casting, Cast-Brass Escutcheons: With concealed hinge and set screw.
 - a. Finish: Polished chrome-plated **OR** Rough brass **OR** Polished chrome-plated and rough brass, **as directed**.
 5. One-Piece, Stamped-Steel Escutcheons: With set screw **OR** spring clips, **as directed**, and chrome-plated finish.
 6. Split-Plate, Stamped-Steel Escutcheons: With concealed **OR** exposed-rivet, **as directed**, hinge, set screw **OR** spring clips, **as directed**, and chrome-plated finish.
 7. One-Piece, Floor-Plate Escutcheons: Cast iron.
 8. Split-Casting, Floor-Plate Escutcheons: Cast brass with concealed hinge and set screw.
- J. Grout
 1. Description: ASTM C 1107, Grade B, nonshrink and nonmetallic, dry hydraulic-cement grout.
 - a. Characteristics: Post-hardening, volume adjusting, nonstaining, noncorrosive, nongaseous, and recommended for interior and exterior applications.
 - b. Design Mix: **5000-psi (34.5-MPa)**, 28-day compressive strength.
 - c. Packaging: Premixed and factory packaged.
- K. Nitrogen
 1. Description: Comply with USP 28 - NF 23 for oil-free dry nitrogen.

1.3 EXECUTION

A. Preparation

1. Cleaning of Medical Gas Tubing: If manufacturer-cleaned and -capped fittings or tubing are not available or if precleaned fittings or tubing must be recleaned because of exposure, have supplier or separate agency acceptable to authorities having jurisdiction perform the following procedures:
 - a. Clean medical gas tube and fittings, valves, gages, and other components of oil, grease, and other readily oxidizable materials as required for oxygen service according to CGA G-4.1, "Cleaning Equipment for Oxygen Service."
 - b. Wash medical gas tubing and components in hot, alkaline-cleaner-water solution of sodium carbonate or trisodium phosphate in proportion of **1 lb (0.453 kg)** of chemical to **3 gal. (11.3 L)** of water.
 - 1) Scrub to ensure complete cleaning.
 - 2) Rinse with clean, hot water to remove cleaning solution.

B. Piping Applications

1. Connect new copper tubing to existing tubing with memory-metal couplings.
2. Nonhealthcare Laboratory Low Vacuum Piping: Use one of the following piping materials for each size range:
 - a. **NPS 4 (DN 100)** and Smaller: Type L, copper medical gas **OR M (C)** copper water, **as directed**, tube; wrought-copper fittings; and brazed **OR** soldered, **as directed**, joints.
 - b. **NPS 4 (DN 100)** and Smaller: Type L, copper medical gas **OR M (C)** copper water, **as directed**, tube; press-type fittings; and pressure-sealed joints.
 - c. **NPS 5 to NPS 8 (DN 125 to DN 200)**: Type L, copper medical gas **OR M (C)** copper water, **as directed**, tube; wrought-copper fittings; and brazed **OR** soldered, **as directed**, joints.
3. Nonhealthcare Laboratory High Vacuum Piping: Use one of the following piping materials for each size range:
 - a. **NPS 4 (DN 100)** and Smaller: Type L, copper medical gas **OR M (C)** copper water, **as directed**, tube; wrought-copper fittings; and brazed **OR** soldered, **as directed**, joints.
 - b. **NPS 4 (DN 100)** and Smaller: Type L, copper medical gas **OR M (C)** copper water, **as directed**, tube; press-type fittings; and pressure-sealed joints.
 - c. **NPS 5 to NPS 8 (DN 125 to DN 200)**: Type L, copper medical gas **OR M (C)** copper water, **as directed**, tube; wrought-copper fittings; and brazed **OR** soldered, **as directed**, joints.
4. Medical Vacuum Piping: Use one of the following piping materials for each size range:
 - a. **NPS 4 (DN 100)** and Smaller: Type L, copper medical gas **OR M (C)** copper water, **as directed**, tube; wrought-copper fittings; and brazed joints.
 - b. **NPS 4 (DN 100)** and Smaller: Type L, copper medical gas **OR M (C)** copper water, **as directed**, tube; press-type fittings; and pressure-sealed joints.
 - c. **NPS 5 to NPS 8 (DN 125 to DN 200)**: Type L, copper medical gas **OR M (C)** copper water, **as directed**, tube; wrought-copper fittings; and brazed joints.
5. WAGD Evacuation Piping: Use one of the following piping materials for each size range:
 - a. **NPS 4 (DN 100)** and Smaller: Type L, copper medical gas **OR M (C)** copper water, **as directed**, tube; wrought-copper fittings; and brazed joints.
 - b. **NPS 4 (DN 100)** and Smaller: Type L, copper medical gas **OR M (C)** copper water, **as directed**, tube; press-type fittings; and pressure-sealed joints.
 - c. **NPS 5 to NPS 8 (DN 125 to DN 200)**: Type L, copper medical gas **OR M (C)** copper water, **as directed**, tube; wrought-copper fittings; and brazed joints.
6. Dental Vacuum Piping: Use one of the following piping materials for each size range:
 - a. **NPS 4 (DN 100)** and Smaller: Type L, copper medical gas **OR M (C)** copper water, **as directed**, tube; wrought-copper fittings; and brazed **OR** soldered, **as directed**, joints.
 - b. **NPS 4 (DN 100)** and Smaller: Type L, copper medical gas **OR M (C)** copper water, **as directed**, tube; press-type fittings; and pressure-sealed joints.
 - c. **NPS 5 to NPS 8 (DN 125 to DN 200)**: Type L, copper medical gas **OR M (C)** copper water, **as directed**, tube; wrought-copper fittings; and brazed **OR** soldered, **as directed**, joints.
7. HVE Piping: Use one of the following piping materials for each size range:

- a. **NPS 4 (DN 100)** and Smaller: Type L, copper medical gas **OR M (C)** copper water, **as directed**, tube; wrought-copper fittings; and brazed **OR** soldered, **as directed**, joints.
 - b. **NPS 4 (DN 100)** and Smaller: Type L, copper medical gas **OR M (C)** copper water, **as directed**, tube; press-type fittings; and pressure-sealed joints.
 - c. **NPS 4 (DN 100)** and Smaller: Schedule 40 PVC pipe, Schedule 40 PVC fittings **OR** Schedule 80 PVC pipe, Schedule 80 PVC fittings, **as directed**, and solvent-cemented joints.
 - d. **NPS 5 to NPS 8 (DN 125 to DN 200)**: Type L, copper medical gas **OR M (C)** copper water, **as directed**, tube; wrought-copper fittings; and brazed **OR** soldered, **as directed**, joints.
 - e. **NPS 5 to NPS 8 (DN 125 to DN 200)**: Schedule 40 PVC pipe, Schedule 40 PVC fittings **OR** Schedule 80 PVC pipe, Schedule 80 PVC fittings, **as directed**, and solvent-cemented joints.
8. Medical Laboratory Vacuum Piping: Use one of the following piping materials for each size range:
- a. **NPS 4 (DN 100)** and Smaller: Type L, copper medical gas **OR M (C)** copper water, **as directed**, tube; wrought-copper fittings; and brazed joints.
 - b. **NPS 4 (DN 100)** and Smaller: Type L, copper medical gas **OR M (C)** copper water, **as directed**, tube; press-type fittings; and pressure-sealed joints.
 - c. **NPS 5 to NPS 8 (DN 125 to DN 200)**: Type L, copper medical gas **OR M (C)** copper water, **as directed**, tube; wrought-copper fittings; and brazed joints.
9. Drain Piping: Use one of the following piping materials:
- a. Copper water tube, cast- or wrought-copper fittings, and soldered **OR** press-type fittings, and pressure-sealed, **as directed**, joints.
 - b. PVC pipe, PVC fittings, and solvent-cemented joints.

C. Piping Installation

1. Drawing plans, schematics, and diagrams indicate general location and arrangement of vacuum piping. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, air-compressor sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.
2. Comply with ASSE Standard #6010 for installation of vacuum piping.
3. Install piping concealed from view and protected from physical contact by building occupants unless otherwise indicated and except in equipment rooms and service areas.
4. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
5. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal and coordinate with other services occupying that space.
6. Install piping adjacent to equipment and specialties to allow service and maintenance.
7. Install vacuum and drain piping with 1 percent slope downward in direction of flow.
8. Install nipples, unions, and special fittings, and valves with pressure ratings same as or higher than piping pressure rating used in applications below unless otherwise indicated.
9. Install eccentric reducers, if available, where vacuum piping is reduced in direction of flow, with bottoms of both pipes and reducer fitting flush.
10. Provide drain leg and drain trap at end of each main and branch and at low points.
11. Install thermometer and vacuum gage on inlet piping to each vacuum producer and on each receiver and separator, **as directed**. Comply with requirements in Division 22 Section "Meters And Gages For Plumbing Piping".
12. Install piping to permit valve servicing.
13. Install piping free of sags and bends.
14. Install fittings for changes in direction and for branch connections. Extruded-tee branch outlets in copper tubing may be made where specified.
15. Install medical vacuum piping to medical vacuum service connections specified in this Section and to equipment specified in other Sections requiring medical vacuum service.

16. Install seismic restraints on vacuum piping. Seismic-restraint devices are specified in Division 22 Section "Vibration And Seismic Controls For Plumbing Piping And Equipment".
 17. Install medical vacuum service connections recessed in walls. Attach roughing-in assembly to substrate; attach finishing assembly to roughing-in assembly.
 18. Install medical vacuum bottle bracket adjacent to each wall-mounted medical vacuum service connection suction inlet.
 19. Connect vacuum piping to vacuum producers and to equipment requiring vacuum service.
 20. Install unions, in copper vacuum tubing adjacent to each valve and at final connection to each piece of equipment, machine, and specialty.
 21. Install unions, in PVC vacuum piping **NPS 2 (DN 50)** and smaller, adjacent to each valve and at final connection to each piece of equipment, machine, and specialty.
 22. Install flanges, in PVC vacuum piping **NPS 2-1/2 (DN 65)** and larger, adjacent to flanged valves and at final connection to each piece of equipment, machine, and specialty.
- D. Valve Applications
1. Valves for Copper Vacuum Tubing: Use copper alloy ball and bronze check types.
 2. Valves for PVC Vacuum Piping:
 - a. **NPS 4 (DN 100)** and Smaller: Use copper alloy ball and bronze **OR** PVC ball, butterfly, and, **as directed**, check types.
 - b. **NPS 5 (DN 125)** and Larger: Use PVC butterfly and check types.
- E. Valve Installation
1. Install shutoff valve at each connection to and from vacuum equipment and specialties.
 2. Install check valves to maintain correct direction of vacuum flow to vacuum-producing equipment.
 3. Install valve boxes recessed in wall and anchored to substrate. Single boxes may be used for multiple valves that serve same area or function.
 4. Install zone valves and gages in valve boxes. Rotate valves to angle that prevents closure of cover when valve is in closed position.
 5. Install safety valves on vacuum receivers, where required by NFPA 99, and where recommended by specialty manufacturers.
 6. Install automatic drain valves on equipment, specialties, and piping with drain connection. Run drain piping to floor drain, so contents spill over or into it.
 7. Install flexible pipe connectors in suction inlet piping to each vacuum producer.
- F. Joint Construction
1. Ream ends of pipes and tubes and remove burrs.
 2. Remove scale, slag, dirt, and debris from outside of cleaned tubing and fittings before assembly.
 3. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
 4. Threaded Joints: Apply appropriate tape to external pipe threads.
 5. Brazed Joints: Join copper tube and fittings according to CDA's "Copper Tube Handbook," "Brazed Joints" Chapter. Continuously purge joint with oil-free dry nitrogen during brazing.
 6. Soldered Joints: Apply ASTM B 813, water-flushable flux to tube end. Join copper tube and fittings according to ASTM B 828.
 7. Extruded-Tee Outlets: Form branches in copper tube according to ASTM F 2014, with tools recommended by procedure manufacture.
 8. Flanged Joints:
 - a. Copper Tubing: Install flange on copper tubes. Use pipe-flange gasket between flanges. Join flanges with gasket and bolts according to ASME B31.9 for bolting procedure.
 - b. PVC Piping: Install PVC flange on PVC pipes. Use pipe-flange gasket between flanges. Join flanges with gasket and bolts according to ASME B31.9 for bolting procedure.
 9. Pressure-Sealed Joints: Join copper tube and copper and copper-alloy fittings with tools recommended by fitting manufacturer.
 10. Memory-Metal Coupling Joints: Join new copper tube to existing tube according to procedures developed by fitting manufacturer for installation of memory-metal coupling joints.
 11. Solvent-Cemented Joints: Clean and dry joining surfaces. Join PVC pipe and fittings according to the following:

- a. Comply with ASTM F 402 for safe-handling practice of cleaners, primers, and solvent cements.
- b. Apply primer and join according to ASME B31.9 for solvent-cemented joints and to ASTM D 2672.

G. Medical Vacuum Piping Alarm System Installation

1. Panels for medical vacuum piping systems may be combined in single panels with medical compressed-air piping systems and medical gas piping systems.
2. Install medical vacuum piping system alarm system components in locations required by and according to NFPA 99.
3. Install medical vacuum piping system area and master alarm panels where indicated.
4. Install computer interface cabinet with connection to medical vacuum piping alarm system and to facility computer.

H. Sleeve Installation

1. Sleeves are not required for core-drilled holes.
2. Permanent sleeves are not required for holes formed by removable PE sleeves.
3. Install sleeves for pipes passing through concrete and masonry walls and concrete floor and roof slabs using galvanized-steel pipe **OR** galvanized-steel sheet **OR** stack sleeve fittings **OR** PVC pipe, **as directed**.
 - a. Wall Penetrations: Cut sleeves to length for mounting flush with both surfaces.
 - b. Floor Penetrations: Extend sleeves installed in floors of mechanical equipment areas or other wet areas **2 inches (50 mm)** above finished floor level. Extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified.

OR

Install sleeves in new walls and slabs as new walls and slabs are constructed.

4. Install sleeves that are large enough to provide **1/4-inch (6.4-mm)** annular clear space between sleeve and pipe or pipe insulation. Use the following sleeve materials:
 - a. PVC **OR** Steel, **as directed**, Pipe Sleeves: For pipes smaller than **NPS 6 (DN 150)**.
 - b. Steel Sheet Sleeves: For pipes **NPS 6 (DN 150)** and larger, penetrating gypsum board partitions.
 - c. Stack Sleeve Fittings: For pipes penetrating floors with membrane waterproofing. Secure flashing between clamping flanges. Install section of cast-iron soil pipe to extend sleeve to **2 inches (50 mm)** above finished floor level. Comply with requirements in Division 07 Section "Sheet Metal Flashing And Trim" for flashing.
 - 1) Seal space outside of sleeve fittings with grout.
5. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Comply with requirements in Division 07 Section "Penetration Firestopping".

I. Escutcheon Installation

1. Install escutcheons for penetrations of walls, ceilings, and floors according to the following:
 - a. New Piping:
 - 1) Piping with Fitting or Sleeve Protruding from Wall: One piece, deep pattern.
 - 2) Bare Piping at Wall and Floor Penetrations in Finished Spaces: One piece, cast brass with polished chrome-plated finish **OR** stamped steel with set screw **OR** stamped steel with set screw or spring clips **OR** stamped steel with spring clips, **as directed**.
 - 3) Bare Piping at Ceiling Penetrations in Finished Spaces: One piece, cast brass with polished chrome-plated finish **OR** One piece or split casting, cast brass with polished chrome-plated finish **OR** Split casting, cast brass with polished chrome-plated finish **OR** One-piece, stamped steel with set screw **OR** One piece or split plate, stamped steel with set screw **OR** Split plate, stamped steel with set screw, **as directed**.

- 4) Bare Piping in Unfinished Service Spaces: One piece, cast brass with polished chrome-plated finish **OR** cast brass with rough-brass finish **OR** stamped steel with set screw **OR** stamped steel with spring clips **OR** stamped steel with set screw or spring clips, **as directed**.
- 5) Bare Piping in Equipment Rooms: One piece, cast brass **OR** stamped steel with set screw **OR** stamped steel with spring clips **OR** stamped steel with set screw or spring clips, **as directed**.
- 6) Bare Piping at Floor Penetrations in Equipment Rooms: One-piece floor plate.
- b. Existing Piping:
 - 1) Chrome-Plated Piping: Split casting, cast brass with chrome-plated finish.
 - 2) Insulated Piping: Split plate, stamped steel with concealed **OR** exposed-rivet, **as directed**, hinge and spring clips.
 - 3) Bare Piping at Wall and Floor Penetrations in Finished Spaces: Split casting, cast brass with chrome-plated finish **OR** plate, stamped steel with concealed hinge and spring clips, **as directed**.
 - 4) Bare Piping at Ceiling Penetrations in Finished Spaces: Split casting, cast brass with chrome-plated finish **OR** plate, stamped steel with concealed hinge and set screw, **as directed**.
 - 5) Bare Piping in Unfinished Service Spaces: Split casting, cast brass with polished chrome-plated finish **OR** casting, cast brass with rough-brass finish **OR** plate, stamped steel with concealed hinge and set screw or spring clips **OR** plate, stamped steel with concealed or exposed-rivet hinge and set screw or spring clips **OR** plate, stamped steel with exposed-rivet hinge and set screw or spring clips, **as directed**.
 - 6) Bare Piping in Equipment Rooms: Split casting, cast brass **OR** plate, stamped steel with set screw or spring clips, **as directed**.
 - 7) Bare Piping at Floor Penetrations in Equipment Rooms: Split-casting floor plate.
- J. Hanger And Support Installation
 1. Comply with requirements in Division 22 Section "Hangers And Supports For Plumbing Piping And Equipment" for pipe hanger and support devices.
 2. Vertical Piping: MSS Type 8 or 42, clamps.
 3. Individual, Straight, Horizontal Piping Runs:
 - a. 100 Feet (30 m) and Less: MSS Type 1, adjustable, steel, clevis hangers.
 - b. Longer Than 100 Feet (30 m): MSS Type 43, adjustable, roller hangers.
 4. Multiple, Straight, Horizontal Piping Runs 100 Feet (30 m) or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze. Comply with requirements in Division 22 Section "Hangers And Supports For Plumbing Piping And Equipment" for trapeze hangers.
 5. Base of Vertical Piping: MSS Type 52, spring hangers.
 6. Support horizontal piping within 12 inches (300 mm) of each fitting and coupling.
 7. Rod diameter may be reduced 1 size for double-rod hangers, with 3/8-inch (10-mm) minimum rods.
 8. Install hangers for copper tubing with the following maximum horizontal spacing and minimum rod diameters:
 - a. NPS 1/4 (DN 8): 60 inches (1500 mm) with 3/8-inch (10-mm) rod.
 - b. NPS 3/8 and NPS 1/2 (DN 10 and DN 15): 72 inches (1800 mm) with 3/8-inch (10-mm) rod.
 - c. NPS 3/4 (DN 20): 84 inches (2100 mm) with 3/8-inch (10-mm) rod.
 - d. NPS 1 (DN 25): 96 inches (2400 mm) with 3/8-inch (10-mm) rod.
 - e. NPS 1-1/4 (DN 32): 108 inches (2700 mm) with 3/8-inch (10-mm) rod.
 - f. NPS 1-1/2 (DN 40): 10 feet (3 m) with 3/8-inch (10-mm) rod.
 - g. NPS 2 (DN 50): 11 feet (3.4 m) with 3/8-inch (10-mm) rod.
 - h. NPS 2-1/2 (DN 65): 13 feet (4 m) with 1/2-inch (13-mm) rod.
 - i. NPS 3 (DN 80): 14 feet (4.3 m) with 1/2-inch (13-mm) rod.
 - j. NPS 3-1/2 (DN 90): 15 feet (4.6 m) with 1/2-inch (13-mm) rod.
 - k. NPS 4 (DN 100): 16 feet (4.9 m) with 1/2-inch (13-mm) rod.
 - l. NPS 5 (DN 125): 18 feet (5.5 m) with 1/2-inch (13-mm) rod.

- m. **NPS 6 (DN 150): 20 feet (6 m) with 5/8-inch (16-mm) rod.**
 - n. **NPS 8 (DN 200): 23 feet (7 m) with 3/4-inch (19-mm) rod.**
 - 9. Install supports for vertical copper tubing every **10 feet (3 m).**
 - 10. Install hangers **OR** vinyl-coated hangers, **as directed**, for PVC piping with the following maximum horizontal spacing and minimum rod diameters:
 - a. **NPS 1 (DN 25) and Smaller: 30 inches (760 mm) with 3/8-inch (10-mm) rod.**
 - b. **NPS 1-1/2 to NPS 2 (DN 40 to DN 50): 36 inches (900 mm) with 3/8-inch (10-mm) rod.**
 - c. **NPS 2-1/2 and NPS 3 (DN 65 and DN 80): 42 inches (1150 mm) with 1/2-inch (13-mm) rod.**
 - d. **NPS 4 and NPS 5 (DN 100 and DN 125): 48 inches (1220 mm) with 1/2-inch (13-mm) rod.**
 - e. **NPS 6 and NPS 8 (DN 150 and DN 200): 54 inches (1350 mm) with 5/8-inch (16-mm) rod.**
 - 11. Install supports for vertical PVC piping every **48 inches (1220 mm).**
- K. Labeling And Identification**
- 1. Install identifying labels and devices for laboratory vacuum piping, valves, and specialties. Comply with requirements in Division 22 Section "Identification For Plumbing Piping And Equipment".
 - 2. Install identifying labels and devices for medical vacuum piping systems according to NFPA 99. Use the following or similar captions and color-coding for piping products where required by NFPA 99:
 - a. Medical Vacuum: Black letters on white background.
 - b. WAGD: White letters on violet background.
 - c. Dental Vacuum: Black boxed letters on white-and-black diagonal stripe background.
 - d. HVE: Black boxed letters on white-and-black diagonal stripe background.
 - e. Medical Laboratory Vacuum: Black boxed letters on white-and-black checkerboard background.
- L. Field Quality Control For Laboratory Facility Nonmedical Vacuum Piping**
- 1. Perform tests and inspections of vacuum piping in nonmedical laboratory facilities.
 - 2. Tests and Inspections:
 - a. Piping Leak Tests for Vacuum Piping: Test new and modified parts of existing piping. Cap and fill vacuum piping with oil-free, dry nitrogen. Isolate test source and let stand for four hours to equalize temperature. Refill system, if required, to test pressure; hold for two hours with no drop in pressure.
 - 1) Test Pressure for Copper Tubing: **100 psig (690 kPa) OR 150 psig (1035 kPa), as directed.**
 - 2) Test Pressure for PVC Piping: **50 psig (345 kPa) OR 100 psig (690 kPa), as directed.**
 - b. Repair leaks and retest until no leaks exist.
 - c. Inspect filters for proper operation.
 - 3. Prepare test reports.
- M. Field Quality Control For Healthcare Facility Medical Vacuum Piping**
- 1. Perform tests and inspections of medical vacuum piping systems in healthcare facilities and prepare test reports.
 - 2. Tests and Inspections:
 - a. Medical Vacuum Testing Coordination: Perform tests, inspections, verifications, and certification of medical vacuum piping systems concurrently with tests, inspections, and certification of medical compressed-air piping and medical gas piping systems.
 - b. Perform the following Installer tests according to requirements in NFPA 99 and ASSE Standard #6010:
 - 1) Initial blow down.
 - 2) Initial pressure test.
 - 3) Cross-connection test.
 - 4) Piping purge test.

- 5) Standing pressure test for vacuum systems.
 - 6) Repair leaks and retest until no leaks exist.
 - c. System Verification: Comply with requirements in NFPA 99, ASSE Standard #6020, and ASSE Standard #6030 for verification of medical vacuum piping systems and perform the following tests and inspections:
 - 1) Standing pressure test.
 - 2) Individual-pressurization **OR** Pressure-differential, **as directed**, cross-connection test.
 - 3) Valve test.
 - 4) Master and area alarm tests.
 - 5) Piping purge test.
 - 6) Final tie-in test.
 - 7) Operational vacuum test.
 - 8) Verify correct labeling of equipment and components.
 - d. Testing Certification: Certify that specified tests, inspections, and procedures have been performed and certify report results. Include the following:
 - 1) Inspections performed.
 - 2) Procedures, materials, and gases used.
 - 3) Test methods used.
 - 4) Results of tests.
 - 3. Remove and replace components that do not pass tests and inspections and retest as specified above.
- N. Demonstration
- 1. Train the Owner's maintenance personnel to adjust, operate, and maintain medical vacuum alarm systems.

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SECTION 22 11 16 00i - GAS PIPING FOR LABORATORY AND HEALTHCARE FACILITIES

1.1 GENERAL

A. Description Of Work

1. This specification covers the furnishing and installation of materials for gas piping for laboratory and healthcare facilities. Products shall be as follows or as directed by the Owner. Installation procedures shall be in accordance with the products manufacturer's recommendations. Demolition and removal of materials shall be as required to support the work.

B. Summary

1. This Section includes the following:
 - a. Carbon dioxide piping and specialties designated "medical carbon dioxide" operating at **50 to 55 psig (345 to 380 kPa)**.
 - b. Helium piping, designated "medical helium" operating at **50 to 55 psig (345 to 380 kPa)**.
 - c. Nitrogen piping and specialties designated "medical nitrogen" operating at **160 to 185 psig (1100 to 1275 kPa) OR higher than 200 psig (1380 kPa), as directed**.
 - d. Nitrous oxide piping and specialties designated "medical nitrous oxide" operating at **50 to 55 psig (345 to 380 kPa)**.
 - e. Oxygen piping and specialties designated "medical oxygen" operating at **50 to 55 psig (345 to 380 kPa)**.

C. Definitions

1. CR: Chlorosulfonated polyethylene synthetic rubber.
2. D.I.S.S.: Diameter-index safety system.
3. Low Voltage: As defined in NFPA 70 for circuits and equipment operating at less than 50 V or for remote-control, signaling power-limited circuits.
4. Medical gas piping systems include medical carbon dioxide, medical helium, medical nitrogen, medical nitrous oxide, and medical oxygen nonflammable gas for healthcare facility patient care or for healthcare laboratory applications.
5. Specialty Gas: Gas, other than medical gas, for nonmedical laboratory facility applications.

D. Performance Requirements

1. Seismic Performance: Gas manifolds, Bulk gas storage tanks, Gas manifolds and bulk gas storage tanks, and piping shall withstand the effects of earthquake motions determined according to SEI/ASCE 7.
 - a. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified."

E. Submittals

1. Product Data: For the following:
 - a. Tubes and fittings.
 - b. Valves and valve boxes.
 - c. Medical gas service connections.
 - d. Electrical service connections.
 - e. Patient service consoles.
 - f. Medical nitrogen pressure control panels.
 - g. Ceiling columns. Include integral service connections.
 - h. Ceiling hose assemblies. Include integral service connections.
 - i. Gas manifolds.
 - j. Bulk gas storage tanks. Include rated capacities and operating weights.
 - k. Medical gas alarm system components.
 - l. Gas cylinder storage racks.
2. Shop Drawings: Diagram power, signal, and control wiring.



3. Piping Material Certification: Signed by Installer certifying that medical gas piping materials comply with NFPA 99 requirements.
4. Brazing certificates.
5. Manufacturer Seismic Qualification Certification: Submit certification that gas manifolds and bulk gas storage tanks, accessories, and components will withstand seismic forces defined in Division 22 Section "Vibration And Seismic Controls For Plumbing Piping And Equipment". Include the following:
 - a. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
6. Certificates of Shop Inspection and Data Report for Bulk Gas Storage Tanks: As required by ASME Boiler and Pressure Vessel Code.
7. Field quality-control test reports.
8. Operation and maintenance data.

F. Quality Assurance

1. Installer Qualifications:
 - a. Medical Gas Piping Systems for Healthcare Facilities: Qualify installers according to ASSE Standard #6010 for installers.
2. Testing Agency Qualifications: An independent testing agency, with the experience and capability to conduct the medical gas piping testing indicated, that is a member of the Medical Gas Professional Healthcare Organization or is an NRTL as defined by OSHA in 29 CFR 1910.7, and that is acceptable to authorities having jurisdiction.
 - a. Qualify testing personnel according to ASSE Standard #6020 for inspectors and ASSE Standard #6030 for verifiers.
3. Brazing: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications"; or AWS B2.2, "Standard for Brazing Procedure and Performance Qualification."
4. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
5. ASME Compliance: Fabricate and label bulk medical gas storage tanks to comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.
6. NFPA Compliance:
 - a. Comply with NFPA 50, "Bulk Oxygen Systems at Consumer Sites," for bulk oxygen storage tanks.
 - b. Comply with NFPA 99, "Health Care Facilities," for medical gas piping system materials and installation.
7. CGA Compliance: Comply with CGA G-8.1, "Nitrous Oxide Systems at Consumer Sites," for bulk nitrous oxide storage tanks.
8. UL Compliance:
 - a. Comply with UL 498, "Attachment Plugs and Receptacles," for electrical service connections.
 - b. Comply with UL 544, "Medical and Dental Equipment," for medical gas specialties.

G. Project Conditions

1. Interruption of Existing Specialty and Medical Gas Service(s): Do not interrupt specialty or medical gas service to facilities occupied by the Owner or others unless permitted under the following conditions and then only after arranging to provide temporary service according to requirements indicated:
 - a. Notify the Owner no fewer than two days in advance of proposed interruption of specialty and medical gas service(s).
 - b. Do not proceed with interruption of specialty and medical gas service(s) without the Owner's written permission.

1.2 PRODUCTS

A. Pipes, Tubes, And Fittings

1. Copper Medical Gas Tube: ASTM B 819, Type K **OR** Type L, **as directed**, seamless, drawn temper that has been manufacturer cleaned, purged, and sealed for medical gas service or according to CGA G-4.1 for oxygen service. Include standard color marking "OXY," "MED," "OXY/MED," "OXY/ACR," or "ACR/MED" in green for Type K tube and blue for Type L tube.
 - a. General Requirements for Copper Fittings: Manufacturer cleaned, purged, and bagged for oxygen service according to CGA G-4.1.
 - b. Wrought-Copper Fittings: ASME B16.22, solder-joint pressure type or MSS SP-73, with dimensions for brazed joints.
 - c. Copper Unions: ASME B16.22 or MSS SP-123, wrought copper or cast-copper alloy.
 - d. Press-Type Fittings:
 - 1) **NPS 2 (DN 50)** and Smaller: Wrought-copper fitting with EPDM O-ring seal in each end.
 - 2) **NPS 2-1/2 to NPS 4 (DN 65 to DN 100)**: Bronze fitting with stainless-steel grip ring and EPDM O-ring seal in each end.
 - e. Memory-Metal Couplings: Cryogenic compression fitting made of ASTM F 2063, nickel-titanium, shape-memory-alloy, and that has been manufacturer cleaned, purged, and sealed for oxygen service according to CGA G-4.1.
2. PVC Pipe: ASTM D 1785, Schedule 40 and Schedule 80.
 - a. PVC Fittings: ASTM D 2466, Schedule 40 **OR** ASTM D 2467, Schedule 80, **as directed**; socket type.

B. Joining Materials

1. Brazing Filler Metals: AWS A5.8/A5.8M, BCuP Series, copper-phosphorus alloys.
2. Threaded-Joint Tape: PTFE.
3. Solvent Cement for Joining PVC Piping: ASTM D 2564. Include primer complying with ASTM F 656.

C. Valves

1. General Requirements for Valves: Manufacturer cleaned, purged, and bagged according to CGA G-4.1 for oxygen service.
2. Ball Valves: MSS SP-110, 3-piece body, brass or bronze.
 - a. Pressure Rating: **300 psig (2070 kPa)** minimum.
 - b. Ball: Full-port, chrome-plated brass.
 - c. Seats: PTFE or TFE.
 - d. Handle: Lever type with locking device, **as directed**.
 - e. Stem: Blowout proof with PTFE or TFE seal.
 - f. Ends: Manufacturer-installed ASTM B 819, copper-tube extensions.
3. Check Valves: In-line pattern, bronze.
 - a. Pressure Rating: **300 psig (2070 kPa)** minimum.
 - b. Operation: Spring loaded.
 - c. Ends: Manufacturer-installed ASTM B 819, copper-tube extensions.
4. Zone Valves: MSS SP-110, 3-piece-body, brass or bronze ball valve with gage.
 - a. Pressure Rating: **300 psig (2070 kPa)** minimum.
 - b. Ball: Full-port, chrome-plated brass.
 - c. Seats: PTFE or TFE.
 - d. Handle: Lever type with locking device, **as directed**.
 - e. Stem: Blowout proof with PTFE or TFE seal.
 - f. Ends: Manufacturer-installed ASTM B 819, copper-tube extensions.
 - g. Pressure Gage: Manufacturer-installed on one copper-tube extension.
5. Zone Valve Boxes: Formed steel with anchors for recessed mounting, holes with grommets in box sides for tubing extension protection, and of size for single or multiple valves with pressure gages and in sizes required to permit manual operation of valves.
 - a. Interior Finish: Factory-applied white enamel.



- b. Cover Plate: Aluminum or extruded-anodized aluminum **OR** Satin-chrome finish steel **OR** Stainless steel with NAAMM AMP 503, No. 4 finish, **as directed**, with frangible or removable windows.
- c. Valve-Box Windows: Clear or tinted transparent plastic with labeling that includes rooms served, according to NFPA 99.

OR

Zone Valve Boxes: Formed or extruded aluminum with anchors for recessed mounting, holes with grommets in box sides for tubing extension protection, and of size for single or multiple valves with pressure gages and in sizes required to permit manual operation of valves.

- a. Interior Finish: Factory-applied white enamel.
 - b. Cover Plate: Aluminum or extruded-anodized aluminum **OR** Stainless steel with NAAMM AMP 503, No. 4 finish, **as directed**, with frangible or removable windows.
 - c. Valve-Box Windows: Clear or tinted transparent plastic with labeling that includes rooms served, according to NFPA 99.
6. Emergency Oxygen Connections: Low-pressure oxygen inlet assembly for connection to building oxygen piping systems.
 - a. Enclosure: Weatherproof hinged locking cover with caption similar to "Emergency Low-Pressure Gaseous Oxygen Inlet."
 - b. Inlet: Manufacturer-installed, **NPS 1 or NPS 1-1/4 (DN 25 or DN 32)**, ASTM B 819, copper tubing with **NPS 1 (DN 25)** minimum ball valve and plugged inlet.
 - c. Safety Valve: Bronze-body, pressure relief valve set at **75 or 80 psig (520 or 550 kPa)**.
 - d. Instrumentation: Pressure gage.
 7. Safety Valves: Bronze-body, ASME-construction, poppet, pressure-relief type with settings to match system requirements.
 8. Pressure Regulators: Bronze **OR** Stainless-steel, **as directed**, body and trim; spring-loaded, diaphragm-operated, relieving type; manual pressure-setting adjustment; rated for **250-psig (1725-kPa)** minimum inlet pressure; and capable of controlling delivered gas pressure within **0.5 psig for each 10-psig (5.0 kPa for each 100-kPa)** inlet pressure.

D. Medical Gas Service Connections

1. General Requirements for Medical Gas Service Connections: For specific medical gas pressure and suction service listed. Include roughing-in assemblies, finishing assemblies, and cover plates. Individual cover plates are not required if service connection is in multiple unit or assembly with cover plate. Furnish recessed-type units made for concealed piping unless otherwise indicated.
 - a. Roughing-in Assembly:
 - 1) Steel outlet box for recessed mounting and concealed piping.
 - 2) Brass-body outlet block with secondary check valve that will prevent gas flow when primary valve is removed. Suction inlets to be without secondary valve.
 - 3) Double seals that will prevent gas leakage.
 - 4) ASTM B 819, **NPS 3/8 (DN 10)** copper outlet tube brazed to valve with service marking and tube-end dust cap.
 - b. Finishing Assembly:
 - 1) Brass housing with primary check valve.
 - 2) Double seals that will prevent gas leakage.
 - 3) Cover plate with gas-service label.
 - c. Quick-Coupler Service Connections: Pressure outlets for carbon dioxide, nitrous oxide, oxygen, and **<Insert medical gas>** service connections with noninterchangeable keyed indexing to prevent interchange between services, constructed to permit one-handed connection and removal of equipment, and with positive-locking ring that retains equipment stem in valve during use.
 - d. D.I.S.S. Service Connections: Pressure outlets, complying with CGA V-5, with threaded indexing to prevent interchange between services, constructed to permit one-handed connection and removal of equipment.
 - 1) Medical Carbon Dioxide Service Connections: D.I.S.S. No. 1080.

- 2) Medical Helium Service Connections: D.I.S.S. No. 1060.
 - 3) Medical Nitrogen Service Connections: D.I.S.S. No. 1120.
 - 4) Medical Nitrous Oxide Service Connections: D.I.S.S. No. 1040.
 - 5) Medical Oxygen Service Connections: D.I.S.S. No. 1240.
 - e. Cover Plates: One piece, stainless steel, with NAAMM AMP 503, No. 4 finish **OR** metal, with chrome-plated finish **OR** anodized aluminum, **as directed**, and permanent, color-coded, identifying label matching corresponding service.
- E. Electrical Service Connections
1. Power Outlets: UL 498, Hospital Grade, 125-V receptacles; color selected. Include the following configurations complying with NEMA WD 1:
 - a. L5-20R, locking type, 20 A, single or duplex.
 - b. L5-20R, isolated ground, locking type, 20 A, single or duplex.
 - c. Explosion proof, 20 A, 2 pole, 3 wire, single; suitable for Class I, Group C hazardous location and interchangeable with receptacles used in nonhazardous areas; flush mounted.
 - d. 5-20R, straight blade, 20 A, duplex.
 - e. 5-20R, isolated ground, straight blade, 20 A, duplex.
 2. Electrical Accessory Outlets: Provide the following configured receptacles in color selected:
 - a. Patient Equipment Ground Jack: Single pole, 30 A.
 - b. Patient Monitoring: Single, 5 and 37 pin.
 3. Wall Outlet Cover Plates: One piece, stainless steel, with NAAMM AMP 503, No. 4 finish **OR** metal, with chrome-plated finish **OR** anodized aluminum, **as directed**, and permanent identifying label.
- F. Patient Service Consoles
1. General Requirements for Patient Service Consoles: Recessed- or semirecessed-mounting wall units with medical gas service connections as specified in "Medical Gas Service Connections" Article and electrical service connections as specified in "Electrical Service Connections" Article, **as directed**. Include labels indicating services, and the following:
 - a. Recessed- or semirecessed-mounting steel console box or mounting bracket.
 - b. Concealed supplies.
 - c. Cover Plate: One piece, anodized aluminum **OR** stainless steel, **as directed**, and permanent identifying label with service connections for the following:
 - 1) Medical Air: Quick-coupler pressure outlet.
 - 2) Medical Oxygen: Quick-coupler pressure outlet.
 - 3) Medical Vacuum: Quick-coupler suction inlet.
 - 4) Medical vacuum bottle bracket.
 - 5) L5-20R, locking type, 20 A, single **OR** duplex, **as directed**.
- G. Medical Nitrogen Pressure Control Panels
1. Description: Steel box and support brackets for recessed roughing-in with stainless-steel or anodized-aluminum cover plate with printed operating instructions. Include manifold assembly consisting of inlet supply valve, inlet supply pressure gage, line-pressure control regulator, outlet supply pressure gage, D.I.S.S. service connection, and piping outlet for remote service connection.
 - a. Minimum Working Pressure: **200 psig (1380 kPa)**.
 - b. Line-Pressure Control Regulator: Self-relieving diaphragm type with precision manual adjustment.
 - c. Pressure Gages: **0- to 300-psig (0- to 2070-kPa)** range.
 - d. Service Connection: CGA V-5, D.I.S.S. No. 1120, nitrogen outlet.
 - e. Before final assembly, provide temporary dust shield and U-tube for testing.
 - f. Label cover plate "Nitrogen Pressure Control."
- H. Ceiling Columns
1. General Requirements for Ceiling Columns: Ceiling-mounting units with medical gas service connections as specified in "Medical Gas Service Connections" Article and electrical service

connections as specified in "Electrical Service Connections" Article, **as directed**. Include labels indicating services, and the following:

- a. Ceiling-Mounting Plate: Manufacturer's standard plate or roughing-in assembly.
 - b. Exposed Surfaces: Minimum **0.0375-inch- (0.95-mm-)** thick stainless steel with NAAMM AMP 503, No. 4 directional polish.
 - c. Servicing: Include access panels or means of removing shroud.
 - d. Blank cover plates for cutouts not having service connections.
 - e. ASTM B 819, **NPS 3/8 (DN 10)** copper-tube extensions for connection to medical gas systems.
 - f. Service Connections: Type and number indicated.
 - g. Dust Covers: For medical gas service connection.
2. Rigid Ceiling Columns: **44-inch- (1120-mm-)** long, rectangular fixed column section with 2 **OR 4, as directed**, double intravenous medication hooks. Include **0.078-inch- (2.0-mm-)** thick, stainless-steel bottom plate with the following service connections:
- a. Instrument Air: One D.I.S.S. No. 1160 pressure outlet(s).
 - b. Medical Air: One quick-coupler **OR** D.I.S.S. No. 1160, **as directed**, pressure outlet(s).
 - c. Medical Carbon Dioxide: One quick-coupler **OR** D.I.S.S. No. 1080, **as directed**, pressure outlet(s).
 - d. Medical Helium: One D.I.S.S. No. 1060, pressure outlet(s).
 - e. Medical Nitrogen: One D.I.S.S. No. 1120 pressure outlet(s).
 - f. Medical Nitrous Oxide: One quick-coupler **OR** D.I.S.S. No. 1040, **as directed**, pressure outlet(s).
 - g. Medical Oxygen: Two quick-coupler **OR** D.I.S.S. No. 1240, **as directed**, pressure outlets.
 - h. Medical Vacuum: Two quick-coupler **OR** D.I.S.S. No. 1220, **as directed**, suction inlets.
 - i. Vacuum Bottle Brackets: Two.
 - j. WAGD Evacuation: One quick-coupler **OR** D.I.S.S. No. 2220, **as directed**, suction inlet(s).
 - k. Power: 2 **OR 4, as directed**, L5-20R, locking-type, 20-A, single receptacles.
 - l. Patient Equipment: 2 **OR 4, as directed**, ground-jack, single-pole, 30-A receptacles.
3. Retractable Ceiling Columns: Manually adjustable using release and lock handles capable of locking column in all positions from fully retracted to fully extended; **15-inch- (380-mm-)** long, rectangular counterbalanced telescoping section with 2 **OR 4, as directed**, double intravenous medication hooks; and **36-inch- (915-mm-)** long, fixed column section. Include **0.078-inch- (2.0-mm-)** thick, stainless-steel bottom plate with the following service connections:
- a. Instrument Air: One D.I.S.S. No. 1160 pressure outlet(s).
 - b. Medical Air: One quick-coupler **OR** D.I.S.S. No. 1160, **as directed**, pressure outlet(s).
 - c. Medical Carbon Dioxide: One quick-coupler **OR** D.I.S.S. No. 1080, **as directed**, pressure outlet(s).
 - d. Medical Helium: One D.I.S.S. No. 1060, pressure outlet(s).
 - e. Medical Nitrogen: One D.I.S.S. No. 1120 pressure outlet(s).
 - f. Medical Nitrous Oxide: One quick-coupler **OR** D.I.S.S. No. 1040, **as directed**, pressure outlet(s).
 - g. Medical Oxygen: Two quick-coupler **OR** D.I.S.S. No. 1240, **as directed**, pressure outlets.
 - h. Medical Vacuum: Two quick-coupler **OR** D.I.S.S. No. 1220, **as directed**, suction inlets.
 - i. Vacuum Bottle Brackets: Two.
 - j. WAGD Evacuation: One quick-coupler **OR** D.I.S.S. No. 2220, **as directed**, suction inlet(s).
 - k. Power: 2 **OR 4, as directed**, L5-20R, locking-type, 20-A, single receptacles.
 - l. Patient Equipment: 2 **OR 4, as directed**, ground-jack, single-pole, 30-A receptacles.
- I. Ceiling Hose Assemblies
1. Ceiling Hose Assemblies, General: Ceiling-mounting units with medical gas service connections as specified in "Medical Gas Service Connections" Article and electrical service connections as specified in "Electrical Service Connections" Article, **as directed**. Include labels indicating services, and the following:
 - a. Ceiling-Mounting Plate: Manufacturer's standard plate or roughing-in assembly.

- b. Exposed Surfaces: Minimum **0.0375-inch- (0.95-mm-)** thick stainless steel with NAAMM AMP 503, No. 4 directional polish.
 - c. Servicing: Include access panels or means of removing shroud.
 - d. Blank cover plates for cutouts not having service connections.
 - e. ASTM B 819, **NPS 3/8 (DN 10)** copper-tube extensions for connection to medical gas systems.
 - f. Service Connections: Type and number indicated.
 - g. Dust Covers: For medical gas service connection.
 2. Hose-Reel Service Assemblies: Individual, concealed, retractable hose-reel units with stainless-steel face plates, steel mounting boxes, factory- or field-fabricated mounting brackets, and color-coded service hoses with adjustable stops and service connections matching hoses. Include **15 feet (4.5 m)** minimum of conductive, CR, **1/4- or 5/16-inch- (6.4- or 7.9-mm-)** ID, medical gas hoses rated for **200-psig (1380-kPa)** minimum working pressure, and the following service connections:
 - a. Instrument Air Hose: D.I.S.S. No. 1160 pressure outlet.
 - b. Medical Air Hose: Quick-coupler **OR** D.I.S.S. No. 1160, **as directed**, pressure outlet.
 - c. Medical Carbon Dioxide Hose: Quick-coupler **OR** D.I.S.S. No. 1080, **as directed**, pressure outlet.
 - d. Medical Nitrogen Hose: D.I.S.S. No. 1120 pressure outlet.
 - e. Medical Nitrous Oxide Hose: Quick-coupler **OR** D.I.S.S. No. 1040, **as directed**, pressure outlet.
 - f. Medical Oxygen Hose: Quick-coupler **OR** D.I.S.S. No. 1240, **as directed**, pressure outlet.
 - g. Medical Vacuum Hose: Quick-coupler **OR** D.I.S.S. No. 1220, **as directed**, suction inlet.
 - h. WAGD Evacuation Hose: Quick-coupler **OR** D.I.S.S. No. 2220, **as directed**, suction inlet.
 - i. Power: L5-20R, locking-type, 20-A, single, power receptacle.
 3. Fixed Hose Service Assemblies: Individual, concealed hose connection with stainless-steel face plates, steel mounting boxes, factory- or field-fabricated mounting brackets, and color-coded service hoses with retractor device and service connections matching hoses. Include **72 inches (1830 mm)** of conductive, CR, **1/4- or 5/16-inch- (6.4- or 7.9-mm-)**, ID, medical gas hoses rated for **200-psig (1380-kPa)** minimum working pressure, and the following service hose connections:
 - a. Instrument Air Hose: D.I.S.S. No. 1160 pressure outlet.
 - b. Medical Air Hose: Quick-coupler **OR** D.I.S.S. No. 1160, **as directed**, pressure outlet.
 - c. Medical Carbon Dioxide Hose: Quick-coupler **OR** D.I.S.S. No. 1080, **as directed**, pressure outlet.
 - d. Medical Nitrogen Hose: D.I.S.S. No. 1120 pressure outlet.
 - e. Medical Nitrous Oxide Hose: Quick-coupler **OR** D.I.S.S. No. 1040, **as directed**, pressure outlet.
 - f. Medical Oxygen Hose: Quick-coupler **OR** D.I.S.S. No. 1240, **as directed**, pressure outlet.
 - g. Medical Vacuum Hose: Quick-coupler **OR** D.I.S.S. No. 1220, **as directed**, suction inlet.
 - h. WAGD Evacuation Hose: Quick-coupler **OR** D.I.S.S. No. 2220, **as directed**, suction inlet.
 - i. Power: L5-20R, locking-type, 20-A, single, power receptacle.
- J. Gas Manifolds
 1. Simplex Specialty Gas Manifolds:
 - a. Control Panel Unit: Weatherproof cabinet, supply and delivery pressure gages, electrical alarm system connections and transformer, indicator lights or devices, manifold connection, line-pressure regulator, shutoff valves, and safety valve.
 - b. Manifold and Header: Nonferrous-metal header for number of cylinders indicated. Units include design for **2000-psig (13.8-MPa)** minimum inlet pressure. Include cylinder bank header with inlet (pigtail) connections complying with CGA V-1, individual inlet check valves, shutoff valve, pressure regulator, check valve, and pressure gage.
 - c. **<Insert specialty gas>** Manifold: For **<Insert number cylinders>** capacity at **55-psig (380-kPa)** line pressure, with electric heater or orifice design that will prevent freezing during high demand.
 - d. Specialty Gas Cylinders: Will be furnished by the Owner **OR** Number and type of medical gas cylinders required for complete manifold systems, **as directed**.

- e. Label manifold control unit with permanent label identifying specialty gas type and system operating pressure.
- f. Mounting: Wall with mounting brackets for manifold control cabinet and header **OR** Floor with support legs for manifold control cabinet, **as directed**.
- 2. Duplex Specialty Gas Manifolds:
 - a. Central Control Panel Unit: Weatherproof cabinet, supply and delivery pressure gages, electrical alarm system connections and transformer, indicator lights or devices, manifold connection, line-pressure regulator, shutoff valves, and safety valve.
 - b. Manifold and Headers: Duplex, nonferrous-metal header for number of cylinders indicated, divided into two equal banks. Units include design for **2000-psig (13.8-MPa)** minimum inlet pressure. Include cylinder bank headers with inlet (pigtail) connections complying with CGA V-1, individual inlet check valves, shutoff valve, pressure regulator, check valve, and pressure gage.
 - c. Operation: Automatic, pressure-switch-activated changeover from one cylinder bank to the other when first bank becomes exhausted, without line-pressure fluctuation or resetting of regulators and without supply interruption by shutoff of either cylinder bank header.
 - d. **<Insert specialty gas>** Manifold: For **<Insert number cylinders>** capacity at **55-psig (380-kPa)** line pressure, with electric heater or orifice design that will prevent freezing during high demand.
 - e. Specialty Gas Cylinders: Will be furnished by the Owner **OR** Number and type of medical gas cylinders required for complete manifold systems, **as directed**.
 - f. Label manifold control unit with permanent label identifying specialty gas type and system operating pressure.
 - g. Mounting: Wall with mounting brackets for manifold control cabinet and headers **OR** Floor with support legs for manifold control cabinet, **as directed**.
- 3. Medical Gas Manifolds: Comply with NFPA 99, Ch. 5, for high-pressure medical gas cylinders.
 - a. Central Control Panel Unit: Weatherproof cabinet, supply and delivery pressure gages, electrical alarm system connections and transformer, indicator lights or devices, manifold connection, pressure changeover switch, line-pressure regulator, shutoff valves, and safety valve.
 - b. Manifold and Headers: Duplex, nonferrous-metal header for number of cylinders indicated, divided into two equal banks. Units include design for **2000-psig (13.8-MPa)** minimum inlet pressure, except nitrous oxide manifolds may be designed for **800 psig (5520 kPa)** and carbon dioxide manifolds may be designed for **1500 psig (10.35 MPa)**. Include cylinder bank headers with inlet (pigtail) connections complying with CGA V-1, individual inlet check valves, shutoff valve, pressure regulator, check valve, and pressure gage.
 - c. Operation: Automatic, pressure-switch-activated changeover from one cylinder bank to the other when first bank becomes exhausted, without line-pressure fluctuation or resetting of regulators and without supply interruption by shutoff of either cylinder bank header.
 - d. Medical Carbon Dioxide Manifolds: For 2 cylinders and **250-cfh (1.97-L/s)** **OR** 4 cylinders and **500-cfh (3.94-L/s)**, **as directed**, capacity at **55-psig (380-kPa)** line pressure.
 - e. Medical Helium Manifolds: For 2 cylinders and **250-cfh (1.97-L/s)** **OR** 4 cylinders and **500-cfh (3.94-L/s)**, **as directed**, capacity at **55-psig (380-kPa)** line pressure.
 - f. Medical Nitrous Oxide Manifolds: For 8 cylinders and **1333-cfh (10.5-L/s)** **OR** 12 cylinders and **2000-cfh (15.7-L/s)**, **as directed**, capacity at **55-psig (380-kPa)** line pressure, with electric heater or orifice design that will prevent freezing during high demand.
 - g. Medical Nitrogen Manifolds: For 8 cylinders and **2000-cfh (15.7-L/s)** **OR** 12 cylinders and **3000-cfh (23.6-L/s)**, **as directed**, capacity at **180-psig (1240-kPa)** **OR** higher than **200-psig (1380-kPa)**, **as directed**, line pressure.
 - h. Medical Oxygen Manifolds: For 12 cylinders and **1500-cfh (11.8-L/s)** **OR** 20 cylinders and **2500-cfh (19.7-L/s)**, **as directed**, capacity at **55-psig (380-kPa)**, **as directed**, line pressure.
 - i. Medical Gas Cylinders: Will be furnished by the Owner **OR** Number and type of medical gas cylinders required for complete manifold systems, **as directed**.
 - j. Label manifold control unit with permanent label identifying medical gas type and system operating pressure.

- k. Mounting: Wall with mounting brackets for manifold control cabinet and headers **OR** Floor with support legs for manifold control cabinet, **as directed**.

K. Bulk Gas Storage Tanks

1. Bulk Specialty Gas Storage Tanks:
2. Bulk Medical Gas Storage Tanks:
 - a. Bulk Medical Gas Storage Tank Systems: Bulk storage tank with connections for alarm system, continuous supply, and reserve supply that will operate only during emergencies, complying with NFPA 99, "Health Care Facilities."
 - b. Controls: Include actuating switch for alarm system connection and means for automatic actuating of reserve supply.
 - c. Bulk Medical Gas Storage Tanks: Vertical mounting, double-wall construction with inner vessel fabricated according to ASME Boiler and Pressure Vessel Code for unfired pressure vessels and suitable for medical gas service. Include insulation and vacuum seal between walls. Fabricate outer shell from carbon steel with factory-applied manufacturer's standard protective paint finish suitable for exterior installation. Include the following features, specialties, and components:
 - 1) Safety Valves: ASME construction with pressure setting to correspond to tank working pressure and as required for component or system being protected.
 - 2) Pressure Gages: For tank pressure and facility service line pressure.
 - 3) Contents Gage: High- and low-level indicator with electric signal circuit connection.
 - 4) Drain Valves: For piping, inner vessel, and outer shell.
 - 5) Fill Assembly: Fill connection, piping, valves, relief devices, and controls.
 - 6) Facility Service Assembly: Piping, valves, relief devices, vaporizer, shutoff valve, pressure regulator, line shutoff valve or check valve, and reserve supply connection for connection to building service piping.
 - 7) Include permanent label showing medical gas type, storage tank capacity, tank pressure rating, vaporizer capacity, and operating instructions.
 - 8) Liquid Oxygen Storage Tank: Nickel-steel or stainless-steel inner vessel with **250-psig (1725-kPa)** minimum working pressure. Include electric **OR** steam **OR** ambient vaporizer, **as directed**.
 - 9) Liquid Nitrous Oxide Storage Tank: Steel-alloy inner vessel with **300-psig (2070-kPa)** minimum working pressure. Include electric **OR** steam, **as directed**, vaporizer.
 - d. Oxygen Reserve Supply: Manifold header for high-pressure cylinders, fabricated from copper-tube or brass pipe and fittings and suitable for pressures up to **4000 psig (27.6 MPa)**. Include header inlet connections complying with CGA V-1, with individual inlet check valves, header shutoff valve, header pressure regulator, line shutoff valve or check valve, pressure gage, and inlet connections for number of cylinders indicated.
 - e. Nitrous Oxide Reserve Supply: Manifold header for high-pressure cylinders, fabricated from copper-tube or brass pipe and fittings and suitable for pressures up to **4000 psig (27.6 MPa)**. Include header inlet connections complying with CGA V-1, with individual inlet check valves, header shutoff valve, header pressure regulator, line shutoff valve or check valve, pressure gage, inlet connections for number of cylinders indicated, and electric heater.

L. Medical Gas Piping Alarm Systems

1. Panels for medical gas piping systems may be combined in single panels with medical compressed-air and medical vacuum piping systems.
2. Components: Designed for continuous service and to operate on power supplied from 120 **OR** 240 **OR** 277, **as directed**, -V ac power source to alarm panels and with connections for low-voltage wiring to remote sensing devices. Include step-down transformers if required.
3. Pressure Switches or Pressure Transducer Sensors: Continuous line monitoring with electrical connections for alarm system.
 - a. Low-Pressure Operating Range: **0- to 100-psig (0- to 690-kPa)**.
 - b. High-Pressure Operating Range: Up to **250-psig (1725-kPa)**.

4. General Requirements for Medical Gas Alarm Panels: Factory wired with audible and color-coded visible signals to indicate specified functions.
 - a. Mounting: Exposed, surface **OR** Recessed, **as directed**, installation.
 - b. Enclosures: Fabricated from minimum **0.047-inch- (1.2-mm-)** thick steel or minimum **0.05-inch- (1.27-mm-)** thick aluminum, with knockouts for electrical and piping connections.
5. Master Alarm Panels: With separate trouble alarm signals, pressure gages, and indicators for medical gas piping systems.
 - a. Include alarm signals when the following conditions exist:
 - 1) Medical Carbon Dioxide: Pressure drops below **40 psig (275 kPa)** or rises above **60 psig (415 kPa)** and changeover is made to alternate bank.
 - 2) Medical Helium: Pressure drops below **40 psig (275 kPa)** or rises above **60 psig (415 kPa)** and changeover is made to alternate bank.
 - 3) Medical Nitrogen: Pressure drops below **145 psig (1000 kPa)** or rises above **200 psig (1380 kPa)** and changeover is made to alternate bank.
 - 4) Medical Nitrous Oxide (for bulk oxygen storage tank system with cylinder reserve): Liquid level is low, pressure downstream from main shutoff valve drops below **40 psig (275 kPa)** or rises above **60 psig (415 kPa)**, changeover is made to reserve, reserve is in use, and reserve level is low.
 - 5) Medical Nitrous Oxide (for nitrous oxide manifold system): Pressure drops below **40 psig (275 kPa)** or rises above **60 psig (415 kPa)** and changeover is made to alternate bank.
 - 6) Medical Oxygen (for bulk oxygen storage tank system with cylinder reserve): Liquid level is low, pressure downstream from main shutoff valve drops below **40 psig (275 kPa)** or rises above **60 psig (415 kPa)**, changeover is made to reserve, reserve is in use, reserve level is low, and reserve pressure is low.
 - 7) Medical Oxygen (for oxygen manifold system): Pressure downstream from main shutoff valve drops below **40 psig (275 kPa)** or rises above **60 psig (415 kPa)** and changeover is made to alternate bank.
6. Anesthetizing-Area Alarm Panels: Separate trouble alarm signals; pressure gages; and indicators for medical gas piping systems.
 - a. Include alarm signals when the following conditions exist:
 - 1) Medical Carbon Dioxide: Pressure drops below **40 psig (275 kPa)** or rises above **60 psig (415 kPa)**.
 - 2) Medical Helium: Pressure drops below **40 psig (275 kPa)** or rises above **60 psig (415 kPa)**.
 - 3) Medical Nitrous Oxide: Pressure drops below **40 psig (275 kPa)** or rises above **60 psig (415 kPa)**.
 - 4) Medical Nitrogen: Pressure drops below **145 psig (1000 kPa)** or rises above **200 psig (1380 kPa)**.
 - 5) Medical Oxygen: Pressure drops below **40 psig (275 kPa)** or rises above **60 psig (415 kPa)**.
7. Area Alarm Panels: Separate trouble alarm signals; pressure and vacuum gages; and indicators for medical gas piping systems.
 - a. Include alarm signals when the following conditions exist:
 - 1) Oxygen: Pressure drops below **40 psig (275 kPa)** or rises above **60 psig (415 kPa)**.
8. Dental Area Alarm Panels: Separate trouble alarm signals; pressure and vacuum gages; and indicators for medical gas piping systems.
 - a. Include alarm signals when the following conditions exist:
 - 1) Medical Nitrogen: Pressure drops below **145 psig (1000 kPa)** or rises above **200 psig (1380 kPa)** and changeover is made to alternate bank.
 - 2) Medical Nitrous Oxide (for bulk nitrous oxide storage tank system with cylinder reserve): Liquid level is low, pressure downstream from main shutoff valve drops below **40 psig (275 kPa)** or rises above **60 psig (415 kPa)**, changeover is made to reserve, reserve is in use, and reserve level is low.

- 3) Medical Nitrous Oxide (for nitrous oxide manifold system): Pressure drops below **40 psig (275 kPa)** or rises above **60 psig (415 kPa)** and changeover is made to alternate bank.
- 4) Medical Oxygen (for bulk oxygen storage tank system with cylinder reserve): Liquid level is low, pressure downstream from main shutoff valve drops below **40 psig (275 kPa)** or rises above **60 psig (415 kPa)**, changeover is made to reserve, reserve is in use, reserve level is low, and reserve pressure is low.
- 5) Medical Oxygen (for nitrous oxide manifold system): Pressure downstream from main shutoff valve drops below **40 psig (275 kPa)** or rises above **60 psig (415 kPa)** and changeover is made to alternate bank.
9. Medical Laboratory Area Alarm Panels: Separate trouble alarm signals; pressure and vacuum gages; and indicators for medical gas piping systems.
 - a. Include alarm signals when the following conditions exist:
 - 1) Medical Carbon Dioxide: Pressure drops below **40 psig (275 kPa)** or rises above **60 psig (415 kPa)**.
 - 2) Medical Helium: Pressure drops below **40 psig (275 kPa)** or rises above **60 psig (415 kPa)**.
 - 3) Medical Oxygen: Pressure drops below **40 psig (275 kPa)** or rises above **60 psig (415 kPa)**.
- M. Computer Interface Cabinet
 1. Description: Wall-mounting, welded-steel, control cabinet with gasketed door, mounting brackets, grounding device, and white-enamel finish for connection of medical gas system alarms to facility computer. Include factory-installed signal circuit boards, power transformer, circuit breaker, wiring terminal board, and internal wiring capable of interfacing 20, **as directed**, alarm signals.
- N. Gas Cylinder Storage Racks
 1. Wall Storage Racks: Fabricate racks with chain restraints for upright cylinders as indicated or provide equivalent manufactured wall racks.
 2. Freestanding Storage Racks: Fabricate racks as indicated or provide equivalent manufactured storage racks.
- O. Sleeves
 1. Galvanized-Steel Sheet: **0.0239-inch (0.6-mm)** minimum thickness; round tube closed with welded longitudinal joint.
 2. Stack Sleeve Fittings: Manufactured, cast-iron sleeve with integral clamping flange. Include clamping ring and bolts and nuts for membrane flashing.
 - a. Underdeck Clamp: Clamping ring with set screws.
- P. Escutcheons
 1. General Requirements for Escutcheons: Manufactured wall and ceiling escutcheons and floor plates, with ID to closely fit around pipe and tube and OD that completely covers opening.
 2. One-Piece, Deep-Pattern Escutcheons: Deep-drawn, box-shaped brass with polished chrome-plated finish.
 3. One-Piece, Cast-Brass Escutcheons: With set screw.
 - a. Finish: Polished chrome-plated **OR** Rough brass, **as directed**.
 4. Split-Casting, Cast-Brass Escutcheons: With concealed hinge and set screw.
 - a. Finish: Polished chrome-plated **OR** Rough brass, **as directed**.
 5. One-Piece, Stamped-Steel Escutcheons: With set screw **OR** spring clips, **as directed**, and chrome-plated finish.
 6. Split-Plate, Stamped-Steel Escutcheons: With concealed **OR** exposed-rivet, **as directed**, hinge, set screw **OR** spring clips, **as directed**, and chrome-plated finish.
 7. One-Piece, Floor-Plate Escutcheons: Cast iron.
 8. Split-Casting, Floor-Plate Escutcheons: Cast brass with concealed hinge and set screw.
- Q. Grout

1. Description: ASTM C 1107, Grade B, nonshrink and nonmetallic, dry hydraulic-cement grout.
 - a. Characteristics: Post-hardening, volume adjusting, nonstaining, noncorrosive, nongaseous, and recommended for interior and exterior applications.
 - b. Design Mix: **5000-psi (34.5-MPa)**, 28-day compressive strength.
 - c. Packaging: Premixed and factory packaged.

R. Nitrogen

1. Description: Comply with USP 28 - NF 23 for oil-free dry nitrogen.

1.3 EXECUTION

A. Earthwork

1. Comply with requirements in Division 31 Section "Earth Moving" for excavating, trenching, and backfilling and for underground warning tapes.

B. Piping Applications

1. Nonhealthcare, Specialty Gas Piping: Type L, copper medical gas tube; wrought-copper fittings; and brazed **OR** press-type fittings and pressure-sealed, **as directed**, joints.
2. Nonhealthcare, Specialty Gas Piping **NPS 2-1/2 (DN 65)** and Smaller: Type K **OR** Type L, **as directed**, copper medical gas tube; wrought-copper fittings; and brazed **OR** press-type fittings and pressure-sealed, **as directed**, joints.
3. Nonhealthcare, Specialty Gas Piping **NPS 3 (DN 80)** and Larger: Type K, copper tube; wrought-copper fittings; and brazed **OR** press-type fittings and pressure-sealed, **as directed**, joints.
4. Medical Gas Piping: Use Type L, copper medical gas tube; wrought-copper fittings; and brazed joints.
5. Medical Gas Piping Except Nitrogen: Use Type L, copper medical gas tube; wrought-copper fittings; and brazed joints.
6. Medical Nitrogen Piping: Type L, copper medical gas tube; wrought-copper fittings; and brazed joints.
7. Medical Nitrogen Piping **NPS 2-1/2 (DN 65)** and Smaller: Type K **OR** Type L, **as directed**, copper medical gas tube; wrought-copper fittings; and brazed joints.
8. Medical Nitrogen Piping **NPS 3 (DN 80)** and Larger: Type K, copper tube; wrought-copper fittings; and brazed joints.
9. Protective Conduit: Use PVC pipe, PVC fittings, and solvent-cemented joints.

C. Piping Installation

1. Drawing plans, schematics, and diagrams indicate general location and arrangement of gas piping. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, air-compressor sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.
2. Comply with ASSE Standard #6010 for installation of medical gas piping.
3. Install piping concealed from view and protected from physical contact by building occupants unless otherwise indicated and except in equipment rooms and service areas.
4. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
5. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal and coordinate with other services occupying that space.
6. Install piping adjacent to equipment and specialties to allow service and maintenance.
7. Install nipples, unions, and special fittings, and valves with pressure ratings same as or higher than system pressure rating used in applications below unless otherwise indicated.
8. Install piping to permit valve servicing.
9. Install piping free of sags and bends.
10. Install fittings for changes in direction and branch connections.

11. Install medical gas piping to medical gas service connections specified in this Section, to medical gas service connections in equipment specified in this Section, and to equipment specified in other Sections requiring medical gas service.
 12. Install exterior, buried medical gas piping in protective conduit fabricated with PVC pipe and fittings. Do not extend conduit through foundation wall.
 13. Install seismic restraints on gas piping. Seismic-restraint devices are specified in Division 22 Section "Vibration And Seismic Controls For Plumbing Piping And Equipment".
 14. Install medical gas service connections recessed in walls. Attach roughing-in assembly to substrate; attach finishing assembly to roughing-in assembly.
 15. Connect gas piping to gas sources and to gas outlets and equipment requiring gas service.
 16. Install unions, in copper tubing adjacent to each valve and at final connection to each piece of equipment and specialty.
- D. Valve Installation
1. Install shutoff valve at each connection to gas laboratory and healthcare equipment and specialties.
 2. Install check valves to maintain correct direction of gas flow from laboratory and healthcare gas supplies.
 3. Install valve boxes recessed in wall and anchored to substrate. Single boxes may be used for multiple valves that serve same area or function.
 4. Install zone valves and gages in valve boxes. Rotate valves to angle that prevents closure of cover when valve is in closed position.
 5. Install pressure regulators on gas piping where reduced pressure is required.
 6. Install emergency oxygen connection with pressure relief valve and full-size discharge piping to outside, with check valve downstream from pressure relief valve and with ball valve and check valve in supply main from bulk oxygen storage tank.
- E. Joint Construction
1. Ream ends of PVC pipes and remove burrs.
 2. Remove scale, slag, dirt, and debris from outside of cleaned tubing and fittings before assembly.
 3. Threaded Joints: Apply appropriate tape to external pipe threads.
 4. Brazed Joints: Join copper tube and fittings according to CDA's "Copper Tube Handbook," "Brazed Joints" Chapter. Continuously purge joint with oil-free, dry nitrogen during brazing.
 5. Pressure-Sealed Joints: Join copper tube and press-type fittings with tools recommended by fitting manufacturer.
 6. Memory-Metal Coupling Joints: Join new copper tube to existing tube according to procedures developed by fitting manufacturer for installation of memory-metal coupling joints.
 7. Solvent-Cemented Joints: Clean and dry joining surfaces. Join PVC pipe and fittings according to the following:
 - a. Comply with ASTM F 402 for safe-handling practice of cleaners, primers, and solvent cements.
 - b. Apply primer and join according to ASME B31.9 for solvent-cemented joints and to ASTM D 2672.
- F. Gas Service Component Installation
1. Assemble patient service console with service connections. Install with supplies concealed, in walls. Attach console box or mounting bracket to substrate.
 2. Install nitrogen pressure-control panels in walls. Attach to substrate.
 3. Assemble ceiling columns and install anchored to substrate. Provide structural steel, hanger rods, anchors, and fasteners in addition to components furnished with specialties necessary to fabricate supports.
 4. Assemble ceiling assemblies and install anchored to substrate. Provide structural steel, hanger rods, anchors, and fasteners in addition to components furnished with specialties necessary to fabricate supports.
 5. Install gas manifolds on concrete base, **as directed**, anchored to substrate.
 6. Install gas cylinders and connect to manifold piping.

7. Install gas manifolds with seismic restraints as indicated.
8. Install bulk gas storage tanks and reserve supply tanks level on concrete bases. Set tanks and connect gas piping to tanks according to applicable requirements in NFPA 50 for bulk oxygen storage systems, **as directed**. Install tanks level and plumb, firmly anchored to concrete bases; maintain NFPA 50 and tank manufacturer's recommended clearances. Orient tanks so controls and devices are accessible for servicing.
9. Install bulk gas storage tanks and reserve supply tanks with seismic restraints.

G. Medical Gas Piping Alarm System Installation

1. Install medical gas alarm system components in locations required by and according to NFPA 99.
2. Install medical gas area and master alarm panels where indicated.
3. Install computer interface cabinet with connection to medical gas piping alarm system and facility computer.

H. Sleeve Installation

1. Sleeves are not required for core-drilled holes.
2. Permanent sleeves are not required for holes formed by removable PE sleeves.
3. Install sleeves for pipes passing through concrete and masonry walls and concrete floor and roof slabs using galvanized-steel pipe **OR** galvanized-steel sheet **OR** stack sleeve fittings **OR** PVC pipe, **as directed**.
 - a. Wall Penetrations: Cut sleeves to length for mounting flush with both surfaces.
 - b. Floor Penetrations: Extend sleeves installed in floors of mechanical equipment areas or other wet areas **2 inches (50 mm)** above finished floor level. Extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified.

OR

Install sleeves in new walls and slabs as new walls and slabs are constructed.

4. Install sleeves that are large enough to provide **1/4-inch (6.4-mm)** annular clear space between sleeve and pipe or pipe insulation. Use the following sleeve materials:
 - a. PVC **OR** Steel, **as directed**, Pipe Sleeves: For pipes smaller than **NPS 6 (DN 150)**.
 - b. Steel Sheet Sleeves: For pipes **NPS 6 (DN 150)** and larger, penetrating gypsum board partitions.
 - c. Stack Sleeve Fittings: For pipes penetrating floors with membrane waterproofing. Secure flashing between clamping flanges. Install section of cast-iron soil pipe to extend sleeve to **2 inches (50 mm)** above finished floor level. Comply with requirements in Division 07 Section "Sheet Metal Flashing And Trim" for flashing.
 - 1) Seal space outside of sleeve fittings with grout.
5. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Comply with requirements in Division 07 Section "Penetration Firestopping".

I. Escutcheon Installation

1. Install escutcheons for penetrations of walls, ceilings, and floors according to the following:
 - a. New Piping:
 - 1) Piping with Fitting or Sleeve Protruding from Wall: One piece, deep pattern.
 - 2) Bare Piping at Wall and Floor Penetrations in Finished Spaces: One piece, cast brass with polished chrome-plated finish **OR** stamped steel with set screw **OR** stamped steel with set screw or spring clips **OR** stamped steel with spring clips, **as directed**.
 - 3) Bare Piping at Ceiling Penetrations in Finished Spaces: One piece, cast brass with polished chrome-plated finish **OR** One piece or split casting, cast brass with polished chrome-plated finish **OR** Split casting, cast brass with polished chrome-plated finish **OR** One piece, stamped steel with set screw **OR** One piece or split plate, stamped steel with set screw **OR** Split plate, stamped steel with set screw, **as directed**.

- 4) Bare Piping in Unfinished Service Spaces: One piece, cast brass with polished chrome-plated finish **OR** cast brass with rough-brass finish **OR** stamped steel with set screw **OR** stamped steel with spring clips **OR** stamped steel with set screw or spring clips, **as directed**.
- 5) Bare Piping in Equipment Rooms: One piece, cast brass **OR** stamped steel with set screw **OR** stamped steel with spring clips **OR** stamped steel with set screw or spring clips, **as directed**.
- 6) Bare Piping at Floor Penetrations in Equipment Rooms: One-piece floor plate.
- b. Existing Piping:
 - 1) Chrome-Plated Piping: Split casting, cast brass with chrome-plated finish.
 - 2) Insulated Piping: Split plate, stamped steel with concealed **OR** exposed-rivet, **as directed**, hinge and spring clips.
 - 3) Bare Piping at Wall and Floor Penetrations in Finished Spaces: Split casting, cast brass with chrome-plated finish **OR** plate, stamped steel with concealed hinge and spring clips, **as directed**.
 - 4) Bare Piping at Ceiling Penetrations in Finished Spaces: Split casting, cast brass with chrome-plated finish **OR** plate, stamped steel with concealed hinge and set screw, **as directed**.
 - 5) Bare Piping in Unfinished Service Spaces: Split casting, cast brass with polished chrome-plated finish **OR** casting, cast brass with rough-brass finish **OR** plate, stamped steel with concealed hinge and set screw or spring clips **OR** plate, stamped steel with concealed or exposed-rivet hinge and set screw or spring clips **OR** plate, stamped steel with exposed-rivet hinge and set screw or spring clips, **as directed**.
 - 6) Bare Piping in Equipment Rooms: Split casting, cast brass **OR** plate, stamped steel with set screw or spring clips, **as directed**.
 - 7) Bare Piping at Floor Penetrations in Equipment Rooms: Split-casting floor plate.
- J. Hanger And Support Installation
 1. Comply with requirements in Division 22 Section "Vibration And Seismic Controls For Plumbing Piping And Equipment" for seismic-restraint devices.
 2. Comply with requirements in Division 22 Section "Hangers And Supports For Plumbing Piping And Equipment" for pipe hanger and support devices.
 3. Vertical Piping: MSS Type 8 or 42, clamps.
 4. Individual, Straight, Horizontal Piping Runs:
 - a. 100 Feet (30 m) and Less: MSS Type 1, adjustable, steel, clevis hangers.
 - b. Longer Than 100 Feet (30 m): MSS Type 43, adjustable, roller hangers.
 5. Multiple, Straight, Horizontal Piping Runs 100 Feet (30 m) or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze. Comply with requirements in Division 22 Section "Hangers And Supports For Plumbing Piping And Equipment" for trapeze hangers.
 6. Base of Vertical Piping: MSS Type 52, spring hangers.
 7. Support horizontal piping within 12 inches (300 mm) of each fitting and coupling.
 8. Rod diameter may be reduced 1 size for double-rod hangers, with 3/8-inch (10-mm) minimum rods.
 9. Install hangers for copper tubing with the following maximum horizontal spacing and minimum rod diameters:
 - a. NPS 1/4 (DN 8): 60 inches (1500 mm) with 3/8-inch (10-mm) rod.
 - b. NPS 3/8 and NPS 1/2 (DN 10 and DN 15): 72 inches (1800 mm) with 3/8-inch (10-mm) rod.
 - c. NPS 3/4 (DN 20): 84 inches (2100 mm) with 3/8-inch (10-mm) rod.
 - d. NPS 1 (DN 25): 96 inches (2400 mm) with 3/8-inch (10-mm) rod.
 - e. NPS 1-1/4 (DN 32): 108 inches (2700 mm) with 3/8-inch (10-mm) rod.
 - f. NPS 1-1/2 (DN 40): 10 feet (3 m) with 3/8-inch (10-mm) rod.
 - g. NPS 2 (DN 50): 11 feet (3.4 m) with 3/8-inch (10-mm) rod.
 - h. NPS 2-1/2 (DN 65): 13 feet (4 m) with 1/2-inch (13-mm) rod.
 - i. NPS 3 (DN 80): 14 feet (4.3 m) with 1/2-inch (13-mm) rod.
 - j. NPS 3-1/2 (DN 90): 15 feet (4.6 m) with 1/2-inch (13-mm) rod.

- k. NPS 4 (DN 100): 16 feet (4.9 m) with 1/2-inch (13-mm) rod.
 - l. NPS 5 (DN 125): 18 feet (5.5 m) with 1/2-inch (13-mm) rod.
 - m. NPS 6 (DN 150): 20 feet (6 m) with 5/8-inch (16-mm) rod.
 - n. NPS 8 (DN 200): 23 feet (7 m) with 3/4-inch (19-mm) rod.
- 10. Install supports for vertical copper tubing every 10 feet (3 m).
- K. Labeling And Identification
 - 1. Install identifying labels and devices for specialty gas piping, valves, and specialties. Comply with requirements in Division 22 Section "Identification For Plumbing Piping And Equipment".
 - 2. Install identifying labels and devices for healthcare medical gas piping systems according to NFPA 99. Use the following or similar captions and color-coding for piping products where required by NFPA 99:
 - a. Carbon Dioxide: Black or white letters on gray background.
 - b. Helium: White letters on brown background.
 - c. Nitrogen: White letters on black background.
 - d. Nitrous Oxide: White letters on blue background.
 - e. Oxygen: White letters on green background or green letters on white background.
- L. Field Quality Control For Laboratory Facility Specialty Gas
 - 1. Perform field tests and inspections of specialty gas piping for nonhealthcare laboratory facilities and prepare test reports.
 - 2. Tests and Inspections:
 - a. Piping Leak Tests for Specialty Gas Piping: Test new and modified parts of existing piping. Cap and fill specialty gas piping with oil-free, dry nitrogen to pressure of 50 psig (345 kPa) above system operating pressure, but not less than 150 psig (1035 kPa). Isolate test source and let stand for four hours to equalize temperature. Refill system, if required, to test pressure; hold for two hours with no drop in pressure.
 - b. Repair leaks and retest until no leaks exist.
 - c. Inspect specialty gas regulators for proper operation.
- M. Field Quality Control For Healthcare Facility Medical Gas
 - 1. Perform tests and inspections of medical gas piping systems in healthcare facilities and prepare test reports.
 - 2. Tests and Inspections:
 - a. Medical Gas Piping Testing Coordination: Perform tests, inspections, verifications, and certification of medical gas piping systems concurrently with tests, inspections, and certification of medical compressed-air piping and medical vacuum piping systems.
 - b. Preparation: Perform the following Installer tests according to requirements in NFPA 99 and ASSE Standard #6010:
 - 1) Initial blow down.
 - 2) Initial pressure test.
 - 3) Cross-connection test.
 - 4) Piping purge test.
 - 5) Standing pressure test for positive pressure medical gas piping.
 - 6) Standing pressure test for vacuum systems.
 - 7) Repair leaks and retest until no leaks exist.
 - c. System Verification: Comply with requirements in NFPA 99, ASSE Standard #6020, and ASSE Standard #6030 for verification of medical gas piping systems and perform the following tests and inspections:
 - 1) Standing pressure test.
 - 2) Individual-pressurization **OR** Pressure-differential, **as directed**, cross-connection test.
 - 3) Valve test.
 - 4) Master and area alarm tests.
 - 5) Piping purge test.

- 6) Piping particulate test.
- 7) Piping purity test.
- 8) Final tie-in test.
- 9) Operational pressure test.
- 10) Medical gas concentration test.
- 11) Medical air purity test.
- 12) Verify correct labeling of equipment and components.
- 13) Verify the following source equipment:
 - a) Medical gas supply sources.
- d. Testing Certification: Certify that specified tests, inspections, and procedures have been performed and certify report results. Include the following:
 - 1) Inspections performed.
 - 2) Procedures, materials, and gases used.
 - 3) Test methods used.
 - 4) Results of tests.
3. Remove and replace components that do not pass tests and inspections and retest as specified above.

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Task	Specification	Specification Description
22 11 16 00	21 05 23 00	Piped Utilities Basic Materials And Methods
22 11 16 00	07 63 00 00	Common Work Results for Fire Suppression
22 11 16 00	07 63 00 00a	Common Work Results for Plumbing
22 11 16 00	07 63 00 00b	Common Work Results for HVAC

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SECTION 22 11 19 00 - ELECTRONIC AIR CLEANERS

1.1 GENERAL

A. Description Of Work

1. This specification covers the furnishing and installation of materials for electronic air cleaners. Products shall be as follows or as directed by the Owner. Installation procedures shall be in accordance with the product manufacturer's recommendations. Demolition and removal of materials shall be as required to support the work.

B. Summary

1. Section Includes:
 - a. Electronic air cleaners.
 - b. Side-service housings.
 - c. Front- and rear-access filter frames.
 - d. Filter gages.

C. Submittals

1. Product Data: For each type of product indicated. Include dimensions; operating characteristics; required clearances and access; rated flow capacity, including initial and final pressure drop at rated airflow; efficiency and test method; fire classification; furnished specialties; and accessories for each model indicated.
2. LEED Submittal:
 - a. Product Data for Prerequisite EQ 1: Documentation indicating that units comply with ASHRAE 62.1, Section 5 - "Systems and Equipment."
3. Shop Drawings: For each electronic air cleaner. Include plans, elevations, sections, details, and attachments to other work.
 - a. Show filter assembly, dimensions, materials, and methods of assembly of components.
 - b. Include setting drawings, templates, and requirements for installing anchor bolts and anchorages.
 - c. Wiring Diagrams: For power, signal, and control wiring.
4. Field quality-control reports.
5. Operation and Maintenance Data: For each type of filter and housing to include in emergency, operation, and maintenance manuals.

D. Quality Assurance

1. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
2. ASHRAE Compliance:
 - a. Comply with applicable requirements in ASHRAE 62.1, Section 4 - "Outdoor Air Quality," Section 5 - "Systems and Equipment," and Section 7 - "Construction and Startup."
 - b. Comply with ASHRAE 52.1 for arrestance and with ASHRAE 52.2 for MERV for methods of testing and rating air-filter units.
3. Comply with NFPA 90A and NFPA 90B.
4. Comply with ARI 850.
5. Comply with UL 867.

1.2 PRODUCTS

A. Electronic Air Cleaners

1. Description: Factory-fabricated electronic air cleaner operating by electrostatic precipitation principles.



2. Prefilter Media: Four **OR** Six, **as directed**, alternate layers of galvanized-steel **OR** aluminum **OR** stainless-steel, **as directed**, flat and herringbone-crimp screen.
3. Prefilter: Comply with requirements in Division 23 Section "Particulate Air Filtration" for flat **OR** pleated **OR** ring, **as directed**, panel. Size and airflow capacity shall match those of electronic air cleaners.
 - a. Depth: 1 inch (25 mm) **OR** 2 inches (50 mm) **OR** 4 inches (100 mm), **as directed**.
 - b. Filter Unit Class: UL 900, Class 1 **OR** Class 2, **as directed**.
 - c. Arrestance: 85 percent when tested according to ASHRAE 52.1.
 - d. MERV: 8 when tested according to ASHRAE 52.2.
4. Final Filter: Comply with requirements in Division 23 Section "Particulate Air Filtration" for supported bag **OR** unsupported bag **OR** rigid-cell box **OR** V-bank cell **OR** self-supported pocket, **as directed**. Size and airflow capacity shall match those of gas-phase filters.
 - a. Depth: 12 inches (300 mm) **OR** 18 inches (450 mm) **OR** 24 inches (600 mm), **as directed**.
 - b. Filter Unit Class: UL 900, Class 1 **OR** Class 2, **as directed**.
 - c. Arrestance: 85 percent when tested according to ASHRAE 52.1.
 - d. MERV: 13 when tested according to ASHRAE 52.2.
5. Collection Cells: Aluminum, independently supported and nested.
 - a. Ionizing Section: Alternately spaced grounded struts and charged ionizing wires.
 - b. Collecting Section: Alternately grounded and charged plates, with insulators located out of airstream.
6. Power Pack: Self-contained, prewired rectifying unit to convert 120 **OR** 208/240 **OR** 480, **as directed**, -V ac, single-phase, 60-Hz power to approximately 12,000-V dc for ionizer and 6000-V dc for collector; include overload protection, on-off switch, pilot light showing operating status, and access door interlock.
7. Safety Accessories: Manual-reset safety switches and warning lights for filter plenum access doors, signal lights and safety switching upstream and downstream from unit within duct, and enameled high-voltage warning signs.
8. Collection Section Cleaning System:
 - a. Detergent Reservoir Tank: 30 gal. (110 L) **OR** 55 gal. (200 L), **as directed**, with pump, motor, solenoid valve, level sensor, backflow preventer, wye-strainer, and ball valve.
 - b. Detergent.
 - c. Dispensing System: Motor-driven oscillating copper manifolds with brass spray nozzles on each side of the collector.
9. Mist Eliminators: Upstream **OR** Upstream and downstream **OR** Downstream, **as directed**.
10. Controls: Programmable logic controller in remotely mounted NEMA 250, Type 12 enclosure; with integral time clock and manual override.
 - a. Contacts for enable-disable control by building automation system.
11. Finish of Interior Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.

B. Fan Section

1. Fan: Forward curved, belt driven.
2. Motor:
 - a. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in Division 23 Section "Common Motor Requirements For Hvac Equipment".
 - b. Type: Permanent-split capacitor with SCR for speed adjustment **OR** Electronically commutated motor, **as directed**.
 - c. Fan-Motor Assembly Isolation: Rubber isolators.
 - d. Enclosure: Totally enclosed, fan cooled, and explosion proof **OR** dust-ignition proof, **as directed**.
 - e. Enclosure Materials: Cast iron **OR** Cast aluminum **OR** Rolled steel, **as directed**.
 - f. Motor Bearings: Sealed ball.
 - g. Unusual Service Conditions:
 - 1) Ambient Temperature: <Insert deg F (deg C)>.

- 2) Altitude: <Insert feet (m)> above sea level.
 - 3) High humidity.
 - h. Efficiency: Premium efficient.
 - i. NEMA Design: <Insert designation>.
 - j. Service Factor: <Insert value>.
 - k. Motor Speed: Single speed **OR** Multispeed, **as directed**.
 - 1) Speed Control: Infinitely adjustable with pneumatic-electric and electronic controls.
- C. Cabinet
1. Description: 16-gage galvanized steel with epoxy powder finish for suspended, wall, frame, or duct mounting.
- D. Side-Service Housings
1. Description: Factory-assembled, side-service housings, with bottom drain, **as directed**, constructed of galvanized steel **OR** aluminum, **as directed**, and configured for stacking, with flanges to connect to duct or casing system.
 2. Access Doors: Hinged with continuous **OR** Continuous, **as directed**, gaskets on perimeter and positive-locking devices.
 3. Sealing: Incorporate positive-sealing gasket material on channels to seal top and bottom of filter cartridge frames to prevent bypass of unfiltered air.
 4. Finish of Interior Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.
- E. Front- And Rear-Access Filter Frames
1. Framing System: Galvanized-steel **OR** Aluminum, **as directed**, framing members with access for either upstream (front) or downstream (rear) filter servicing, cut to size and prepunched for assembly into modules with bottom drain, **as directed**, and configured for stacking. Vertically support filters to prevent deflection of horizontal members without interfering with either filter installation or operation.
 2. Prefilters: Incorporate a separate track with spring clips, **as directed**, removable from front or back, **as directed**.
 3. Final Filters: Integral tracks to accommodate particulate **OR** gas-phase, **as directed**, disposable filters.
 4. Sealing: Factory-installed, positive-sealing device for each row of filters to ensure seal between gasketed filter elements to prevent bypass of unfiltered air.
 5. Finish of Interior Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.
- F. Filter Gages
1. Diaphragm type, with dial and pointer in metal case, vent valves, black figures on white background, and front recalibration adjustment.
 - a. Diameter: 4-1/2 inches (115 mm) **OR** 2 inches (50 mm), **as directed**.
 - b. Scale Range for Filter Media Having a Recommended Final Resistance of 0.5-Inch wg (125 Pa) or Less: 0- to 0.5-inch wg (0 to 125 Pa).
 - c. Scale Range for Filter Media Having a Recommended Final Resistance of 0.5- to 1-Inch wg (125 to 250 Pa) or Less: 0- to 1.0-inch wg (0 to 250 Pa).
 - d. Scale Range for Filter Media Having a Recommended Final Resistance of 1.0- to 2.0-Inch wg (250 to 500 Pa) or Less: 0- to 2.0-inch wg (0 to 500 Pa).
 - e. Scale Range for Filter Media Having a Recommended Final Resistance of 2.0- to 3.0-Inch wg (500 to 750 Pa) or Less: 0- to 3.0-inch wg (0 to 750 Pa).
 - f. Scale Range for Filter Media Having a Recommended Final Resistance of 3.0- to 4.0-Inch wg (750 to 1000 Pa) or Less: 0- to 4.0-inch wg (0 to 1000 Pa).
 2. Manometer-Type Filter Gage: Molded plastic, with epoxy-coated aluminum scale, logarithmic-curve tube gage, with integral leveling indicator, graduated to read from 0- to 3.0-inch wg (0 to 750 Pa), and accurate within 3 percent of full-scale range.
 3. Accessories: Static-pressure tips, tubing, gage connections, and mounting bracket.

1.3 EXECUTION

A. Installation

1. Position each filter unit with clearance for normal service and maintenance. Anchor filter holding frames to substrate.
2. Install filters in position to prevent passage of unfiltered air.
3. Do not operate fan system until filters (temporary or permanent) are in place. Replace temporary filters used during construction and testing with new, clean filters.
4. Operate electronic air cleaners for 24 hours as part of startup before filters are put into operation.
5. Install filter-gage, static-pressure taps upstream and downstream from filters. Install filter gages on filter banks with separate static-pressure taps upstream and downstream from filters. Mount filter gages on outside of filter housing or filter plenum in an accessible position. Adjust and level inclined gages.
6. Install and connect water-supply and drainage piping.
7. Coordinate filter installations with duct and air-handling-unit installations.

B. Field Quality Control

1. Perform tests and inspections.
2. Tests and Inspections: Test for leakage of unfiltered air while system is operating.
3. Air filter will be considered defective if it does not pass tests and inspections.
4. Prepare test and inspection reports.

C. Cleaning

1. After completing system installation and testing, adjusting, and balancing air-handling and air-distribution systems, clean filter housings and install new prefilter and final-filter media.

END OF SECTION 22 11 19 00

Task	Specification	Specification Description
22 11 19 00	01 22 16 00	No Specification Required
22 11 19 00	21 05 23 00	Piped Utilities Basic Materials And Methods
22 11 19 00	13 12 13 00	Water Distribution
22 11 19 00	07 63 00 00	Common Work Results for Fire Suppression
22 11 19 00	07 63 00 00a	Common Work Results for Plumbing
22 11 19 00	07 63 00 00b	Common Work Results for HVAC
22 11 19 00	22 11 16 00d	Steam And Condensate Piping

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SECTION 22 11 23 13 - WATER DISTRIBUTION PUMPS

1.1 GENERAL

A. Description Of Work

1. This specification covers the furnishing and installation of materials for domestic water pumps. Products shall be as follows or as directed by the Owner. Installation procedures shall be in accordance with the products manufacturer's recommendations. Demolition and removal of materials shall be as required to support the work.

B. Summary

1. Section Includes:
 - a. In-line, sealless centrifugal pumps.
 - b. Horizontally mounted, in-line, separately coupled centrifugal pumps.
 - c. Horizontally mounted, in-line, close-coupled centrifugal pumps.
 - d. Vertically mounted, in-line, close-coupled centrifugal pumps.

C. Definitions

1. Low Voltage: As defined in NFPA 70 for circuits and equipment operating at less than 50 V or for remote-control, signaling power-limited circuits.

D. Submittals

1. Product Data: For each type of product indicated. Include materials of construction, rated capacities, certified performance curves with operating points plotted on curves, operating characteristics, electrical characteristics, and furnished specialties and accessories.
2. Operation and Maintenance Data: For domestic water pumps to include in operation and maintenance manuals.

E. Quality Assurance

1. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
2. UL Compliance: Comply with UL 778 for motor-operated water pumps.

F. Delivery, Storage, And Handling

1. Retain shipping flange protective covers and protective coatings during storage.
2. Protect bearings and couplings against damage.
3. Comply with pump manufacturer's written rigging instructions for handling.

G. Coordination

1. Coordinate sizes and locations of concrete bases with actual equipment provided.

1.2 PRODUCTS

A. In-Line, Sealless Centrifugal Pumps

1. Description: Factory-assembled and -tested, in-line, close-coupled, canned-motor, sealless, overhung-impeller centrifugal pumps.
2. Pump Construction:
 - a. Pump and Motor Assembly: Hermetically sealed, replaceable-cartridge type with motor and impeller on common shaft and designed for installation with pump and motor shaft horizontal.
 - b. Casing: Bronze, with threaded or companion-flange connections.
 - c. Impeller: Plastic.
 - d. Motor: Single speed, unless otherwise indicated.

- B. Horizontally Mounted, In-Line, Separately Coupled Centrifugal Pumps
1. Description: Factory-assembled and -tested, in-line, single-stage, separately coupled, overhung-impeller centrifugal pumps designed for installation with pump and motor shafts mounted horizontal.
 2. Pump Construction:
 - a. Casing: Radially split with threaded companion-flange connections for pumps with **NPS 2 (DN 50)** pipe connections and flanged connections for pumps with **NPS 2-1/2 (DN 65)** pipe connections.
 - b. Impeller: Statically and dynamically balanced, closed, and keyed to shaft.
 - c. Shaft and Shaft Sleeve: Steel shaft, with copper-alloy shaft sleeve.
 - d. Coupling: Flexible.
 - e. Seal: Mechanical, with carbon-steel rotating ring, stainless-steel spring, ceramic seat, and rubber bellows and gasket.
 - f. Bearings: Oil-lubricated; bronze-journal or ball type.
 - g. Shaft Coupling: Flexible, capable of absorbing torsional vibration and shaft misalignment.
 3. Motor: Single speed, with grease-lubricated ball bearings; and resiliently **OR** rigidly, **as directed**, mounted to pump casing.
- C. Horizontally Mounted, In-Line, Close-Coupled Centrifugal Pumps
1. Description: Factory-assembled and -tested, in-line, single-stage, close-coupled, overhung-impeller centrifugal pumps designed for installation with pump and motor shaft mounted horizontal.
 2. Pump Construction:
 - a. Casing: Radially split with threaded companion-flange connections for pumps with **NPS 2 (DN 50)** pipe connections and flanged connections for pumps with **NPS 2-1/2 (DN 65)** pipe connections.
 - b. Impeller: Statically and dynamically balanced, closed, and keyed to shaft.
 - c. Shaft and Shaft Sleeve: Steel shaft with deflector, with copper-alloy shaft sleeve. Include water slinger on shaft between motor and seal.
 - d. Seal: Mechanical, with carbon-steel rotating ring, stainless-steel spring, ceramic seat, and rubber bellows and gasket.
 - e. Bearings: Oil-lubricated; bronze-journal or ball type.
 - f. Shaft Coupling: Flexible, capable of absorbing torsional vibration and shaft misalignment.
 3. Motor: Single speed, with grease-lubricated ball bearings; and resiliently or rigidly mounted to pump casing.
- D. Vertically Mounted, In-Line, Close-Coupled Centrifugal Pumps
1. Description: Factory-assembled and -tested, in-line, single-stage, close-coupled, overhung-impeller centrifugal pumps designed for installation with pump and motor shaft mounted vertical.
 2. Pump Construction:
 - a. Casing: Radially split, cast iron, with wear rings and threaded companion-flange connections for pumps with **NPS 2 (DN 50)** pipe connections and flanged connections for pumps with **NPS 2-1/2 (DN 65)** pipe connections. Include pump manufacturer's base attachment for mounting pump on concrete base, **as directed**.
 - b. Impeller: Statically and dynamically balanced, closed, and keyed to shaft.
 - c. Shaft and Shaft Sleeve: Stainless-steel or steel **OR** Stainless-steel, **as directed**, shaft, with copper-alloy shaft sleeve.
 - d. Seal: Mechanical, with carbon-steel rotating ring, stainless-steel spring, ceramic seat, and rubber bellows and gasket. Include water slinger on shaft between motor and seal.
 - e. Bearings: Oil-lubricated; bronze-journal or ball type.
 - f. Shaft Coupling: Flexible or rigid type if pump is provided with coupling.
 3. Motor: Single speed, with grease-lubricated ball bearings; and rigidly mounted to pump casing.
- E. Motors

1. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in Division 22 Section "Common Motor Requirements For Plumbing Equipment".
 - a. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.
 - b. Controllers, Electrical Devices, and Wiring: Comply with requirements for electrical devices and connections specified in Division 22.

F. Controls

1. Pressure Switches: Electric, adjustable for control of water-supply pump.
 - a. Type: Water-immersion pressure sensor, for installation in piping.
 - b. Enclosure: NEMA 250, Type 4X.
 - c. Operation of Pump: On or off.
 - d. Transformer: Provide if required.
 - e. Power Requirement: 24 V, ac **OR** 120 V, ac, **as directed**.
 - f. Settings: Start pump at <Insert pressure> and stop pump at <Insert pressure>.
2. Thermostats: Electric; adjustable for control of hot-water circulation pump.
 - a. Type: Water-immersion temperature sensor, for installation in piping.
 - b. Range: **50 to 125 deg F (10 to 52 deg C) OR 65 to 200 deg F (18 to 93 deg C) OR 100 to 240 deg F (38 to 116 deg C), as directed.**
 - c. Enclosure: NEMA 250, Type 4X.
 - d. Operation of Pump: On or off.
 - e. Transformer: Provide if required.
 - f. Power Requirement: 24 V, ac **OR** 120 V, ac, **as directed**.
 - g. Settings: Start pump at **105 deg F (41 deg C) OR 110 deg F (43 deg C) OR 115 deg F (46 deg C), as directed**, and stop pump at **120 deg F (49 deg C) OR 125 deg F (52 deg C), as directed**.
3. Timers: Electric, for control of hot-water circulation pump.
 - a. Type: Programmable, seven-day clock with manual override on-off switch.
 - b. Enclosure: NEMA 250, Type 1, suitable for wall mounting.
 - c. Operation of Pump: On or off.
 - d. Transformer: Provide if required.
 - e. Power Requirement: 24 V, ac **OR** 120 V, ac, **as directed**.
 - f. Programmable Sequence of Operation: Up to two on-off cycles each day for seven days.
4. Time-Delay Relays: Electric, for control of hot-water circulation pump between water heater and connected hot-water storage tank.
 - a. Type: Adjustable time-delay relay.
 - b. Range: Up to five minutes.
 - c. Setting: Five minutes.
 - d. Enclosure: NEMA 250, Type 4X.
 - e. Operation of Pump: On or off.
 - f. Transformer: Provide if required.
 - g. Power Requirement: 24 V, ac **OR** 120 V, ac, **as directed**.
 - h. Programmable Sequence of Operation: Limit pump operation to periods of burner operation plus maximum five minutes after the burner stops.

1.3 EXECUTION

A. Examination

1. Examine roughing-in of domestic-water-piping system to verify actual locations of connections before pump installation.

B. Pump Installation

1. Comply with HI 1.4.
2. Install in-line, sealless centrifugal pumps with shaft horizontal unless otherwise indicated.

3. Install horizontally mounted, in-line, separately coupled and close-coupled centrifugal pumps with shaft(s) horizontal.
4. Install vertically mounted, in-line, close-coupled centrifugal pumps with shaft vertical.
5. Pump Mounting: Install vertically mounted, in-line, close-coupled centrifugal pumps with cast-iron base mounted on concrete base using elastomeric pads **OR** elastomeric mounts **OR** restrained spring isolators, **as directed**. Comply with requirements for concrete base specified in Division 03 Section "Cast-in-place Concrete".
 - a. Minimum Deflection: **1/4 inch (6 mm) OR 1 inch (25 mm), as directed**.
 - b. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on **18-inch (450-mm)** centers around the full perimeter of concrete base.
 - c. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.
 - d. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 - e. Install anchor bolts to elevations required for proper attachment to supported equipment.
6. Install continuous-thread hanger rods and spring hangers **OR** spring hangers with vertical-limit stop, **as directed**, of size required to support pump weight.
 - a. Comply with requirements for vibration isolation devices specified in Division 22 Section "Vibration And Seismic Controls For Plumbing Piping And Equipment". Fabricate brackets or supports as required.
 - b. Comply with requirements for hangers and supports specified in Division 22 Section "Hangers And Supports For Plumbing Piping And Equipment".
7. Install pressure switches in water supply piping.
8. Install thermostats in hot-water return piping.
9. Install timers on wall in engineer's office, **as directed**.
10. Install time-delay relays in piping between water heaters and hot-water storage tanks.

C. Connections

1. Comply with requirements for piping specified in Division 22 Section "Domestic Water Piping". Drawings indicate general arrangement of piping, fittings, and specialties.
2. Install piping adjacent to pumps to allow service and maintenance.
3. Connect domestic water piping to pumps. Install suction and discharge piping equal to or greater than size of pump nozzles.
 - a. Install flexible connectors adjacent to pumps in suction and discharge piping of the following pumps:
 - 1) Horizontally mounted, in-line, separately coupled centrifugal pumps.
 - 2) Horizontally mounted, in-line, close-coupled centrifugal pumps.
 - 3) Vertically mounted, in-line, close-coupled centrifugal pumps.
 - 4) Comply with requirements for flexible connectors specified in Division 22 Section "Domestic Water Piping".
 - b. Install shutoff valve and strainer on suction side of each pump, and check, shutoff, and throttling valves on discharge side of each pump. Install valves same size as connected piping. Comply with requirements for valves specified in Division 22 Section "General-duty Valves For Plumbing Piping" and comply with requirements for strainers specified in Division 22 Section "Domestic Water Piping Specialties".
 - c. Install pressure gage and snubber, **as directed**, at suction of each pump and pressure gage and snubber, **as directed**, at discharge of each pump. Install at integral pressure-gage tapplings where provided or install pressure-gage connectors in suction and discharge piping around pumps. Comply with requirements for pressure gages and snubbers specified in Division 22 Section "Meters And Gages For Plumbing Piping".
4. Comply with Division 22 for electrical connections, and wiring methods.
5. Connect pressure switches, thermostats, time-delay relays, and timers to pumps that they control.
6. Interlock pump between water heater and hot-water storage tank with water heater burner and time-delay relay.

- D. Identification
1. Comply with requirements for identification specified in Division 22 Section "Identification For Plumbing Piping And Equipment" for identification of pumps.
- E. Startup Service
1. Engage a factory-authorized service representative to perform **OR** Perform, **as directed**, startup service.
 - a. Complete installation and startup checks according to manufacturer's written instructions.
 - b. Check piping connections for tightness.
 - c. Clean strainers on suction piping.
 - d. Set pressure switches, thermostats, timers, and time-delay relays for automatic starting and stopping operation of pumps.
 - e. Perform the following startup checks for each pump before starting:
 - 1) Verify bearing lubrication.
 - 2) Verify that pump is free to rotate by hand and that pump for handling hot liquid is free to rotate with pump hot and cold. If pump is bound or drags, do not operate until cause of trouble is determined and corrected.
 - 3) Verify that pump is rotating in the correct direction.
 - f. Prime pump by opening suction valves and closing drains, and prepare pump for operation.
 - g. Start motor.
 - h. Open discharge valve slowly.
 - i. Adjust temperature settings on thermostats.
 - j. Adjust timer settings.
- F. Adjusting
1. Adjust domestic water pumps to function smoothly, and lubricate as recommended by manufacturer.
 2. Adjust initial temperature set points.
 3. Set field-adjustable switches and circuit-breaker trip ranges as indicated.

END OF SECTION 22 11 23 13

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SECTION 22 11 23 13a - PACKAGED BOOSTER PUMPS

1.1 GENERAL

A. Description Of Work

1. This specification covers the furnishing and installation of materials for packaged booster pumps. Products shall be as follows or as directed by the Owner. Installation procedures shall be in accordance with the products manufacturer's recommendations. Demolition and removal of materials shall be as required to support the work.

B. Summary

1. Section Includes:
 - a. Simplex, constant-speed booster pumps.
 - b. Multiplex, constant-speed booster pumps.
 - c. Simplex, variable-speed booster pumps.
 - d. Multiplex, variable-speed booster pumps.

C. Definitions

1. VFC: Variable-frequency controller(s).

D. Performance Requirements

1. Seismic Performance: Booster pumps shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.
 - a. The term "withstand" means "the booster pump will remain in place without separation of any parts from the booster pump when subjected to the seismic forces specified and the booster pump will be fully operational after the seismic event."

E. Submittals

1. Product Data: For each type of product indicated. Include construction details, material descriptions, and dimensions of individual components and profiles **OR** Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories, **as directed**.
2. Shop Drawings: For booster pumps. Include plans, elevations, sections, details, and attachments to other work.
 - a. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
 - b. Wiring Diagrams: For power, signal, and control wiring.
3. Seismic Qualification Certificates: For booster pumps, accessories, and components, from manufacturer.
 - a. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
 - b. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
 - c. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
4. Operation and Maintenance Data: For booster pumps to include in emergency, operation, and maintenance manuals.

F. Quality Assurance

1. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
2. ASME Compliance: Comply with ASME B31.9 for piping.
3. UL Compliance for Packaged Pumping Systems:
 - a. UL 508, "Industrial Control Equipment."

- b. UL 508A, "Industrial Control Panels."
- c. UL 778, "Motor-Operated Water Pumps."
- d. UL 1995, "Heating and Cooling Equipment."
- 4. Booster pumps shall be listed and labeled as packaged pumping systems by testing agency acceptable to authorities having jurisdiction.

G. Delivery, Storage, And Handling

- 1. Retain protective coatings and flange's protective covers during storage.

H. Coordination

- 1. Coordinate sizes and locations of concrete bases with actual equipment provided.

1.2 PRODUCTS

A. Simplex, Constant-Speed Booster Pumps

- 1. Description: Factory-assembled and -tested, fluid-handling system for domestic water, with pump, piping, valves, specialties, and controls, and mounted on base.
- 2. Pump:
 - a. Type: End suction as defined in HI 1.1-1.2 and HI 1.3 for end-suction, close-coupled, single-stage, overhung-impeller, centrifugal pump.
 - b. Casing: Radially split; bronze **OR** cast iron **OR** stainless steel, **as directed**.
 - c. Impeller: Closed, ASTM B 584 cast bronze **OR** stainless steel, **s directed**; statically and dynamically balanced and keyed to shaft.
 - d. Shaft and Shaft Sleeve: Steel shaft, with copper-alloy shaft sleeve and deflector.
 - e. Seal: Mechanical.
 - f. Orientation: Mounted horizontally or vertically.
- 3. Motor: Single speed, with grease-lubricated or pre-greased, permanently shielded, ball-type bearings, and directly mounted to pump casing. Select motor that will not overload through full range of pump performance curve.
- 4. Piping: Copper tube and copper fittings **OR** Stainless-steel pipe and fittings **OR** Stainless-steel pipe and fitting headers and copper tube and copper fittings between headers and pump **OR** Galvanized-steel pipe and cast-iron fittings, **as directed**.
- 5. Valves:
 - a. Shutoff Valves **NPS 2 (DN 50)** and smaller: Gate valve or two-piece, full-port ball valve, in pump suction and discharge piping.
 - b. Shutoff Valves **NPS 2-1/2 (DN 65)** and Larger: Gate valve or lug-type butterfly valve, in pump suction and discharge piping.
 - c. Check Valve **NPS 2 (DN 50)** and smaller: Silent or swing type in pump discharge piping.
 - d. Check Valve **NPS 2-1/2 (DN 65)** and Larger: Silent type in pump discharge piping.
 - e. Control Valve: Adjustable, automatic, pilot-operated or direct-acting, pressure-reducing type in pump discharge piping.
 - f. Control Valve: Combination adjustable, automatic, pilot-operated or direct-acting pressure-reducing-and-check type in pump discharge piping.
 - g. Thermal-Relief Valve: Temperature-and-pressure relief type in pump discharge piping.
- 6. Dielectric Fittings: With insulating material isolating joined dissimilar metals.
- 7. Hydropneumatic Tank: Precharged, ASME-construction, **as directed**, diaphragm or bladder tank made of materials complying with NSF 61.
- 8. Control Panel: Factory installed and connected as an integral part of booster pump; automatic for single-pump, constant-speed operation, with load control and protection functions.
 - a. Control Logic: Electromechanical system with switches, relays **OR** Solid-state system with transducers, programmable microprocessor, **as directed**, and other devices in the controller.

- b. Motor Controller: NEMA ICS 2, general-purpose, Class A, full-voltage, combination-magnetic type with undervoltage release feature, motor-circuit-protector-type disconnect, and short-circuit protective device.
 - 1) Control Voltage: 24 **OR** 120, **as directed**, -V ac, with integral control-power transformer.
- c. Motor Controller: NEMA ICS 2, solid-state, reduced-voltage type.
 - 1) Control Voltage: 24 **OR** 120, **as directed**, -V ac, with integral control-power transformer.
- d. Enclosure: NEMA 250, Type 1 **OR** Type 3R **OR** Type 4 **OR** Type 12, **as directed**.
- e. Motor Overload Protection: Overload relay in each phase.
- f. Starting Devices: Hand-off-automatic selector switch in cover of control panel, plus pilot device for automatic control.
- g. Pump Operation: Current- or pressure- sensing method.
 - 1) Time Delay: Controls pump on-off operation; adjustable from 1 to 300 seconds.
- h. Instrumentation: Suction and discharge pressure gages.
- i. Light: Running light for pump.
- j. Thermal-bleed cutoff.
- k. Low-suction-pressure **OR** Water-storage-tank, low-level, **as directed**, cutout.
- l. High-suction-pressure cutout.
- m. Low-discharge-pressure cutout.
- n. High-discharge-pressure cutout.
- o. Building Automation System Interface: Provide auxiliary contacts for interface to BACnet **OR** LonWorks, **as directed**, building automation system. Building automation systems are specified in Division 23 Section "Instrumentation And Control For Hvac". Include the following:
 - 1) On-off status of pump.
 - 2) Alarm status.
- 9. Base: Structural steel.
- B. Multiplex, Constant-Speed Booster Pumps
 - 1. Description: Factory-assembled and -tested, fluid-handling system for domestic water, with pumps, piping, valves, specialties, and controls, and mounted on base.
 - 2. Pumps:
 - a. Type: End suction as defined in HI 1.1-1.2 and HI 1.3 for end-suction, close-coupled, single-stage, overhung-impeller, centrifugal pump.
 - b. Casing: Radially split; bronze **OR** cast iron **OR** stainless steel, **as directed**.
 - c. Impeller: Closed, ASTM B 584 cast bronze **OR** stainless steel, **as directed**; statically and dynamically balanced and keyed to shaft.
 - d. Shaft and Shaft Sleeve: Steel shaft, with copper-alloy shaft sleeve and deflector.
 - e. Seal: Mechanical.
 - f. Orientation: Mounted horizontally or vertically.
 - OR**
 - Pumps:
 - a. Type: End suction as defined in HI 1.1-1.2 and HI 1.3 for end-suction, frame-mounted, separately coupled, single-stage, overhung-impeller, centrifugal pump. Include back-pullout design, **as directed**.
 - b. Casing: Radially split; bronze **OR** cast iron **OR** stainless steel, **as directed**.
 - c. Impeller: Closed, ASTM B 584 cast bronze **OR** stainless steel, **as directed**; statically and dynamically balanced and keyed to shaft.
 - d. Shaft and Shaft Sleeve: Stainless-steel or steel, **as directed**, shaft, with copper-alloy shaft sleeve and deflector.
 - e. Seal: Mechanical.
 - f. Bearing: Grease-lubricated or pre-greased, permanently shielded ball type.
 - g. Coupling: Flexible, with metal guard.
 - OR**
 - Pumps:

- a. Type: In line, single stage as defined in HI 1.1-1.2 and HI 1.3 for in-line, single-stage, close-coupled, overhung-impeller, centrifugal pump.
 - b. Casing: Radially split; bronze **OR** cast iron **OR** stainless steel, **as directed**.
 - c. Impeller: Closed, ASTM B 584 cast bronze **OR** stainless steel, **as directed**; statically and dynamically balanced and keyed to shaft.
 - d. Shaft and Shaft Sleeve: Stainless-steel or steel, **as directed**, shaft, with copper-alloy shaft sleeve.
 - e. Seal: Mechanical.
 - f. Bearing: Grease-lubricated or pre-greased, permanently shielded ball type.
- OR**
- Pumps:
- a. Type: Vertical, multistage as defined in HI 1.1-1.2 and HI 1.3 for in-line, multistage, separately coupled, overhung-impeller, centrifugal pump.
 - b. Casing: Cast-iron or steel base and stainless-steel chamber.
 - c. Impeller: Closed, stainless steel; statically and dynamically balanced and keyed to shaft.
 - d. Shaft: Stainless steel.
 - e. Seal: Mechanical.
 - f. Bearing: Water-lubricated sleeve type.
- OR**
- Pumps:
- a. Type: Vertical, can, as defined in HI 2.1-2.2 and HI 2.3 for in-line, barrel or can, lineshaft, vertical pump.
 - b. Impeller: Closed, stainless steel; statically and dynamically balanced and keyed to shaft.
 - c. Bowls: Epoxy-coated cast iron **OR** Cast iron, **as directed**.
 - d. Shaft: Stainless steel.
 - e. Seals: Mechanical and stuffing-box types.
 - f. Bearings: Water-lubricated bushing type.
3. Motors: Single speed, with grease-lubricated or pre-greased, permanently shielded, ball-type bearings. Select motors that will not overload through full range of pump performance curve.
 4. Piping: Copper tube and copper fittings **OR** Stainless-steel pipe and fittings **OR** Stainless-steel pipe and fitting headers and copper tube and copper fittings between headers and pump **OR** Galvanized-steel pipe and cast-iron fittings, **as directed**.
 5. Valves:
 - a. Shutoff Valves **NPS 2 (DN 50)** and smaller: Gate valve or two-piece, full-port ball valve, in each pump's suction and discharge piping.
 - b. Shutoff Valves **NPS 2-1/2 (DN 65)** and Larger: Gate valve or lug-type butterfly valve, in each pump's suction and discharge piping and in inlet and outlet headers, **as directed**.
 - c. Check Valves **NPS 2 (DN 50)** and smaller: Silent or swing type in each pump's discharge piping.
 - d. Check Valves **NPS 2-1/2 (DN 65)** and Larger: Silent type in each pump's discharge piping.
 - e. Control Valves: Adjustable, automatic, pilot-operated or direct-acting, pressure-reducing type in each pump's discharge piping.
 - f. Control Valves: Combination adjustable, automatic, pilot-operated or direct-acting pressure-reducing-and-check type in each pump's discharge piping.
 - g. Thermal-Relief Valve: Temperature-and-pressure relief type in pump's discharge header piping.
 6. Dielectric Fittings: With insulating material isolating joined dissimilar metals.
 7. Control Panel: Factory installed and connected as an integral part of booster pump; automatic for multiple-pump, constant-speed operation, with load control and protection functions.
 - a. Control Logic: Electromechanical system with switches, relays **OR** Solid-state system with transducers, programmable microprocessor, **as directed**, and other devices in the controller.
 - b. Motor Controller: NEMA ICS 2, general-purpose, Class A, full-voltage, combination-magnetic type with undervoltage release feature, motor-circuit-protector-type disconnect, and short-circuit protective device.

- 1) Control Voltage: 24 **OR** 120, **as directed**, -V ac, with integral control-power transformer.
 - c. Motor Controller: NEMA ICS 2, solid-state, reduced-voltage type.
 - 1) Control Voltage: 24 **OR** 120, **as directed**, -V ac, with integral control-power transformer.
 - d. Enclosure: NEMA 250, Type 1 **OR** Type 3R **OR** Type 4 **OR** Type 12, **as directed**.
 - e. Motor Overload Protection: Overload relay in each phase.
 - f. Starting Devices: Hand-off-automatic selector switch for each pump in cover of control panel, plus pilot device for automatic control.
 - 1) Duplex, Automatic, Alternating Starter: Switches lead pump to lag main pump and to two-pump operation.
 - 2) Triplex, Sequence (Lead-Lag-Lag) Starter: Switches lead pump to one lag main pump and to three-pump operation.
 - g. Pump Operation and Sequencing: Current- or pressure- sensing method.
 - 1) Time Delay: Controls pump on-off operation; adjustable from 1 to 300 seconds.
 - h. Instrumentation: Suction and discharge pressure gages.
 - i. Lights: Running light for each pump.
 - j. Alarm Signal Device: Sounds alarm when backup pumps are operating.
 - 1) Time Delay: Controls alarm operation; adjustable from 1 to 300 seconds, with automatic **OR** manual, **as directed**, reset.
 - k. Thermal-bleed cutoff.
 - l. Low-suction-pressure **OR** Water-storage-tank, low-level, **as directed**, cutout.
 - m. High-suction-pressure cutout.
 - n. Low-discharge-pressure cutout.
 - o. High-discharge-pressure cutout.
 - p. Building Automation System Interface: Provide auxiliary contacts for interface to BACnet **OR** LonWorks, **as directed**, building automation system. Building automation systems are specified in Division 23 Section "Instrumentation And Control For Hvac". Include the following:
 - 1) On-off status of each pump.
 - 2) Alarm status.
 8. Base: Structural steel.
- C. Simplex, Variable-Speed Booster Pumps
1. Description: Factory-assembled and -tested, fluid-handling system for domestic water, with pump, piping, valves, specialties, and controls, and mounted on base.
 2. Pump:
 - a. Type: End suction as defined in HI 1.1-1.2 and HI 1.3 for end-suction, close-coupled, single-stage, overhung-impeller, centrifugal pump.
 - b. Casing: Radially split; bronze **OR** cast iron **OR** stainless steel, **as directed**.
 - c. Impeller: Closed, ASTM B 584 cast bronze **OR** stainless steel, **as directed**; statically and dynamically balanced and keyed to shaft.
 - d. Shaft and Shaft Sleeve: Steel shaft, with copper-alloy shaft sleeve and deflector.
 - e. Seal: Mechanical.
 - f. Orientation: Mounted horizontally or vertically.
 3. Motor: Single speed, with grease-lubricated or pre-greased, permanently shielded, ball-type bearings, and directly mounted to pump casing. Select motor that will not overload through full range of pump performance curve.
 4. Piping: Copper tube and copper fittings **OR** Stainless-steel pipe and fittings **OR** Stainless-steel pipe and fitting headers and copper tube and copper fittings between headers and pump **OR** Galvanized-steel pipe and cast-iron fittings, **as directed**.
 5. Valves:
 - a. Shutoff Valves **NPS 2 (DN 50)** and Smaller: Gate valve or two-piece, full-port ball valve, in pump suction and discharge piping.
 - b. Shutoff Valves **NPS 2-1/2 (DN 65)** and Larger: Gate valve or lug-type butterfly valve, in pump suction and discharge piping.

- c. Check Valve **NPS 2 (DN 50)** and Smaller: Silent or swing type in pump discharge piping.
 - d. Check Valve **NPS 2-1/2 (DN 65)** and Larger: Silent type in pump discharge piping.
 - e. Thermal-Relief Valve: Temperature-and-pressure relief type in pump discharge piping.
 - 6. Dielectric Fittings: With insulating material isolating joined dissimilar metals.
 - 7. Hydropneumatic Tank: Precharged, ASME-construction, **as directed**, diaphragm or bladder tank made of materials complying with NSF 61.
 - 8. Control Panel: Factory installed and connected as an integral part of booster pump; automatic for single-pump, variable-speed operation, with load control and protection functions.
 - a. Control Logic: Solid-state system with transducers, programmable microprocessor, VFC, and other devices in the controller.
 - b. Motor Controller: NEMA ICS 2, variable-frequency, solid-state type.
 - 1) Control Voltage: 24 **OR** 120, **as directed**, -V ac, with integral control-power transformer.
 - c. Enclosure: NEMA 250, Type 1 **OR** Type 3R **OR** Type 4 **OR** Type 12, **as directed**.
 - d. Motor Overload Protection: Overload relay in each phase.
 - e. Starting Devices: Hand-off-automatic selector switch in cover of control panel, plus pilot device for automatic control.
 - f. Pump Operation: Pressure-sensing method.
 - 1) Time Delay: Controls pump on-off operation; adjustable from 1 to 300 seconds.
 - g. VFC: Voltage-source, pulse-width, modulating-frequency converter; installed in control panel.
 - h. Manual Bypass: Magnetic contactor arranged to transfer to constant-speed operation upon VFC failure.
 - i. Instrumentation: Suction and discharge pressure gages.
 - j. Light: Running light for pump.
 - k. Thermal-bleed cutoff.
 - l. Low-suction-pressure **OR** Water-storage-tank, low-level, **as directed**, cutout.
 - m. High-suction-pressure cutout.
 - n. Low-discharge-pressure cutout.
 - o. High-discharge-pressure cutout.
 - p. Building Automation System Interface: Provide auxiliary contacts for interface to BACnet **OR** LonWorks, **as directed**, building automation system. Building automation systems are specified in Division 23 Section "Instrumentation And Control For Hvac". Include the following:
 - 1) On-off status of each pump.
 - 2) Alarm status.
 - 9. Base: Structural steel.
- D. Multiplex, Variable-Speed Booster Pumps
- 1. Description: Factory-assembled and -tested, fluid-handling system for domestic water, with pumps, piping, valves, specialties, and controls, and mounted on base.
 - 2. Pumps:
 - a. Type: End suction as defined in HI 1.1-1.2 and HI 1.3 for end-suction, close-coupled, single-stage, overhung-impeller, centrifugal pump.
 - b. Casing: Radially split; bronze **OR** cast iron **OR** stainless steel, **as directed**.
 - c. Impeller: Closed, ASTM B 584 cast bronze **OR** stainless steel, **as directed**; statically and dynamically balanced and keyed to shaft.
 - d. Shaft and Shaft Sleeve: Steel shaft, with copper-alloy shaft sleeve and deflector.
 - e. Seal: Mechanical.
 - f. Orientation: Mounted horizontally or vertically.
 - 3. Pumps:
 - a. Type: End suction as defined in HI 1.1-1.2 and HI 1.3 for end-suction, frame-mounted, separately coupled, single-stage, overhung-impeller, centrifugal pump. Include back-pullout design, **as directed**.
 - b. Casing: Radially split; bronze **OR** cast iron **OR** stainless steel, **as directed**.

- c. Impeller: Closed, ASTM B 584 cast bronze **OR** stainless steel, **as directed**; statically and dynamically balanced and keyed to shaft.
- d. Shaft and Shaft Sleeve: Stainless-steel or steel, **as directed**, shaft, with copper-alloy shaft sleeve and deflector.
- e. Seal: Mechanical.
- f. Bearing: Grease-lubricated or pre-greased, permanently shielded ball type.
- g. Coupling: Flexible, with metal guard.
4. Pumps:
 - a. Type: In line, single stage as defined in HI 1.1-1.2 and HI 1.3 for in-line, single-stage, close-coupled, overhung-impeller, centrifugal pump.
 - b. Casing: Radially split; bronze **OR** cast iron **OR** stainless steel, **as directed**.
 - c. Impeller: Closed, ASTM B 584 cast bronze **OR** stainless steel, **as directed**; statically and dynamically balanced and keyed to shaft.
 - d. Shaft and Shaft Sleeve: Stainless-steel or steel, **as directed**, shaft, with copper-alloy shaft sleeve.
 - e. Seal: Mechanical.
 - f. Bearing: Grease-lubricated or pre-greased, permanently shielded ball type.
5. Pumps:
 - a. Type: Vertical, multistage as defined in HI 1.1-1.2 and HI 1.3 for in-line, multistage, separately coupled, overhung-impeller, centrifugal pump.
 - b. Casing: Cast-iron or steel base and stainless-steel chamber.
 - c. Impeller: Closed, stainless steel; statically and dynamically balanced and keyed to shaft.
 - d. Shaft: Stainless steel.
 - e. Seal: Mechanical.
 - f. Bearing: Water-lubricated sleeve type.
6. Pumps:
 - a. Type: Vertical, can, as defined in HI 2.1-2.2 and HI 2.3 for in-line, barrel or can, lineshaft, vertical pump.
 - b. Impeller: Closed, stainless steel; statically and dynamically balanced and keyed to shaft.
 - c. Bowls: Epoxy-coated cast iron **OR** Cast iron, **as directed**.
 - d. Shaft: Stainless steel.
 - e. Seals: Mechanical and stuffing-box types.
 - f. Bearings: Water-lubricated bushing type.
7. Motors: Single speed, with grease-lubricated or pre-greased, permanently shielded, ball-type bearings. Select motors that will not overload through full range of pump performance curve.
8. Piping: Copper tube and copper fittings **OR** Stainless-steel pipe and fittings **OR** Stainless-steel pipe and fitting headers and copper tube and copper fittings between headers and pump **OR** Galvanized-steel pipe and cast-iron fittings, **as directed**.
9. Valves:
 - a. Shutoff Valves **NPS 2 (DN 50)** and Smaller: Gate valve or two-piece, full-port ball valve, in each pump's suction and discharge piping.
 - b. Shutoff Valves **NPS 2-1/2 (DN 65)** and Larger: Gate valve or lug-type butterfly valve, in each pump's suction and discharge piping and in inlet and outlet headers, **as directed**.
 - c. Check Valves **NPS 2 (DN 50)** and Smaller: Silent or swing type in each pump's discharge piping.
 - d. Check Valves **NPS 2-1/2 (DN 65)** and Larger: Silent type in each pump's discharge piping.
 - e. Thermal-Relief Valve: Temperature-and-pressure relief type in pump's discharge header piping.
10. Dielectric Fittings: With insulating material isolating joined dissimilar metals.
11. Control Panel: Factory installed and connected as an integral part of booster pump; automatic for multiple-pump, variable-speed operation, with load control and protection functions.
 - a. Control Logic: Solid-state system with transducers, programmable microprocessor, VFC, and other devices in controller. Install VFC for pump motors larger than 25 hp in separate panel; same type as motor control panel enclosure.
 - b. Motor Controller: NEMA ICS 2, variable-frequency, solid-state type.

- 1) Control Voltage: 24 **OR** 120, **as directed**, -V ac, with integral control-power transformer.
 - c. Enclosure: NEMA 250, Type 1 **OR** Type 3R **OR** Type 4 **OR** Type 12, **as directed**.
 - d. Motor Overload Protection: Overload relay in each phase.
 - e. Starting Devices: Hand-off-automatic selector switch for each pump in cover of control panel, plus pilot device for automatic control.
 - 1) Duplex, Automatic, Alternating Starter: Switches lead pump to lag main pump and to two-pump operation.
 - 2) Triplex, Sequence (Lead-Lag-Lag) Starter: Switches lead pump to one lag main pump and to three-pump operation.
 - f. Pump Operation and Sequencing: Pressure-sensing method or flow-sensing method **OR** Pressure-sensing method for lead pump and flow-sensing method for lag pumps, **as directed**.
 - 1) Time Delay: Controls pump on-off operation; adjustable from 1 to 300 seconds.
 - g. VFC: Voltage-source, pulse-width, modulating-frequency converter for each **OR** lead, **as directed**, pump.
 - h. Manual Bypass: Magnetic contactor arranged to transfer to constant-speed operation upon VFC failure.
 - i. Instrumentation: Suction and discharge pressure gages.
 - j. Lights: Running light for each pump.
 - k. Alarm Signal Device: Sounds alarm when backup pumps are operating.
 - 1) Time Delay: Controls alarm operation; adjustable from 1 to 300 seconds, with automatic **OR** manual, **as directed**, reset.
 - l. Thermal-bleed cutoff.
 - m. Low-suction-pressure **OR** Water-storage-tank, low-level, **as directed**, cutout.
 - n. High-suction-pressure cutout.
 - o. Low-discharge-pressure cutout.
 - p. High-discharge-pressure cutout.
 - q. Building Automation System Interface: Provide auxiliary contacts for interface to BACnet **OR** LonWorks, **as directed**, building automation system. Building automation systems are specified in Division 23 Section "Instrumentation And Control For Hvac". Include the following:
 - 1) On-off status of each pump.
 - 2) Alarm status.
12. Base: Structural steel.

E. Motors

1. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors.
 - a. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.
 - b. Controllers, Electrical Devices, and Wiring: Comply with requirements for electrical devices and connections specified in NFPA 70.

1.3 EXECUTION

A. Examination

1. Examine roughing-in for booster pumps to verify actual locations of piping connections before booster-pump installation.

B. Installation

1. Equipment Mounting: Install booster pumps on concrete base using elastomeric pads **OR** elastomeric mounts **OR** restrained spring isolators, **as directed**. Comply with requirements for concrete base specified in Division 03 Section "Cast-in-place Concrete", **as directed**.

- a. Minimum Deflection: **1/4 inch (6 mm) OR 1 inch (25 mm), as directed.**
 - b. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on **18-inch (450-mm)** centers around the full perimeter of concrete base.
 - c. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.
 - d. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 - e. Install anchor bolts to elevations required for proper attachment to supported equipment.
 2. Equipment Mounting: Install booster pumps using elastomeric pads **OR** elastomeric mounts **OR** restrained spring isolators, **as directed**. Comply with requirements for vibration isolation devices specified in Division 22 Section "Vibration And Seismic Controls For Plumbing Piping And Equipment".
 - a. Minimum Deflection: **1/4 inch (6 mm) OR 1 inch (25 mm), as directed.**
 3. Support connected domestic-water piping so weight of piping is not supported by booster pumps.
- C. Connections
 1. Comply with requirements for piping specified in Division 22 Section "Domestic Water Piping". Drawings indicate general arrangement of piping, fittings, and specialties.
 2. Connect domestic-water piping to booster pumps. Install suction and discharge pipe equal to or greater than size of system suction and discharge headers **OR** piping, **as directed**.
 - a. Install shutoff valves on piping connections to booster-pump suction and discharge headers **OR** piping, **as directed**. Install ball, butterfly, or gate valves same size as suction and discharge headers **OR** piping, **as directed**. Comply with requirements for general-duty valves specified in Division 22 Section "General-duty Valves For Plumbing Piping".
 - b. Install union, flanged, or grooved-joint connections on suction and discharge headers **OR** piping, **as directed**, at connection to domestic-water piping. Comply with requirements for unions and flanges specified in Division 22 Section "Domestic Water Piping".
 - c. Install valved bypass, same size as and between piping, at connections to booster-pump suction and discharge headers **OR** piping, **as directed**. Comply with requirements for domestic-water piping specified in Division 22 Section "Domestic Water Piping".
 - d. Install flexible connectors, same size as piping, on piping connections to booster-pump suction and discharge headers **OR** piping, **as directed**. Comply with requirements for flexible connectors specified in Division 22 Section "Domestic Water Piping".
 - e. Install piping adjacent to booster pumps to allow service and maintenance.
- D. Identification
 1. Identify system components. Comply with requirements for identification specified in Division 22 Section "Identification For Plumbing Piping And Equipment".
- E. Field Quality Control
 1. Perform tests and inspections.
 2. Tests and Inspections:
 - a. Perform visual and mechanical inspection.
 - b. Leak Test: After installation, charge booster pump and test for leaks. Repair leaks and retest until no leaks exist.
 - c. Operational Test: After electrical circuitry has been energized, start booster pumps to confirm proper motor rotation and booster-pump operation.
 - d. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
 3. Pumps and controls will be considered defective if they do not pass tests and inspections.
 4. Prepare test and inspection reports.
- F. Startup Service
 1. Perform startup service.
 - a. Complete installation and startup checks according to manufacturer's written instructions.



- G. Adjusting
 - 1. Adjust booster pumps to function smoothly, and lubricate as recommended by manufacturer.
 - 2. Adjust pressure set points.
 - 3. Occupancy Adjustments: When requested within 12 months of date of Final Completion, provide on-site assistance in adjusting booster pump to suit actual occupied conditions. Provide up to two visits to Project during other-than-normal occupancy hours for this purpose.
- H. Demonstration
 - 1. Train Owner's maintenance personnel to adjust, operate, and maintain booster pumps.

END OF SECTION 22 11 23 13a

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SECTION 22 11 23 23 - WATER SUPPLY WELLS

1.1 GENERAL

A. Description Of Work

1. This specification covers the furnishing and installation of materials for water supply wells. Products shall be as follows or as directed by the Owner. Installation procedures shall be in accordance with the product manufacturer's recommendations. Demolition and removal of materials shall be as required to support the work.

B. Summary

1. This Section includes the following:
 - a. Cable-tool, Rotary drilled, Reverse-rotary drilled, and Driven water supply wells.
 - b. Jet, Line-shaft, and Submersible well pumps.

C. Definitions

1. ABS: Acrylonitrile-butadiene-styrene plastic.
2. PA: Polyamide (nylon) plastic.
3. PE: Polyethylene plastic.
4. PP: Polypropylene plastic.
5. PVC: Polyvinyl chloride plastic.

D. Submittals

1. Product Data: Submit certified performance curves and rated capacities of selected well pumps and furnished specialties for each type and size of well pump indicated.
2. Shop Drawings: Show layout and connections for well pumps.
 - a. Wiring Diagrams: Power, signal, and control wiring.
3. Field quality-control reports.
4. Operation and maintenance data.

E. Quality Assurance

1. Well Driller Qualifications: An experienced water supply well driller licensed in the jurisdiction where Project is located.
2. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
3. Comply with AWWA A100 for water supply wells.

F. Project Conditions

1. Interruption of Existing Water Service: Do not interrupt water service to facilities occupied by the Owner or others unless permitted under the following conditions and then only after arranging to provide temporary water service according to requirements indicated:
 - a. Notify the Owner no fewer than seven days in advance of proposed interruption of water service.
 - b. Do not proceed with interruption of water service without the Owner's written permission.
2. Well Drilling Water: Provide temporary water and piping for drilling purposes. Provide necessary piping for water supply.

1.2 PRODUCTS

A. Well Casings

1. Steel Casing: AWWA C200, single ply, steel pipe with threaded ends and threaded couplings for threaded joints.

2. ABS Casing: ASTM F 480, ABS, Schedule 40 **OR** 80, **as directed**, bell-and-spigot pipe and couplings for solvent-cemented joints.
 3. PVC Casing: ASTM F 480 and NSF 14, **as directed**, PVC, Schedule 40 **OR** 80, **as directed**, bell-and-spigot pipe and couplings for solvent-cemented joints. Include NSF listing mark "NSF wc," **as directed**.
 4. Pitless Adapter: Fitting, of shape required to fit onto casing, with waterproof seals.
 5. Pitless Unit: Factory-assembled equipment that includes pitless adapter.
 6. Well Seals: Casing cap, with holes for piping and cables, that fits into top of casing and is removable, waterproof, and vermin proof.
- B. Grout
1. Cement: ASTM C 150, Type II.
 2. Aggregates: ASTM C 33, fine and coarse grades.
 3. Water: Potable.
- C. Water Well Screens
1. Screen Material: Fabricated of ASTM A 666, Type 304 stainless steel, welded; with continuous-slot, V-shaped openings that widen inwardly **OR** tube; with slotted or perforated surface and designed for well-screen applications, **as directed**.
 - a. Screen Couplings: Butt-type, stainless-steel coupling rings.
 - b. Screen Fittings: Screen, with necessary fittings, closes bottom and makes tight seal between top of screen and well casing.
 - c. Maximum Entering Velocity: **0.1 fps (0.03 m/s)**.
- D. Pack Materials
1. Coarse, uniformly graded filter sand, maximum **1/8 inch (3 mm)** in diameter.
 2. Fine gravel, maximum **1/4 inch (6 mm)** in diameter.
- E. Jet-Type Well Pumps
1. Description: Shallow **OR** Deep, **as directed**, well-design, jet well pump; self-priming; centrifugal pump capable of continuous operation; with the following features:
 - a. Housing: Cast iron.
 - b. Impeller: Single stage **OR** Multistage, **as directed**, centrifugal; fabricated of corrosion-resistant materials.
 - c. Seals: Mechanical.
 - d. Shaft: Stainless steel.
 - e. Motor: Manufacturer's standard, NEMA MG 1 motor, panel, and accessories.
 - f. Motor Controls: Electronic; variable speed.
 - g. Check valve, ejector, and pressure-control valve.
 2. Pump Accessories:
 - a. Compression Tanks: Comply with requirements in Division 22 Section "Facility Indoor Potable-water Storage Tanks" **OR** Precharged butyl rubber diaphragm, steel shell, fused polymeric lining, and **100-psig (690-kPa)** working pressure, **as directed**.
 - b. Pressure Switches: For pump control; for installation in piping.
 - c. Water Piping: ASTM A 53/A 53M, Schedule 40, galvanized-steel pipe with threaded ends.
 - 1) Cast-Iron Fittings: ASME B16.4, threaded, galvanized.
 - d. Water Piping: ASTM D 2239, SDR Numbers 5.3, 7, or 9 PE pipe; made with PE compound number required to give pressure rating not less than **160 psig (1100 kPa) OR 200 psig (1380 kPa)**, **as directed**. Include NSF listing mark "NSF pw."
 - 1) Fittings for PE Pipe: ASTM D 2609, made of PA, PP, or PVC with serrated, male insert ends matching inside of pipe. Include bands or crimp rings.
- F. Line-Shaft Well Pumps
1. Description: Line-shaft, water **OR** oil, **as directed**, lubricated, vertical-turbine well pump complying with HI 2.1-2.2 and HI 2.3; with the following features:

- a. Impeller Material: Stainless steel **OR** Carbon steel **OR** Bronze, **as directed**.
- b. Motor: Full-voltage starting, vertical hollow- or solid-shaft, squirrel-cage induction type complying with ANSI C50.10.
- c. Pump Base: Cast iron or fabricated steel.
- d. Column Pipe: ASTM A 53/A 53M, Schedule 40, galvanized-steel pipe with threaded ends and cast-iron or steel threaded couplings.

G. Submersible Well Pumps

1. Description: Submersible, vertical-turbine well pump complying with HI 2.1-2.2 and HI 2.3; with the following features:
 - a. Impeller Material: Stainless steel **OR** Silicon bronze, **as directed**.
 - b. Motor: Capable of continuous operation under water, with protected submersible power cable.
 - c. Column Pipe: ASTM A 53/A 53M, Schedule 40, galvanized-steel pipe with threaded ends and cast-iron or steel threaded couplings.
 - d. Discharge Piping: ASTM D 2239, SDR Numbers 5.3, 7, or 9 PE pipe; made with PE compound number required to give pressure rating not less than **160 psig (1100 kPa) OR 200 psig (1380 kPa), as directed**. Include NSF listing mark "NSF pw."
 - 1) Insert Fittings for PE Pipe: ASTM D 2609, made of PA, PP, or PVC with serrated, male insert ends matching inside of pipe. Include bands or crimp rings.

H. Motors

1. General requirements for motors are specified in Division 22 Section "Common Motor Requirements For Plumbing Equipment".
 - a. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.
 - b. Controllers, Electrical Devices, and Wiring: Electrical devices and connections are specified in Division 22.

1.3 EXECUTION

A. Preparation

1. Pilot-Hole Data: Review pilot-hole test analysis furnished by the Owner.
2. Neighborhood Well Data: Review operating and test analyses.

B. Installation

1. Construct well using cable-tool **OR** rotary drilling **OR** reverse-rotary drilling **OR** driven, **as directed**, method.
2. Take samples of substrata formation at **10-foot (3-m)** intervals and at changes in formation throughout entire depth of each water supply well. Carefully preserve samples on-site in glass jars properly labeled for identification.
3. If selecting rotary drilled or reverse-rotary drilled method, excavate for mud pit or provide aboveground structure, acceptable to authorities having jurisdiction, to allow settlement of cuttings and circulation of drill fluids back to well without discharging to on-site waterways.
4. Enlarge pilot hole and install permanent casing, screen, and grout. Install first section of casing with hardened steel driving shoe of an OD slightly larger than casing couplings if threaded couplings are used.
5. Set casing and liners round, plumb, and true to line.
6. Join casing pipe as follows:
 - a. Ream ends of pipe and remove burrs.
 - b. Remove scale, slag, dirt, and debris from inside and outside casing before installation.
 - c. Cut bevel in ends of steel casing pipe and make threaded joints.
 - d. Clean and make solvent-cemented joints for ABS and PVC casings.
7. If rotary drilled or reverse-rotary drilled well, mix grout in proportions of **1 cu. ft. (0.03 cu. m)** or a **94-lb (42.6-kg)** sack of cement with **5 to 6 gal. (19 to 23 L)** of water. Bentonite clay may be added

in amounts of **3 to 5 lb/cu. ft. (1.4 to 2.3 kg/0.03 cu. m)** for a **94-lb (42.6-kg)** sack of cement. If bentonite clay is added, water may be increased to **6.5 gal./cu. ft. (25 L/0.03 cu. m)** of cement.

8. If rotary drilled or reverse-rotary drilled well, place grout continuously, from bottom to top surface, to ensure filling of annular space in one operation. Do not perform other operations in well within 72 hours after grouting of casing. When quick-setting cement is used, this period may be reduced to 24 hours.
9. Provide permanent casing with temporary well cap. Install with top of casing **36 inches (910 mm)** above finished grade, **as directed**.
10. Develop wells to maximum yield per **foot (meter)** of drawdown.
 - a. Extract maximum practical quantity of sand, drill fluid, and other fine materials from water-bearing formation.
 - b. Avoid settlement and disturbance of strata above water-bearing formation.
 - c. Do not disturb sealing around well casings.
 - d. Continue developing wells until water contains no more than 2 ppm of sand by weight when pumped at maximum testing rate.
11. Install jet well pumps with ejector in or attached to pump housing. Place check valve on suction line to prevent drainage of compression tank.
12. Install jet well pumps and pressure and suction lines. Install ejector where pressure and suction lines connect above well screen. Install check valve in suction line, or install foot valve below ejector, to prevent drainage of compression tank.
13. Install line-shaft **OR** submersible, **as directed**, well pumps according to HI 2.1-2.4 and provide access for periodic maintenance.
 - a. Before lowering permanent pump into well, lower a dummy pump that is slightly longer and wider than permanent pump to determine that permanent pump can be installed. Correct alignment problems.
 - b. Before lowering permanent pump into well, start pump to verify correct rotation.
 - c. Securely tighten discharge piping joints.
 - d. Locate line-shaft well pump near well bottom; locate motor above grade. Install driver plate to correctly align motor and pump.
 - e. Connect motor to submersible pump and locate near well bottom.
 - 1) Connect power cable while connection points are dry and undamaged.
 - 2) Do not damage power cable during installation; use cable clamps that do not have sharp edges.
 - 3) Install water-sealed surface plate that will support pump and piping.

C. Connections

1. Piping installation requirements are specified in Division 22 Section "Facility Water Distribution Piping". Drawings indicate general arrangement of piping, fittings, and specialties.
 - a. Connect piping between well pump and water piping.
 - b. Connect water distribution system in trench to well pipe at pitless adapter **OR** unit, **as directed**.
 - c. Connect building water distribution to well pipe inside well house.
2. Ground equipment according to Division 26 Section "Grounding And Bonding For Electrical Systems".
3. Connect wiring according to Division 26 Section "Low-voltage Electrical Power Conductors And Cables".

D. Well Abandonment

1. Comply with AWWA A100 when abandoning water supply wells. Fill and seal holes and casings and restore ground surface to finished grade.
OR
Follow well-abandonment procedures of authorities having jurisdiction. Restore ground surface to finished grade.

E. Field Quality Control

1. Plumbness and Alignment Testing: Comply with AWWA A100.
 2. Furnish samples of water-bearing formation to testing laboratory and well-screen manufacturer for mechanical sieve analysis.
 3. Prepare reports on static level of ground water, level of water for various pumping rates, and depth to water-bearing strata.
 4. Performance Testing: Conduct final pumping tests after wells have been constructed, cleaned, and tested for plumbness and alignment.
 - a. Provide discharge piping to conduct water to locations where disposal will not create a nuisance or endanger adjacent property. Comply with requirements of authorities having jurisdiction.
 - b. Measure elevation to water level in wells.
 - c. Perform two bailer or air-ejection tests to determine expected yield. Test at depths with sufficient quantity of water to satisfy desired yields.
 - d. Test Pump: Variable capacity test pump with capacity equal to maximum expected yields at pressure equal to drawdown in wells, plus losses in pump columns and discharge pipes.
 - e. Start and adjust test pumps and equipment to required pumping rates.
 - f. Record readings of water levels in wells and pumping rates at 30-minute maximum intervals throughout 24-hour minimum period.
 - g. Record maximum yields when drawdown is 60 inches (1500 mm) above top of suction screens after designated times.
 - h. Operate pumping units continuously for eight hours after maximum drawdown is reached.
 - i. Record returning water levels in wells and plot curves of well recovery rates.
 - j. Remove sand, stones, and other foreign materials that may become deposited in wells after completing final tests.
 5. Water Analysis Testing:
 - a. Engage] a qualified testing agency to make bacteriological, physical, and chemical analyses of water from each finished well and report the results. Make analyses according to requirements of authorities having jurisdiction.
OR
Analyze water sample from each finished well for bacteriological, physical, and chemical quality and report the results. Make analyses according to requirements of authorities having jurisdiction.
- F. Cleaning
1. Disinfect water supply wells according to AWWA A100 and AWWA C654 before testing well pumps.
OR
Follow water supply well disinfection procedures required by authorities having jurisdiction before testing well pumps.
- G. Protection
1. Water Quality Protection: Prevent well contamination, including undesirable physical and chemical characteristics.
 2. Ensure that mud pit will not leak or overflow into streams or wetlands. When well is accepted, remove mud and solids in mud pit from Project site and restore site to finished grade.
 3. Provide casings, seals, sterilizing agents, and other materials to eliminate contamination; shut off contaminated water.
 4. Exercise care to prevent breakdown or collapse of strata overlaying that from which water is to be drawn.
 5. Protect water supply wells to prevent tampering and introducing foreign matter. Retain temporary well cap until installation is complete.

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SECTION 22 11 23 23a - HYDRONIC PUMPS

1.1 GENERAL

A. Description Of Work

1. This specification covers the furnishing and installation of materials for hydronic pumps. Products shall be as follows or as directed by the Owner. Installation procedures shall be in accordance with the products manufacturer's recommendations. Demolition and removal of materials shall be as required to support the work.

B. Summary

1. This Section includes the following:
 - a. Close-coupled, in-line centrifugal pumps.
 - b. Close-coupled, end-suction centrifugal pumps.
 - c. Separately coupled, horizontal, in-line centrifugal pumps.
 - d. Separately coupled, vertical, in-line centrifugal pumps.
 - e. Separately coupled, base-mounted, end-suction centrifugal pumps.
 - f. Separately coupled, base-mounted, double-suction centrifugal pumps.
 - g. Separately coupled, vertical-mounted, double-suction centrifugal pumps.
 - h. Separately coupled, vertical-mounted, turbine centrifugal pumps.
 - i. Automatic condensate pump units.

C. Definitions

1. Buna-N: Nitrile rubber.
2. EPT: Ethylene propylene terpolymer.

D. Submittals

1. Product Data: Include certified performance curves and rated capacities, operating characteristics, furnished specialties, final impeller dimensions, and accessories for each type of product indicated. Indicate pump's operating point on curves.
2. Shop Drawings: Show pump layout and connections. Include setting drawings with templates for installing foundation and anchor bolts and other anchorages.
 - a. Wiring Diagrams: Power, signal, and control wiring.
3. Operation and Maintenance Data: For pumps to include in emergency, operation, and maintenance manuals.

E. Quality Assurance

1. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
2. UL Compliance: Comply with UL 778 for motor-operated water pumps.

F. Delivery, Storage, And Handling

1. Manufacturer's Preparation for Shipping: Clean flanges and exposed machined metal surfaces and treat with anticorrosion compound after assembly and testing. Protect flanges, pipe openings, and nozzles with wooden flange covers or with screwed-in plugs.
2. Store pumps in dry location.
3. Retain protective covers for flanges and protective coatings during storage.
4. Protect bearings and couplings against damage from sand, grit, and other foreign matter.
5. Comply with pump manufacturer's written rigging instructions.

1.2 PRODUCTS

A. Close-Coupled, In-Line Centrifugal Pumps

1. Description: Factory-assembled and -tested, centrifugal, overhung-impeller, close-coupled, in-line pump as defined in HI 1.1-1.2 and HI 1.3; designed for installation with pump and motor shafts mounted horizontally or vertically. Rate pump for **125-psig (860-kPa) OR 175-psig (1204-kPa) OR 250-psig (1720-kPa)**, **as directed**, minimum working pressure and a continuous water temperature of **200 deg F (93 deg C) OR 225 deg F (107 deg C) OR 250 deg F (121 deg C)**, **as directed**.
2. Pump Construction:
 - a. Casing: Radially split, cast iron, with replaceable bronze wear rings, **as directed**, threaded gage tappings at inlet and outlet, and threaded companion-flange **OR** union end, **as directed**, connections.
 - b. Impeller: ASTM B 584, cast bronze; statically and dynamically balanced, keyed to shaft, and secured with a locking cap screw. Trim impeller to match specified performance.
 - c. Pump Shaft: Steel, with copper-alloy shaft sleeve **OR** Stainless steel, **as directed**.
 - d. Mechanical Seal: Carbon rotating ring against a ceramic seat held by a stainless-steel spring, and Buna-N **OR** EPT, **as directed**, bellows and gasket. Include water slinger on shaft between motor and seal.
 - e. Packing Seal: Stuffing box, with a minimum of four rings of graphite-impregnated braided yarn with bronze lantern ring between center two graphite rings, and bronze packing gland.
 - f. Pump Bearings: Permanently lubricated ball bearings **OR** Oil lubricated; bronze-journal or thrust type, **as directed**.
3. Motor: Single speed, with permanently lubricated **OR** grease-lubricated, **as directed**, ball bearings, unless otherwise indicated; and rigidly mounted to pump casing. Comply with requirements in Division 23 Section "Common Motor Requirements For Hvac Equipment".

B. Close-Coupled, End-Suction Centrifugal Pumps

1. Description: Factory-assembled and -tested, centrifugal, overhung-impeller, close-coupled, end-suction pump as defined in HI 1.1-1.2 and HI 1.3; designed for installation with pump and motor shafts mounted horizontally. Rate pump for **125-psig (860-kPa) OR 175-psig (1204-kPa)**, **as directed**, minimum working pressure and a continuous water temperature of **225 deg F (107 deg C) OR 250 deg F (121 deg C)**, **as directed**.
2. Pump Construction:
 - a. Casing: Radially split, cast iron, with replaceable bronze wear rings, **as directed**, drain plug at bottom and air vent at top of volute, threaded gage tappings at inlet and outlet, and threaded companion-flange **OR** flanged, **as directed**, connections.
 - b. Impeller: ASTM B 584, cast bronze; statically and dynamically balanced, keyed to shaft, and secured with a locking cap screw. Trim impeller to match specified performance.
 - c. Pump Shaft: Steel, with copper-alloy shaft sleeve **OR** Stainless steel, **as directed**.
 - d. Mechanical Seal: Carbon rotating ring against a ceramic seat held by a stainless-steel spring, and Buna-N **OR** EPT, **as directed**, bellows and gasket. Include water slinger on shaft between motor and seal.
 - e. Pump Bearings: Permanently lubricated ball bearings **OR** Oil lubricated; bronze-journal or thrust type, **as directed**.
 - f. Motor: Single speed, with permanently lubricated **OR** grease-lubricated, **as directed**, ball bearings, unless otherwise indicated; rigidly mounted to pump casing with integral pump support. Comply with requirements in Division 23 Section "Common Motor Requirements For Hvac Equipment".

C. Separately Coupled, Horizontal, In-Line Centrifugal Pumps

1. Description: Factory-assembled and -tested, centrifugal, overhung-impeller, separately coupled, in-line pump as defined in HI 1.1-1.2 and HI 1.3; designed for installation with pump and motor shafts mounted horizontally. Rate pump for **125-psig (860-kPa) OR 175-psig (1204-kPa)**, **as**

- directed**, minimum working pressure and a continuous water temperature of **225 deg F (107 deg C) OR 250 deg F (121 deg C)**, **as directed**.
2. Pump Construction:
 - a. Casing: Radially split, cast iron, with threaded gage tappings at inlet and outlet, and threaded companion-flange **OR** union end, **as directed**, connections.
 - b. Impeller: ASTM B 584, cast bronze; statically and dynamically balanced, and keyed to shaft. Trim impeller to match specified performance.
 - c. Pump Shaft: Steel, with copper-alloy shaft sleeve **OR** Stainless steel, **as directed**.
 - d. Mechanical Seal: Carbon rotating ring against a ceramic seat held by a stainless-steel spring, and Buna-N **OR** EPT, **as directed**, bellows and gasket. Include water slinger on shaft between motor and seal.
 - e. Pump Bearings: Permanently lubricated ball bearings **OR** Oil lubricated; bronze-journal or thrust type, **as directed**.
 3. Shaft Coupling: Molded rubber insert with interlocking spider **OR** Interlocking frame with interconnecting springs, **as directed**, capable of absorbing vibration.
 4. Motor: Single speed, with permanently lubricated ball **OR** oil-lubricated sleeve, **as directed**, bearings, unless otherwise indicated; and resiliently **OR** rigidly, **as directed**, mounted to pump casing. Comply with requirements in Division 23 Section "Common Motor Requirements For Hvac Equipment".
- D. Separately Coupled, Vertical, In-Line Centrifugal Pumps
1. Description: Factory-assembled and -tested, centrifugal, overhung-impeller, separately coupled, in-line pump as defined in HI 1.1-1.2 and HI 1.3; designed for installation with pump and motor shafts mounted vertically. Rate pump for **125-psig (860-kPa) OR 175-psig (1204-kPa) OR 250-psig (1720-kPa)**, **as directed**, minimum working pressure and a continuous water temperature of **200 deg F (93 deg C) OR 225 deg F (107 deg C) OR 250 deg F (121 deg C)**, **as directed**.
 2. Pump Construction:
 - a. Casing: Radially split, cast iron, with replaceable bronze wear rings, **as directed**, threaded gage tappings at inlet and outlet, and threaded companion-flange **OR** union end, **as directed**, connections.
 - b. Impeller: ASTM B 584, cast bronze; statically and dynamically balanced, keyed to shaft, and secured with a locking cap screw. Trim impeller to match specified performance.
 - c. Pump Shaft: Steel, with copper-alloy shaft sleeve **OR** Stainless steel, **as directed**.
 - d. Mechanical Seal: Carbon rotating ring against a ceramic seat held by a stainless-steel spring, and Buna-N **OR** EPT, **as directed**, bellows and gasket. Include water slinger on shaft between motor and seal.
 - e. Packing Seal: Stuffing box, with a minimum of four rings of graphite-impregnated braided yarn with bronze lantern ring between center two graphite rings, and bronze packing gland.
 - f. Pump Bearings: Permanently lubricated ball bearings **OR** Oil lubricated; bronze-journal or thrust type, **as directed**.
 3. Shaft Coupling: Axially split spacer coupling.
 4. Motor: Single speed, with permanently lubricated **OR** grease-lubricated, **as directed**, ball bearings, unless otherwise indicated; rigidly mounted to pump casing with lifting eye and supporting lugs in motor enclosure. Comply with requirements in Division 23 Section "Common Motor Requirements For Hvac Equipment".
- E. Separately Coupled, Base-Mounted, End-Suction Centrifugal Pumps
1. Description: Factory-assembled and -tested, centrifugal, overhung-impeller, separately coupled, end-suction pump as defined in HI 1.1-1.2 and HI 1.3; designed for base mounting, with pump and motor shafts horizontal. Rate pump for **125-psig (860-kPa) OR 175-psig (1204-kPa) OR 250-psig (1720-kPa)**, **as directed**, minimum working pressure and a continuous water temperature of **200 deg F (93 deg C) OR 225 deg F (107 deg C) OR 250 deg F (121 deg C)**, **as directed**.
 2. Pump Construction:
 - a. Casing: Radially split, cast iron, with replaceable bronze wear rings, **as directed**, threaded gage tappings at inlet and outlet, drain plug at bottom and air vent at top of volute, and threaded companion-flange **OR** flanged, **as directed**, connections. Provide integral mount

on volute to support the casing, and attached piping to allow removal and replacement of impeller without disconnecting piping or requiring the realignment of pump and motor shaft, **as directed**.

- b. Impeller: ASTM B 584, cast bronze; statically and dynamically balanced, keyed to shaft, and secured with a locking cap screw. Trim impeller to match specified performance.
 - c. Pump Shaft: Steel, with copper-alloy shaft sleeve **OR** Stainless steel, **as directed**.
 - d. Mechanical Seal: Carbon rotating ring against a ceramic seat held by a stainless-steel spring, and Buna-N **OR** EPT, **as directed**, bellows and gasket.
 - e. Packing Seal: Stuffing box, with a minimum of four rings of graphite-impregnated braided yarn with bronze lantern ring between center two graphite rings, and bronze packing gland.
 - f. Pump Bearings: Grease-lubricated ball bearings contained in cast-iron housing with grease fittings.
3. Shaft Coupling: Molded rubber insert and interlocking spider capable of absorbing vibration. Couplings shall be drop-out type to allow disassembly and removal without removing pump shaft or motor **OR** EPDM coupling sleeve for variable-speed applications, **as directed**.
 4. Coupling Guard: Dual rated; ANSI B15.1, Section 8; OSHA 1910.219 approved; steel; removable; attached to mounting frame.
 5. Mounting Frame: Welded-steel frame and cross members, factory fabricated from ASTM A 36/A 36M channels and angles. Fabricate to mount pump casing, coupling guard, and motor.
 6. Motor: Single speed, with permanently lubricated **OR** grease-lubricated, **as directed**, ball bearings, unless otherwise indicated; secured to mounting frame, with adjustable alignment. Comply with requirements in Division 23 Section "Common Motor Requirements For Hvac Equipment".

F. Separately Coupled, Base-Mounted, Double-Suction Centrifugal Pumps

1. Description: Factory-assembled and -tested, centrifugal, impeller-between-bearings, separately coupled, double-suction pump as defined in HI 1.1-1.2 and HI 1.3; designed for base mounting, with pump and motor shafts horizontal. Rate pump for **125-psig (860-kPa) OR 175-psig (1204-kPa) OR 250-psig (1720-kPa)**, **as directed**, minimum working pressure and a continuous water temperature of **200 deg F (93 deg C) OR 225 deg F (107 deg C) OR 250 deg F (121 deg C)**, **as directed**.
2. Pump Construction:
 - a. Casing: Radially **OR** Horizontally, **as directed**, split, cast iron, with replaceable bronze wear rings, **as directed**, threaded gage tappings at inlet and outlet, drain plug at bottom and air vent at top of volute, and ASME B16.1, Class 125 **OR** 250, **as directed**, flanges. Casing supports shall allow removal and replacement of impeller without disconnecting piping, **as directed**.
 - b. Impeller: ASTM B 584, cast bronze; statically and dynamically balanced, and keyed to shaft. Trim impeller to match specified performance.
 - c. Pump Shaft: Stainless steel.
 - d. Mechanical Seal: Carbon rotating ring against a ceramic seat held by a stainless-steel spring, and Buna-N **OR** EPT, **as directed**, bellows and gasket.
 - e. Packing Seal: Stuffing box, with a minimum of four rings of graphite-impregnated braided yarn with bronze lantern ring between center two graphite rings, and bronze packing gland.
 - f. Pump Bearings: Grease-lubricated ball bearings contained in cast-iron housing with grease fittings.
3. Shaft Coupling: Molded rubber insert and interlocking spider capable of absorbing vibration. Couplings shall be drop-out type to allow disassembly and removal without removing pump shaft or motor **OR** EPDM coupling sleeve for variable-speed applications, **as directed**.
4. Coupling Guard: Dual rated; ANSI B15.1, Section 8; OSHA 1910.219 approved; steel; removable; attached to mounting frame.
5. Mounting Frame: Welded-steel frame and cross members, factory fabricated from ASTM A 36/A 36M channels and angles. Fabricate to mount pump casing, coupling guard, and motor.

6. Motor: Single speed, with grease-lubricated ball bearings, unless otherwise indicated; secured to mounting frame, with adjustable alignment. Comply with requirements in Division 23 Section "Common Motor Requirements For Hvac Equipment".
- G. Separately Coupled, Vertical-Mounted, Double-Suction Centrifugal Pumps
 1. Description: Factory-assembled and -tested, centrifugal, impeller-between-bearings, separately coupled, double-suction pump as defined in HI 1.1-1.2 and HI 1.3; designed for installation with pump and motor shafts mounted vertically. Rate pump for 125-psig (860-kPa) OR 175-psig (1204-kPa) OR 250-psig (1720-kPa), as directed, minimum working pressure and a continuous water temperature of 200 deg F (93 deg C) OR 225 deg F (107 deg C) OR 250 deg F (121 deg C), as directed.
 2. Pump Construction:
 - a. Casing: Radially split, cast iron, with replaceable bronze wear rings, as directed, threaded gage tappings at inlet and outlet, drain plug at bottom of volute, mounting support, and ASME B16.1, Class 125 OR 250, as directed, flanges.
 - b. Impeller: ASTM B 584, cast bronze; statically and dynamically balanced, and keyed to shaft. Trim impeller to match specified performance.
 - c. Pump Shaft: Stainless steel.
 - d. Mechanical Seal: Carbon rotating ring against a ceramic seat held by a stainless-steel spring, and Buna-N OR EPT, as directed, bellows and gasket.
 - e. Packing Seal: Stuffing box, with a minimum of four rings of graphite-impregnated braided yarn with bronze lantern ring between center two graphite rings, and bronze packing gland.
 - f. Pump Bearings: Grease-lubricated ball bearings contained in cast-iron housing with grease fittings.
 3. Shaft Coupling: Molded rubber insert and interlocking spider capable of absorbing vibration.
 4. Motor: Single speed, with grease-lubricated ball bearings, unless otherwise indicated; secured to casing. Comply with requirements in Division 23 Section "Common Motor Requirements For Hvac Equipment".
- H. Separately Coupled, Vertical-Mounted, Turbine Centrifugal Pumps
 1. Description: Factory-assembled and -tested, single-stage OR multistage, as directed, centrifugal, impeller-between-bearings, end-suction pump as defined in HI 2.1-2.2 and HI 2.3; designed for installation with pump and motor shafts mounted vertically and projecting into a sump. Rate pump for 125-psig (860-kPa) OR 175-psig (1204-kPa), as directed, minimum working pressure and a continuous water temperature of 200 deg F (93 deg C).
 2. Pump Construction:
 - a. Pump Bowl: Cast iron, with replaceable bronze wear ring, as directed, cone OR basket, as directed, strainer, and suction bell. Water passages of intermediate bowls shall be coated with porcelain enamel, as directed.
 - b. Impeller: ASTM B 584, cast bronze; statically and dynamically balanced, and keyed to shaft. Trim impeller to match specified performance.
 - c. Pump Shaft: Carbon OR Stainless, as directed, steel sized per AWWA E-101.
 - d. Pump Bearings: Water-lubricated bronze and rubber sleeve bearings contained in cast-iron housing.
 - e. Pump Column: ASTM A 53/A 53M, Grade B steel pipe.
 - f. Mechanical Seal: Carbon rotating ring against a ceramic seat held by a stainless-steel spring, and Buna-N bellows and gasket. Seal shall be replaceable without removing the motor or disturbing the piping.
 - g. Packing Seal: Stuffing box, with a minimum of four rings of graphite-impregnated braided yarn with bronze lantern ring between center two graphite rings, and bronze packing gland.
 3. Shaft Coupling: Keyed with locking collets.
 4. Discharge Head: ASME B16.1, Class 125 OR 250, as directed, discharge flange with threaded gage tapping. Top of discharge head shall have a registered fit to accurately locate the driver.
 5. Drive Ratchet: Nonreversing ratchet.

6. Hollow Shaft Motor: Single speed, with grease-lubricated ball bearings, unless otherwise indicated; secured to discharge head. Comply with requirements in Division 23 Section "Common Motor Requirements For Hvac Equipment".

I. Automatic Condensate Pump Units

1. Description: Packaged units with corrosion-resistant pump, plastic tank with cover, and automatic controls. Include factory- or field-installed check valve and a **72-inch- (1800-mm-)** minimum, electrical power cord with plug.

J. Pump Specialty Fittings

1. Suction Diffuser: Angle pattern, **175-psig (1204-kPa) OR 300-psig (2060-kPa), as directed**, pressure rating, cast **OR** ductile, **as directed**,-iron body and end cap, pump-inlet fitting; with bronze startup and bronze or stainless-steel permanent strainers; bronze or stainless-steel straightening vanes; drain plug; and factory-fabricated support.
2. Triple-Duty Valve: Angle or straight pattern, **175-psig (1204-kPa) OR 300-psig (2060-kPa), as directed**, pressure rating, cast **OR** ductile, **as directed**,-iron body, pump-discharge fitting; with drain plug and bronze-fitted shutoff, balancing, and check valve features. Brass gage ports with integral check valve, and orifice for flow measurement.

1.3 EXECUTION

A. Concrete Bases

1. Install concrete bases of dimensions indicated for pumps and controllers. Refer to Division 23 Section "Common Work Results For Hvac"
 - a. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on **18-inch (450-mm)** centers around full perimeter of base.
 - b. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.
 - c. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 - d. Install anchor bolts to elevations required for proper attachment to supported equipment.
2. Cast-in-place concrete materials and placement requirements are specified in Division 31.

B. Pump Installation

1. Comply with HI 1.4 **OR** HI 2.4, **as directed**.
2. Install pumps with access for periodic maintenance including removal of motors, impellers, couplings, and accessories.
3. Independently support pumps and piping so weight of piping is not supported by pumps and weight of pumps is not supported by piping.
4. Install continuous-thread hanger rods and elastomeric hangers **OR** spring hangers **OR** spring hangers with vertical-limit stop, **as directed**, of sufficient size to support pump weight. Vibration isolation devices are specified in Division 23 Section "Vibration And Seismic Controls For Hvac Piping And Equipment". Fabricate brackets or supports as required. Hanger and support materials are specified in Division 23 Section "Hangers And Supports For Hvac Piping And Equipment".
5. Suspend vertically mounted, in-line centrifugal pumps independent of piping. Install pumps with motor and pump shafts vertical. Use continuous-thread hanger rods and elastomeric hangers **OR** spring hangers **OR** spring hangers with vertical-limit stop, **as directed**, of sufficient size to support pump weight. Vibration isolation devices are specified in Division 21 Section(s) "Vibration And Seismic Controls For Fire-suppression Piping And Equipment" AND Division 23 Section(s) "Vibration And Seismic Controls For Hvac Piping And Equipment". Hanger and support materials are specified in Division 22 Section(s) "Hangers And Supports For Plumbing Piping And Equipment" AND Division 23 Section(s) "Hangers And Supports For Hvac Piping And Equipment".

6. Set base-mounted pumps on concrete foundation. Disconnect coupling before setting. Do not reconnect couplings until alignment procedure is complete.
 - a. Support pump baseplate on rectangular metal blocks and shims, or on metal wedges with small taper, at points near foundation bolts to provide a gap of **3/4 to 1-1/2 inches (19 to 38 mm)** between pump base and foundation for grouting.
 - b. Adjust metal supports or wedges until pump and driver shafts are level. Check coupling faces and suction and discharge flanges of pump to verify that they are level and plumb.
 7. Automatic Condensate Pump Units: Install units for collecting condensate and extend to open drain.
- C. Alignment
1. Align pump and motor shafts and piping connections after setting on foundation, grout has been set and foundation bolts have been tightened, and piping connections have been made.
 2. Comply with pump and coupling manufacturers' written instructions.
 3. Adjust pump and motor shafts for angular and offset alignment by methods specified in HI 1.1-1.5, "Centrifugal Pumps for Nomenclature, Definitions, Application and Operation" **OR** HI 2.1-2.5, "Vertical Pumps for Nomenclature, Definitions, Application and Operation", **as directed**.
 4. After alignment is correct, tighten foundation bolts evenly but not too firmly. Completely fill baseplate with nonshrink, nonmetallic grout while metal blocks and shims or wedges are in place. After grout has cured, fully tighten foundation bolts.
- D. Connections
1. Piping installation requirements are specified in other Division 21. Drawings indicate general arrangement of piping, fittings, and specialties.
 2. Install piping adjacent to machine to allow service and maintenance.
 3. Connect piping to pumps. Install valves that are same size as piping connected to pumps.
 4. Install suction and discharge pipe sizes equal to or greater than diameter of pump nozzles.
 5. Install check valve and throttling **OR** triple-duty, **as directed**, valve on discharge side of pumps.
 6. Install Y-type strainer **OR** suction diffuser, **as directed**, and shutoff valve on suction side of pumps.
 7. Install flexible connectors on suction and discharge sides of base-mounted pumps between pump casing and valves.
 8. Install pressure gages on pump suction and discharge, at integral pressure-gage tapping, or install single gage with multiple input selector valve.
 9. Install check valve and gate or ball valve on each condensate pump unit discharge.
 10. Install electrical connections for power, controls, and devices.
 11. Ground equipment according to Division 26 Section "Grounding And Bonding For Electrical Systems".
 12. Connect wiring according to Division 26 Section "Low-voltage Electrical Power Conductors And Cables".

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Task	Specification	Specification Description
22 11 23 23	21 05 23 00	Piped Utilities Basic Materials And Methods

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SECTION 22 12 23 13 - ELECTRIC, DOMESTIC WATER HEATERS

1.1 GENERAL

A. Description Of Work

1. This specification covers the furnishing and installation of materials for electric, water heaters. Products shall be as follows or as directed by the Owner. Installation procedures shall be in accordance with the product manufacturer's recommendations. Demolition and removal of materials shall be as required to support the work.

B. Summary

1. This Section includes the following electric water heaters:
 - a. Household, small-capacity electric water heaters.
 - b. Household, storage electric water heaters.
 - c. Household, collector-to-tank, solar-electric water heaters.
 - d. Household, collector-to-tank, heat-exchanger-coil, solar-electric water heaters.
 - e. Flow-control, instantaneous electric water heaters.
 - f. Thermostat-control, instantaneous electric water heaters.
 - g. Light-commercial electric water heaters.
 - h. Commercial electric booster heaters.
 - i. Commercial, storage electric water heaters.
 - j. Compression tanks.
 - k. Water heater accessories.

C. Submittals

1. Product Data: For each type and size of water heater indicated. Include rated capacities, operating characteristics, furnished specialties, and accessories.
2. LEED Submittal:
 - a. Product Data for Prerequisite EA 2: Documentation indicating that units comply with ASHRAE/IESNA 90.1, Section 7 - "Service Water Heating."
3. Shop Drawings: Diagram power, signal, and control wiring.
4. Manufacturer Seismic Qualification Certification: Submit certification that commercial water heaters, accessories, and components will withstand seismic forces defined in Division 22 Section "Vibration And Seismic Controls For Plumbing Piping And Equipment".
5. Field quality-control test reports.
6. Operation and maintenance data.
7. Warranty: Special warranty specified in this Section.

D. Quality Assurance

1. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
2. ASHRAE/IESNA 90.1 Compliance: Applicable requirements in ASHRAE/IESNA 90.1.
3. ASME Compliance: Where indicated, fabricate and label commercial water heater storage tanks to comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.
4. Comply with NSF 61, "Drinking Water System Components - Health Effects; Sections 1 through 9," for all components that will be in contact with potable water.

E. Warranty

1. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of electric water heaters that fail in materials or workmanship within specified warranty period.
 - a. Failures include, but are not limited to, the following:
 - 1) Structural failures including storage tank and supports.

- 2) Faulty operation of controls.
- 3) Deterioration of metals, metal finishes, and other materials beyond normal use.
- b. Warranty Period(s): From date of Final Completion:
 - 1) Household Electric Water Heaters:
 - a) Storage Tank: Five **OR** Six **OR** 10, **as directed**, years.
 - b) Controls and Other Components: Two **OR** Three, **as directed**, years.
 - 2) Instantaneous Electric Water Heaters: One **OR** Two **OR** Five, **as directed**, year(s).
 - 3) Light-Commercial Electric Water Heaters:
 - a) Storage Tank: Three **OR** Five, **as directed**, years.
 - b) Controls and Other Components: Two **OR** Three, **as directed**, years.
 - 4) Commercial Electric Water Heaters:
 - a) Storage Tank: Three **OR** Five, **as directed**, years.
 - b) Controls and Other Components: Three **OR** Five, **as directed**, years.
 - 5) Compression Tanks: One year.

1.2 PRODUCTS

A. Household Electric Water Heaters

1. Household, Small-Capacity Electric Water Heaters: Comply with UL 174.
 - a. Storage-Tank Construction: Corrosion-resistant metal or steel with corrosion-resistant coating, **as directed**.
 - 1) Tappings: ASME B1.20.1 pipe thread.
 - 2) Pressure Rating: **150 psig (1035 kPa)**.
 - 3) Interior Finish: Comply with NSF 61 barrier materials for potable-water tank linings, including extending lining material into tappings.
 - b. Factory-Installed Storage-Tank Appurtenances:
 - 1) Drain Valve: ASSE 1005, if tank has drain outlet. Provide hose-end drain valve in piping for water heaters without drain outlet. Hose-end drain valves are specified in Division 22 Section "Domestic Water Piping Specialties".
 - 2) Insulation: Comply with ASHRAE/IESNA 90.1 or ASHRAE 90.2, **as directed**.
 - 3) Jacket: Steel with enameled finish.
 - 4) Heating Element: Electric, screw-in immersion type.
 - 5) Temperature Control: Adjustable thermostat.
 - 6) Safety Control: High-temperature-limit cutoff device or system.
 - 7) Power Supply Cord: **24 to 72 inches (610 to 1830 mm)** with plug.
 - 8) Relief Valve: ASME rated and stamped and complying with ASME PTC 25.3 for combination temperature and pressure relief valves. Include relieving capacity at least as great as heat input, and include pressure setting less than water heater working-pressure rating. Select relief valve with sensing element that extends into storage tank.
2. Household, Standard **OR** Tabletop, **as directed**, Storage Electric Water Heaters: Comply with UL 174.
 - a. Storage-Tank Construction: Steel.
 - 1) Tappings: ASME B1.20.1 pipe thread.
 - 2) Pressure Rating: **150 psig (1035 kPa)**.
 - 3) Interior Finish: Comply with NSF 61 barrier materials for potable-water tank linings, including extending lining material into tappings.
 - b. Factory-Installed Storage-Tank Appurtenances:
 - 1) Anode Rod: Replaceable magnesium.
 - 2) Dip Tube: Provide unless cold-water inlet is near bottom of tank.
 - 3) Drain Valve: ASSE 1005.
 - 4) Insulation: Comply with ASHRAE/IESNA 90.1 or ASHRAE 90.2, **as directed**.
 - 5) Jacket: Steel with enameled finish.
 - a) Standard: Cylindrical shape.

- b) Tabletop: Rectangular shape, with flat-top work surface and raised back.
 - 6) Heat Trap Fittings: Inlet type in cold-water inlet and outlet type in hot-water outlet.
 - 7) Heating Elements: Two; electric, screw-in immersion type with 12 kW or less total, and wired for nonsimultaneous operation, unless otherwise indicated.
 - 8) Temperature Control: Adjustable thermostat for each element.
 - 9) Safety Control: High-temperature-limit cutoff device or system.
 - 10) Relief Valve: ASME rated and stamped and complying with ASME PTC 25.3 for combination temperature and pressure relief valves. Include relieving capacity at least as great as heat input, and include pressure setting less than water heater working-pressure rating. Select relief valve with sensing element that extends into storage tank.
- 3. Household, Collector-to-Tank, Solar-Electric Water Heaters: Comply with UL 174 with piping and electrical connections for UL 1279 solar collector system.
 - a. Storage-Tank Construction: Steel.
 - 1) Tappings: ASME B1.20.1 pipe thread.
 - 2) Pressure Rating: 150 psig (1035 kPa).
 - 3) Interior Finish: Comply with NSF 61 barrier materials for potable-water tank linings, including extending lining material into tappings.
 - b. Factory-Installed Storage-Tank Appurtenances:
 - 1) Sensor electrical connections and tank stud for sensor.
 - 2) Anode Rod: Replaceable magnesium.
 - 3) Dip Tube: Provide unless cold-water inlet is near bottom of tank.
 - 4) Drain Valve: ASSE 1005.
 - 5) Insulation: Comply with ASHRAE/IESNA 90.1 or ASHRAE 90.2, **as directed**.
 - 6) Jacket: Steel with enameled finish.
 - 7) Heat Trap Fittings: Inlet type in cold-water inlet and outlet type in hot-water outlet.
 - 8) Heating Element: One; electric, screw-in immersion type with 6 kW or less.
 - 9) Temperature Control: Adjustable thermostat for each element.
 - 10) Safety Control: High-temperature-limit cutoff device or system.
 - 11) Relief Valve: ASME rated and stamped and complying with ASME PTC 25.3 for combination temperature and pressure relief valves. Include relieving capacity at least as great as heat input, and include pressure setting less than water heater working-pressure rating. Select relief valve with sensing element that extends into storage tank.
- 4. Household, Collector-to-Tank, Heat-Exchanger-Coil, Solar-Electric Water Heaters: Comply with UL 174 with integral coil-type heat exchanger.
 - a. Storage-Tank Construction: Steel.
 - 1) Tappings: ASME B1.20.1 pipe thread.
 - 2) Pressure Rating: 150 psig (1035 kPa).
 - 3) Interior Finish: Comply with NSF 61 barrier materials for potable-water tank linings, including extending lining material into tappings.
 - b. Factory-Installed Storage-Tank Appurtenances:
 - 1) Anode Rod: Replaceable magnesium.
 - 2) Dip Tube: Provide unless cold-water inlet is near bottom of tank.
 - 3) Drain Valve: ASSE 1005.
 - 4) Insulation: Comply with ASHRAE/IESNA 90.1 or ASHRAE 90.2, **as directed**.
 - 5) Jacket: Steel with enameled finish.
 - 6) Heat Trap Fittings: Inlet type in cold-water inlet and outlet type in hot-water outlet.
 - 7) Heat Exchanger: Corrosion-resistant-metal immersion coil.
 - 8) Heating Element: One; electric, screw-in immersion type with 6 kW or less.
 - 9) Temperature Control: Adjustable thermostat for each element.
 - 10) Safety Control: High-temperature-limit cutoff device or system.
 - 11) Relief Valve: ASME rated and stamped and complying with ASME PTC 25.3 for combination temperature and pressure relief valves. Include relieving capacity at least as great as heat input, and include pressure setting less than water heater

working-pressure rating. Select relief valve with sensing element that extends into storage tank.

B. Instantaneous Electric Water Heaters

1. Flow-Control, Instantaneous Electric Water Heaters: Comply with UL 499 for tankless electric (water heater) heating appliance.
 - a. Construction: Copper piping or tubing complying with NSF 61 barrier materials for potable water, without storage capacity.
 - 1) Connections: ASME B1.20.1 pipe thread.
 - 2) Pressure Rating: **150 psig (1035 kPa)**.
 - 3) Heating Element: Resistance heating system.
 - 4) Temperature Control: Flow-control fitting.
 - 5) Safety Control: High-temperature-limit cutoff device or system.
 - 6) Jacket: Aluminum or steel with enameled finish or plastic.
 - b. Support: Bracket for wall mounting.
2. Thermostat-Control, Instantaneous Electric Water Heaters: Comply with UL 499 for tankless electric (water heater) heating appliance.
 - a. Construction: Copper piping or tubing complying with NSF 61 barrier materials for potable water, without storage capacity.
 - 1) Connections: ASME B1.20.1 pipe thread.
 - 2) Pressure Rating: **150 psig (1035 kPa)**.
 - 3) Heating Element: Resistance heating system.
 - 4) Temperature Control: Thermostat.
 - 5) Safety Control: High-temperature-limit cutoff device or system.
 - 6) Jacket: Aluminum or steel with enameled finish or plastic.
 - b. Support: Bracket for wall mounting.

C. Light-Commercial Electric Water Heaters

1. Description: Comply with UL 174 for household, storage electric water heaters.
 - a. Storage-Tank Construction: Steel, vertical arrangement.
 - 1) Tappings: ASME B1.20.1 pipe thread.
 - 2) Pressure Rating: **150 psig (1035 kPa)**.
 - 3) Interior Finish: Comply with NSF 61 barrier materials for potable-water tank linings, including extending lining material into tappings.
 - b. Factory-Installed Storage-Tank Appurtenances:
 - 1) Anode Rod: Replaceable magnesium.
 - 2) Dip Tube: Provide unless cold-water inlet is near bottom of tank.
 - 3) Drain Valve: ASSE 1005.
 - 4) Insulation: Comply with ASHRAE/IESNA 90.1 or ASHRAE 90.2, **as directed**.
 - 5) Jacket: Steel with enameled finish.
 - 6) Heat Trap Fittings: Inlet type in cold-water inlet and outlet type in hot-water outlet.
 - 7) Heating Elements: Two; electric, screw-in immersion type; wired for simultaneous operation, unless otherwise indicated.
 - 8) Temperature Control: Adjustable thermostat for each element.
 - 9) Safety Control: High-temperature-limit cutoff device or system.
 - 10) Relief Valve: ASME rated and stamped and complying with ASME PTC 25.3 for combination temperature and pressure relief valves. Include relieving capacity at least as great as heat input, and include pressure setting less than water heater working-pressure rating. Select relief valve with sensing element that extends into storage tank.
 - c. Special Requirements: NSF 5 construction with legs for off-floor installation.

D. Commercial Electric Water Heaters

1. Commercial Electric Booster Heaters: Comply with UL 1453 requirements for booster-type water heaters.

- a. Storage-Tank Construction: Corrosion-resistant metal **OR** Steel, **as directed**.
 - 1) Tappings: ASME B1.20.1 pipe thread.
 - 2) Pressure Rating: **150 psig (1035 kPa)**.
 - 3) Interior Finish: Comply with NSF 61 barrier materials for potable-water tank linings, including extending lining material into tappings.
 - b. Factory-Installed Storage-Tank Appurtenances:
 - 1) Anode Rod: Replaceable magnesium.
 - 2) Drain Valve: Corrosion-resistant metal complying with ASSE 1005.
 - 3) Insulation: Comply with ASHRAE/IESNA 90.1.
 - 4) Jacket: Rectangular shaped, with stainless-steel front panel, unless otherwise indicated.
 - 5) Heating Elements: Electric, screw-in or bolt-on immersion type arranged in multiples of three.
 - a) Option: Booster heaters with 9 kW or less total may have 2 or 3 elements.
 - b) Staging: Input not exceeding 18 kW per step.
 - 6) Temperature Control: Adjustable thermostat, to setting of at least **180 deg F (82 deg C)**.
 - 7) Safety Controls: High-temperature-limit and low-water cutoff devices or systems.
 - 8) Relief Valve: ASME rated and stamped and complying with ASME PTC 25.3, combination temperature and pressure relief valve. Include relieving capacity at least as great as heat input, and include pressure setting less than water heater working-pressure rating. Select relief valve with sensing element that extends into storage tank.
 - 9) Gages: Combination temperature and pressure type or separate thermometer and pressure gage.
 - c. Special Requirements: NSF 5 construction with brackets for undercounter **OR** legs for floor, **as directed**, installation.
2. Commercial, Storage Electric Water Heaters: Comply with UL 1453 requirements for storage-tank-type water heaters.
- a. Storage-Tank Construction: ASME-code **OR** Non-ASME-code, **as directed**, steel horizontal **OR** vertical, **as directed**, arrangement.
 - 1) Tappings: Factory fabricated of materials compatible with tank and piping connections. Attach tappings to tank before testing.
 - a) **NPS 2 (DN 50)** and Smaller: Threaded ends according to ASME B1.20.1.
 - b) **NPS 2-1/2 (DN 65)** and Larger: Flanged ends according to ASME B16.5 for steel and stainless-steel flanges, and according to ASME B16.24 for copper and copper-alloy flanges.
 - 2) Pressure Rating: **150 psig (1035 kPa)**.
 - 3) Interior Finish: Comply with NSF 61 barrier materials for potable-water tank linings, including extending lining material into tappings.
 - b. Factory-Installed Storage-Tank Appurtenances:
 - 1) Anode Rod: Replaceable magnesium.
 - 2) Drain Valve: Corrosion-resistant metal complying with ASSE 1005.
 - 3) Insulation: Comply with ASHRAE/IESNA 90.1.
 - 4) Jacket: Steel with enameled finish.
 - 5) Heating Elements: Electric, screw-in or bolt-on immersion type arranged in multiples of three.
 - a) Staging: Input not exceeding 18 kW per step.
 - 6) Temperature Control: Adjustable thermostat.
 - 7) Safety Controls: High-temperature-limit and low-water cutoff devices or systems.
 - 8) Relief Valves: ASME rated and stamped and complying with ASME PTC 25.3, for combination temperature and pressure relief valves. Include one or more relief valves with total relieving capacity at least as great as heat input, and include pressure setting less than water heater working-pressure rating. Select one relief valve with sensing element that extends into storage tank.
 - c. Special Requirements: NSF 5 construction.



- d. Building Automation System Interface: Normally closed dry contacts for enabling and disabling water heater.

E. Compression Tanks

1. Description: Steel pressure-rated tank constructed with welded joints and factory-installed butyl-rubber diaphragm. Include air precharge to minimum system-operating pressure at tank.
 - a. Construction:
 - 1) Tappings: Factory-fabricated steel, welded to tank before testing and labeling. Include ASME B1.20.1, pipe thread.
 - 2) Interior Finish: Comply with NSF 61 barrier materials for potable-water tank linings, including extending finish into and through tank fittings and outlets.
 - 3) Air-Charging Valve: Factory installed.

F. Water Heater Accessories

1. Combination Temperature and Pressure Relief Valves: ASME rated and stamped and complying with ASME PTC 25.3. Include relieving capacity at least as great as heat input, and include pressure setting less than water heater working-pressure rating. Select relief valves with sensing element that extends into storage tank.
2. Pressure Relief Valves: ASME rated and stamped and complying with ASME PTC 25.3. Include pressure setting less than water heater working-pressure rating.
3. Water Heater Stand and Drain-Pan Units: High-density-polyethylene-plastic, 18-inch- (457-mm-) high, enclosed-base stand complying with IAPMO PS 103 and IAS No. 2. Include integral or separate drain pan with raised edge and NPS 1 (DN 25) drain outlet with ASME B1.20.1 pipe thread.
4. Water Heater Stands: Water heater manufacturer's factory-fabricated steel stand for floor mounting and capable of supporting water heater and water. Include dimension that will support bottom of water heater a minimum of 18 inches (457 mm) above the floor.
5. Water Heater Mounting Brackets: Water heater manufacturer's factory-fabricated steel bracket for wall mounting and capable of supporting water heater and water.
6. Drain Pans: Corrosion-resistant metal with raised edge. Include dimensions not less than base of water heater and include drain outlet not less than NPS 3/4 (DN 20).
7. Piping Manifold Kits: Water heater manufacturer's factory-fabricated inlet and outlet piping arrangement for multiple-unit installation. Include piping and valves for field assembly that are capable of isolating each water heater and of providing balanced flow through each water heater.
8. Piping-Type Heat Traps: Field-fabricated piping arrangement according to ASHRAE/IESNA 90.1 or ASHRAE 90.2, **as directed**.
9. Water Regulators: ASSE 1003, water-pressure reducing valve. Set at 25-psig- (172.5-kPa-) maximum outlet pressure, unless otherwise indicated.
10. Shock Absorbers: ASSE 1010 or PDI WH 201, Size A water hammer arrester.

G. Source Quality Control

1. Test and inspect water heater storage tanks, specified to be ASME-code construction, according to ASME Boiler and Pressure Vessel Code.
2. Hydrostatically test commercial, **as directed**, water heater storage tanks before shipment to minimum of one and one-half times pressure rating.
3. Prepare test reports.

1.3 EXECUTION

A. Water Heater Installation

1. Install commercial water heaters on concrete bases.
 - a. Exception: Omit concrete bases for commercial water heaters if installation on stand, bracket, suspended platform, or direct on floor is indicated.

- b. Concrete base construction requirements are specified in Division 22 Section "Common Work Results For Plumbing".
 2. Install water heaters level and plumb, according to layout drawings, original design, and referenced standards. Maintain manufacturer's recommended clearances. Arrange units so controls and devices needing service are accessible.
 3. Install seismic restraints for light-commercial and commercial water heaters. Anchor to substrate.
 4. Install combination temperature and pressure relief valves in top portion of storage tanks. Use relief valves with sensing elements that extend into tanks. Extend commercial-water-heater relief-valve outlet, with drain piping same as domestic water piping in continuous downward pitch, and discharge by positive air gap onto closest floor drain.
 5. Install combination temperature and pressure relief valves in water piping for water heaters without storage. Extend commercial-water-heater relief-valve outlet, with drain piping same as domestic water piping in continuous downward pitch, and discharge by positive air gap onto closest floor drain.
 6. Install water-heater drain piping as indirect waste to spill by positive air gap into open drains or over floor drains. Install hose-end drain valves at low points in water piping for water heaters that do not have tank drains. Refer to Division 22 Section "Domestic Water Piping Specialties" for hose-end drain valves.
 7. Install thermometer on outlet piping of water heaters. Refer to Division 22 Section "Meters And Gages For Plumbing Piping" for thermometers.
 8. Install thermometers on inlet and outlet piping of household, collector-to-tank, solar-electric water heaters. Refer to Division 22 Section "Meters And Gages For Plumbing Piping" for thermometers.
 9. Install pressure gage(s) on inlet and outlet of commercial electric water- heater piping. Refer to Division 22 Section "Meters And Gages For Plumbing Piping" for pressure gages.
 10. Assemble and install inlet and outlet piping manifold kits for multiple water heaters. Fabricate, modify, or arrange manifolds for balanced water flow through each water heater. Include shutoff valve, thermometer in each water heater inlet and outlet, and throttling valve in each water heater outlet. Refer to Division 22 Section "General-duty Valves For Plumbing Piping" for general-duty valves and to Division 22 Section "Meters And Gages For Plumbing Piping" for thermometers.
 11. Install water regulator, with integral bypass relief valve, in booster-heater inlet piping and water hammer arrester in booster-heater outlet piping.
 12. Install piping-type heat traps on inlet and outlet piping of water heater storage tanks without integral or fitting-type heat traps.
 13. Fill water heaters with water.
 14. Charge compression tanks with air.
- B. Connections
 1. Piping installation requirements are specified in other Division 14. Drawings indicate general arrangement of piping, fittings, and specialties.
 2. Install piping adjacent to water heaters to allow service and maintenance. Arrange piping for easy removal of water heaters.
 3. Ground equipment according to Division 26 Section "Grounding And Bonding For Electrical Systems".
 4. Connect wiring according to Division 26 Section "Low-voltage Electrical Power Conductors And Cables".
- C. Field Quality Control
 1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust field-assembled components and equipment installation, including connections, and to assist in field testing. Report results in writing.
 2. Perform the following field tests and inspections and prepare test reports:
 - a. Leak Test: After installation, test for leaks. Repair leaks and retest until no leaks exist.
 - b. Operational Test: After electrical circuitry has been energized, confirm proper operation.
 - c. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.



3. Remove and replace water heaters that do not pass tests and inspections and retest as specified above.

D. Demonstration

1. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain commercial and instantaneous electric water heaters.

END OF SECTION 22 12 23 13

NOT FOR BID

SECTION 22 12 23 13a - FUEL-FIRED, DOMESTIC WATER HEATERS

1.1 GENERAL

A. Description Of Work

1. This specification covers the furnishing and installation of materials for fuel-fired water heaters. Products shall be as follows or as directed by the Owner. Installation procedures shall be in accordance with the product manufacturer's recommendations. Demolition and removal of materials shall be as required to support the work.

B. Summary

1. This Section includes the following fuel-fired water heaters:
 - a. Household, atmospheric, storage, gas water heaters.
 - b. Household, direct-vent, storage, gas water heaters.
 - c. Household, power-vent, storage, gas water heaters.
 - d. Instantaneous, tankless, gas water heaters.
 - e. Commercial, atmospheric, storage, gas water heaters.
 - f. Commercial, power-burner, storage, gas water heaters.
 - g. Commercial, power-vent, storage, gas water heaters.
 - h. Commercial, high-efficiency, gas water heaters.
 - i. Commercial, coil-type, finned-tube, gas water heaters.
 - j. Commercial, grid-type, finned-tube, gas water heaters.
 - k. Household, oil-fired water heaters.
 - l. Commercial, oil-fired water heaters.
 - m. Large-capacity, oil-fired water heaters.
 - n. Dual-fuel, gas and oil-fired water heaters.
 - o. Compression tanks.
 - p. Water heater accessories.

C. Definitions

1. LP Gas: Liquefied-petroleum fuel gas.

D. Submittals

1. Product Data: For each type and size of water heater indicated. Include rated capacities, operating characteristics, furnished specialties, and accessories.
2. LEED Submittal:
 - a. Product Data for Prerequisite EA 2: Documentation indicating that units comply with ASHRAE/IESNA 90.1, Section 7 - "Service Water Heating."
3. Shop Drawings: Diagram power, signal, and control wiring.
4. Manufacturer Seismic Qualification Certification: Submit certification that commercial water heaters, accessories, and components will withstand seismic forces defined in Division 22 Section "Vibration And Seismic Controls For Plumbing Piping And Equipment". Include the following:
 5. Field quality-control test reports.
 6. Operation and maintenance data.
7. Warranty: Special warranty specified in this Section.

E. Quality Assurance

1. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
2. ASHRAE/IESNA 90.1 Compliance: Applicable requirements in ASHRAE/IESNA 90.1.
3. ASME Compliance:

- a. Where ASME-code construction is indicated, fabricate and label commercial water heater storage tanks to comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.
- b. Where ASME-code construction is indicated, fabricate and label commercial, finned-tube water heaters to comply with ASME Boiler and Pressure Vessel Code: Section IV.
- 4. Comply with NSF 61, "Drinking Water System Components - Health Effects; Sections 1 through 9" for all components that will be in contact with potable water.

F. Warranty

- 1. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of fuel-fired water heaters that fail in materials or workmanship within specified warranty period.
 - a. Failures include, but are not limited to, the following:
 - 1) Structural failures including storage tank and supports.
 - 2) Faulty operation of controls.
 - 3) Deterioration of metals, metal finishes, and other materials beyond normal use.
 - b. Warranty Period(s): From date of Final Completion:
 - 1) Household, Gas Water Heaters:
 - a) Storage Tank: Five **OR** Six **OR** 10, **as directed**, years.
 - b) Controls and Other Components: Two **OR** Three, **as directed**, years.
 - 2) Instantaneous, Gas Water Heaters:
 - a) Heat Exchanger: Five years.
 - b) Controls and Other Components: Three years.
 - 3) Commercial, Gas Water Heaters:
 - a) Storage Tank: Three **OR** Five, **as directed**, years.
 - b) Controls and Other Components: Three **OR** Five, **as directed**, years.
 - 4) Oil-Fired Water Heaters:
 - a) Storage Tank: Three **OR** Five, **as directed**, years.
 - b) Burner and Controls: One **OR** Two **OR** Three, **as directed**, year(s).
 - c) Other Components: Three **OR** Five, **as directed**, years.
 - 5) Dual-Fuel Water Heaters:
 - a) Storage Tank: Three **OR** Five, **as directed**, years.
 - b) Burner and Controls: One **OR** Two **OR** Three, **as directed**, year(s).
 - c) Other Components: Three **OR** Five, **as directed**, years.
 - 6) Compression Tanks: One year.

1.2 PRODUCTS

A. Household, Gas Water Heaters

- 1. Household, Atmospheric, Storage, Gas Water Heaters: Comply with ANSI Z21.10.1/CSA 4.1.
 - a. Storage-Tank Construction: Steel.
 - 1) Tappings: ASME B1.20.1 pipe thread.
 - 2) Pressure Rating: 150 psig (1035 kPa).
 - 3) Interior Finish: Comply with NSF 61 barrier materials for potable-water tank linings, including extending lining material into tappings.
 - b. Factory-Installed, Storage-Tank Appurtenances:
 - 1) Anode Rod: Replaceable magnesium.
 - 2) Dip Tube: Provide unless cold-water inlet is near bottom of tank.
 - 3) Drain Valve: ASSE 1005.
 - 4) Insulation: Comply with ASHRAE/IESNA 90.1 or ASHRAE 90.2, **as directed**.
 - 5) Jacket: Steel with enameled finish.
 - 6) Burner: For use with atmospheric water heaters and for natural-gas **OR** LP-gas, **as directed**, fuel.
 - 7) Automatic Ignition: ANSI Z21.20, electric, automatic, gas-ignition system.

- 8) Temperature Control: Adjustable thermostat.
- 9) Heat Trap Fittings: Inlet type in cold-water inlet and outlet type in hot-water outlet.
- 10) Combination Temperature and Pressure Relief Valve: ANSI Z21.22/CSA 4.4. Include relieving capacity at least as great as heat input, and include pressure setting less than water heater working-pressure rating. Select relief valve with sensing element that extends into storage tank.
- c. Draft Hood: Low-profile-type, draft diverter; complying with ANSI Z21.12.
- d. Automatic Damper: ANSI Z21.66, electrically operated **OR** mechanically activated **OR** thermally activated, **as directed**, automatic-vent-damper device with size matching draft hood.
2. Household, Direct-Vent, Storage, Gas Water Heaters: Comply with ANSI Z21.10.1/CSA 4.1.
 - a. Storage-Tank Construction: Steel.
 - 1) Tappings: ASME B1.20.1 pipe thread.
 - 2) Pressure Rating: **150 psig (1035 kPa)**.
 - 3) Interior Finish: Comply with NSF 61 barrier materials for potable-water tank linings, including extending lining material into tappings.
 - b. Factory-Installed, Storage-Tank Appurtenances:
 - 1) Anode Rod: Replaceable magnesium.
 - 2) Dip Tube: Provide unless cold-water inlet is near bottom of tank.
 - 3) Drain Valve: ASSE 1005.
 - 4) Insulation: Comply with ASHRAE/IESNA 90.1 or ASHRAE 90.2, **as directed**.
 - 5) Jacket: Steel with enameled finish.
 - 6) Burner: For use with direct-vent water heaters and for natural-gas **OR** LP-gas, **as directed**, fuel.
 - 7) Automatic Ignition: ANSI Z21.20, electric, automatic, gas-ignition system.
 - 8) Temperature Control: Adjustable thermostat.
 - 9) Heat Trap Fittings: Inlet type in cold-water inlet and outlet type in hot-water outlet.
 - 10) Combination Temperature and Pressure Relief Valve: ANSI Z21.22/CSA 4.4. Include relieving capacity at least as great as heat input, and include pressure setting less than water heater working-pressure rating. Select relief valve with sensing element that extends into storage tank.
 - c. Direct-Vent System: Through-wall **OR** Through-roof, **as directed**, coaxial- or double-channel, vent assembly with water heater manufacturers' outside intake/exhaust screen.
3. Household, Power-Vent, Storage, Gas Water Heaters: Comply with ANSI Z21.10.1/CSA 4.1.
 - a. Storage-Tank Construction: Steel.
 - 1) Tappings: ASME B1.20.1 pipe thread.
 - 2) Pressure Rating: **150 psig (1035 kPa)**.
 - 3) Interior Finish: Comply with NSF 61 barrier materials for potable-water tank linings, including extending lining material into tappings.
 - b. Factory-Installed, Storage-Tank Appurtenances:
 - 1) Anode Rod: Replaceable magnesium.
 - 2) Dip Tube: Provide unless cold-water inlet is near bottom of tank.
 - 3) Drain Valve: ASSE 1005.
 - 4) Insulation: Comply with ASHRAE/IESNA 90.1 or ASHRAE 90.2, **as directed**.
 - 5) Jacket: Steel with enameled finish.
 - 6) Burner: For use with power-vent water heaters and for natural-gas **OR** LP-gas, **as directed**, fuel.
 - 7) Automatic Ignition: ANSI Z21.20, electric, automatic, gas-ignition system.
 - 8) Temperature Control: Adjustable thermostat.
 - 9) Heat Trap Fittings: Inlet type in cold-water inlet and outlet type in hot-water outlet.
 - 10) Combination Temperature and Pressure Relief Valve: ANSI Z21.22/CSA 4.4. Include relieving capacity at least as great as heat input, and include pressure setting less than water heater working-pressure rating. Select relief valve with sensing element that extends into storage tank.
 - c. Power-Vent System: Exhaust fan, interlocked with burner.



B. Instantaneous, Gas Water Heaters

1. Description: Comply with ANSI Z21.10.3/CSA 4.3, except storage is not required.
 - a. Construction: Copper piping or tubing complying with NSF 61 barrier materials for potable water, without storage capacity.
 - 1) Tappings: ASME B1.20.1 pipe thread.
 - 2) Pressure Rating: **150 psig (1035 kPa)**.
 - 3) Heat Exchanger: Copper tubing.
 - 4) Insulation: Comply with ASHRAE/IESNA 90.1 or ASHRAE 90.2, **as directed**.
 - 5) Burner: For use with tankless water heaters and for natural-gas **OR** LP-gas, **as directed**, fuel.
 - 6) Automatic Ignition: Manufacturer's proprietary system for automatic, gas ignition.
 - 7) Temperature Control: Adjustable thermostat.
 - 8) Jacket: Metal with enameled finish or plastic.
 - b. Support: Bracket for wall mounting.

C. Commercial, Gas Water Heaters

1. Commercial, Atmospheric, Storage, Gas Water Heaters: Comply with ANSI Z21.10.3/CSA 4.3.
 - a. Storage-Tank Construction: ASME-code **OR** Non-ASME-code, **as directed**, steel with **150-psig (1035-kPa)** working-pressure rating.
 - 1) Tappings: Factory fabricated of materials compatible with tank. Attach tappings to tank before testing.
 - a) **NPS 2 (DN 50)** and Smaller: Threaded ends according to ASME B1.20.1.
 - b) **NPS 2-1/2 (DN 65)** and Larger: Flanged ends according to ASME B16.5 for steel and stainless-steel flanges, and according to ASME B16.24 for copper and copper-alloy flanges.
 - 2) Interior Finish: Comply with NSF 61 barrier materials for potable-water tank linings, including extending finish into and through tank fittings and outlets.
 - 3) Lining: Cement **OR** Glass **OR** Nickel plate **OR** Phenolic coating **OR** Sheet copper, **as directed**, complying with NSF 61 barrier materials for potable-water tank linings, including extending lining into and through tank fittings and outlets.
 - b. Factory-Installed, Storage-Tank Appurtenances:
 - 1) Anode Rod: Replaceable magnesium.
 - 2) Dip Tube: Provide unless cold-water inlet is near bottom of tank.
 - 3) Drain Valve: Corrosion-resistant metal complying with ASSE 1005.
 - 4) Insulation: Comply with ASHRAE/IESNA 90.1. Surround entire storage tank except connections and controls.
 - 5) Jacket: Steel with enameled finish.
 - 6) Burner: For use with atmospheric water heaters and for natural-gas **OR** LP-gas, **as directed**, fuel.
 - 7) Automatic Ignition: ANSI Z21.20, electric, automatic, gas-ignition system.
 - 8) Temperature Control: Adjustable thermostat.
 - 9) Safety Controls: Automatic, high-temperature-limit and low-water cutoff devices or systems.
 - 10) Combination Temperature and Pressure Relief Valves: ANSI Z21.22/CSA 4.4. Include one or more relief valves with total relieving capacity at least as great as heat input, and include pressure setting less than water heater working-pressure rating. Select one relief valve with sensing element that extends into storage tank.
 - c. Special Requirements: NSF 5 construction.
 - d. Draft Hood: Draft diverter; complying with ANSI Z21.12.
 - e. Automatic Damper: ANSI Z21.66, electrically operated **OR** mechanically activated **OR** thermally activated, **as directed**, automatic-vent-damper device with size matching draft hood.
 - f. Building Automation System Interface: Normally closed dry contacts for enabling and disabling water heater.
2. Commercial, Power-Burner, Storage, Gas Water Heaters: Comply with ANSI Z21.10.3/CSA 4.3.

- a. Storage-Tank Construction: ASME-code **OR** Non-ASME-code, **as directed**, steel with **150-psig (1035-kPa)** working-pressure rating.
 - 1) Tappings: Factory fabricated of materials compatible with tank. Attach tappings to tank before testing.
 - a) **NPS 2 (DN 50)** and Smaller: Threaded ends according to ASME B1.20.1.
 - b) **NPS 2-1/2 (DN 65)** and Larger: Flanged ends according to ASME B16.5 for steel and stainless-steel flanges, and according to ASME B16.24 for copper and copper-alloy flanges.
 - 2) Interior Finish: Comply with NSF 61 barrier materials for potable-water tank linings, including extending finish into and through tank fittings and outlets.
 - 3) Lining: Cement **OR** Glass **OR** Nickel plate **OR** Phenolic coating **OR** Sheet copper, **as directed**, complying with NSF 61 barrier materials for potable-water tank linings, including extending lining into and through tank fittings and outlets.
 - b. Factory-Installed, Storage-Tank Appurtenances:
 - 1) Anode Rod: Replaceable magnesium.
 - 2) Dip Tube: Provide unless cold-water inlet is near bottom of tank.
 - 3) Drain Valve: Corrosion-resistant metal complying with ASSE 1005.
 - 4) Insulation: Comply with ASHRAE/IESNA 90.1. Surround entire storage tank except connections and controls.
 - 5) Jacket: Steel with enameled finish.
 - 6) Combination Temperature and Pressure Relief Valves: ANSI Z21.22/CSA 4.4. Include one or more relief valves with total relieving capacity at least as great as heat input, and include pressure setting less than water heater working-pressure rating. Select one relief valve with sensing element that extends into storage tank.
 - c. Burner: Comply with UL 795 for power-burner water heaters and for natural-gas **OR** LP-gas, **as directed**, fuel.
 - 1) Automatic Ignition: ANSI Z21.20, electric, automatic, gas-ignition system.
 - d. Temperature Control: Adjustable thermostat.
 - e. Safety Controls: Automatic, high-temperature-limit and low-water cutoff devices or systems.
 - f. Special Requirements: NSF 5 construction.
 - g. Draft Hood: Draft diverter, complying with ANSI Z21.12.
 - h. Building Automation System Interface: Normally closed dry contacts for enabling and disabling water heater.
3. Commercial, Power-Vent, Storage, Gas Water Heaters: Comply with ANSI Z21.10.3/CSA 4.3.
 - a. Storage-Tank Construction: ASME-code **OR** Non-ASME-code, **as directed**, steel with **150-psig (1035-kPa)** working-pressure rating.
 - 1) Tappings: Factory fabricated of materials compatible with tank. Attach tappings to tank before testing.
 - a) **NPS 2 (DN 50)** and Smaller: Threaded ends according to ASME B1.20.1.
 - b) **NPS 2-1/2 (DN 65)** and Larger: Flanged ends according to ASME B16.5 for steel and stainless-steel flanges, and according to ASME B16.24 for copper and copper-alloy flanges.
 - 2) Interior Finish: Comply with NSF 61 barrier materials for potable-water tank linings, including extending finish into and through tank fittings and outlets.
 - 3) Lining: Cement **OR** Glass **OR** Nickel plate **OR** Phenolic coating **OR** Sheet copper, **as directed**, complying with NSF 61 barrier materials for potable-water tank linings, including extending lining into and through tank fittings and outlets.
 - b. Factory-Installed, Storage-Tank Appurtenances:
 - 1) Anode Rod: Replaceable magnesium.
 - 2) Dip Tube: Provide unless cold-water inlet is near bottom of tank.
 - 3) Drain Valve: Corrosion-resistant metal complying with ASSE 1005.
 - 4) Insulation: Comply with ASHRAE/IESNA 90.1. Surround entire storage tank except connections and controls.
 - 5) Jacket: Steel with enameled finish.



- 6) Burner: For use with power-vent water heaters and for natural-gas **OR** LP-gas, **as directed**, fuel.
- 7) Automatic Ignition: ANSI Z21.20, electric, automatic, gas-ignition system.
- 8) Temperature Control: Adjustable thermostat.
- 9) Safety Controls: Automatic, high-temperature-limit and low-water cutoff devices or systems.
- 10) Combination Temperature and Pressure Relief Valves: ANSI Z21.22/CSA 4.4. Include one or more relief valve with total relieving capacity at least as great as heat input, and include pressure setting less than water heater working-pressure rating. Select one relief valve with sensing element that extends into storage tank.
- c. Special Requirements: NSF 5 construction.
- d. Power-Vent System: Exhaust fan, interlocked with burner.
- e. Building Automation System Interface: Normally closed dry contacts for enabling and disabling water heater.
4. Commercial, High-Efficiency, Gas Water Heaters: Comply with ANSI Z21.10.3/CSA 4.3.
 - a. Description: Manufacturer's proprietary design to provide at least 84 **OR** 85 **OR** 88 **OR** 95, **as directed**, percent combustion efficiency at optimum operating conditions. Following features and attributes may be modified or omitted if water heater otherwise complies with requirements for performance.
 - b. Storage-Tank Construction: ASME-code steel with 150-psig (1035-kPa) minimum working-pressure rating.
 - 1) Tappings: Factory fabricated of materials compatible with tank. Attach tappings to tank before testing.
 - a) NPS 2 (DN 50) and Smaller: Threaded ends according to ASME B1.20.1.
 - b) NPS 2-1/2 (DN 65) and Larger: Flanged ends according to ASME B16.5 for steel and stainless-steel flanges, and according to ASME B16.24 for copper and copper-alloy flanges.
 - 2) Interior Finish: Comply with NSF 61 barrier materials for potable-water tank linings, including extending finish into and through tank fittings and outlets.
 - 3) Lining: Cement **OR** Glass **OR** Nickel plate **OR** Phenolic coating **OR** Sheet copper, **as directed**, complying with NSF 61 barrier materials for potable-water tank linings, including extending lining into and through tank fittings and outlets.
 - c. Factory-Installed, Storage-Tank Appurtenances:
 - 1) Anode Rod: Replaceable magnesium.
 - 2) Dip Tube: Provide unless cold-water inlet is near bottom of tank.
 - 3) Drain Valve: Corrosion-resistant metal complying with ASSE 1005.
 - 4) Insulation: Comply with ASHRAE/IESNA 90.1. Surround entire storage tank except connections and controls.
 - 5) Jacket: Steel with enameled finish.
 - 6) Combination Temperature and Pressure Relief Valves: ANSI Z21.22/CSA 4.4. Include one or more relief valves with total relieving capacity at least as great as heat input, and include pressure setting less than water heater working-pressure rating. Select one relief valve with sensing element that extends into storage tank.
 - d. Burner or Heat Exchanger: Comply with UL 795 or approved testing agency requirements for high-efficiency water heaters and for natural-gas **OR** LP-gas, **as directed**, fuel.
 - e. Temperature Control: Adjustable thermostat.
 - f. Safety Controls: Automatic, high-temperature-limit and low-water cutoff devices or systems.
 - g. Building Automation System Interface: Normally closed dry contacts for enabling and disabling water heater.
 - h. Draft Hood: Draft diverter; complying with ANSI Z21.12.
5. Commercial, Coil-Type, Finned-Tube, Gas Water Heaters: Comply with ANSI Z21.13 for hot-water boilers.
 - a. Description: Packaged unit with boiler, storage tank, pump, piping, and controls.

- b. Boiler Construction: ASME code with **160-psig (1100-kPa)** working-pressure rating for hot-water-boiler-type water heater.
 - 1) Heat Exchanger: Helix or spiral, finned-copper-tube coils with bronze headers.
 - 2) Connections: Factory fabricated of materials compatible with boiler. Attach to boiler before testing.
 - a) **NPS 2 (DN 50)** and Smaller: Threaded ends according to ASME B1.20.1.
 - b) **NPS 2-1/2 (DN 65)** and Larger: Flanged ends according to ASME B16.5 for steel and stainless-steel flanges, and according to ASME B16.24 for copper and copper-alloy flanges.
- c. Boiler Appurtenances:
 - 1) Insulation: Comply with ASHRAE/IESNA 90.1. Surround entire boiler except connections and controls.
 - 2) Jacket: Steel with enameled finish.
 - 3) Burner: For use with coil-type, finned-tube water heaters and for natural-gas **OR** LP-gas, **as directed**, fuel.
 - 4) Temperature Control: Adjustable, storage tank temperature-control fitting and flow switch, interlocked with circulator and burner.
 - 5) Safety Control: Automatic, high-temperature-limit cutoff device or system.
 - 6) Automatic Ignition: Intermittent electronic ignition complying with ANSI Z21.20.
- d. Building Automation System Interface: Normally closed dry contacts for enabling and disabling water heater.
- e. Support: Steel base or skids.
- f. Draft Hood: Draft diverter; complying with ANSI Z21.12.
- g. Automatic Damper: ANSI Z21.66, electrically operated **OR** mechanically activated **OR** thermally activated, **as directed**, automatic-vent-damper device with size matching draft hood.
- h. Hot-Water Storage Tank: Connected with piping to circulating pump and water heater.
 - 1) Construction: According to ASME Boiler and Pressure Vessel Code: Section VIII, steel with **150-psig (1035-kPa)** **OR** **125-psig (860-kPa)**, **as directed**, working-pressure rating.
 - 2) Tappings: Factory fabricated of materials compatible with tank. Attach tappings to tank before testing.
 - a) **NPS 2 (DN 50)** and Smaller: Threaded ends according to ASME B1.20.1.
 - b) **NPS 2-1/2 (DN 65)** and Larger: Flanged ends according to ASME B16.5 for steel and stainless-steel flanges, and according to ASME B16.24 for copper and copper-alloy flanges.
 - 3) Interior Finish: Comply with NSF 61 barrier materials for potable-water tank linings, including extending finish into and through tank fittings and outlets.
 - 4) Insulation: Comply with ASHRAE/IESNA 90.1. Surround entire storage tank except connections and controls.
 - 5) Jacket: Steel with enameled finish.
 - 6) Anode Rods: Factory installed, magnesium.
 - 7) Drain Valve: Corrosion-resistant metal complying with ASSE 1005, factory installed.
 - 8) Combination Temperature and Pressure Relief Valves: ANSI Z21.22/CSA 4.4. Include one or more relief valves with total relieving capacity at least as great as heat input, and include pressure setting less than water heater working-pressure rating. Select one relief valve with sensing element that extends into storage tank.
- i. Circulating Pump: UL 778, all-bronze, centrifugal, overhung-impeller, separately coupled, in-line pump as defined in HI 1.1-1.2 and HI 1.3. Include mechanical seals, **125-psig (860-kPa)** minimum working-pressure rating, and **225 deg F (107 deg C)** continuous-water-temperature rating.
- j. Piping: Copper tubing; copper, solder-joint fittings; and brazed or flanged joints.
- k. Mounting: Water heater, tank, and accessories factory mounted on skids.
6. Commercial, Grid-Type, Finned-Tube, Gas Water Heaters: Comply with ANSI Z21.13 for hot-water boilers.
 - a. Description: Packaged unit with boiler, storage tank, pump, piping, and controls.

- b. Boiler Construction: ASME code with **160-psig (1100-kPa)** working-pressure rating for hot-water-boiler-type water heater.
 - 1) Heat Exchanger: Horizontal, straight, finned-copper tubes with bronze headers.
 - 2) Connections: Factory fabricated of materials compatible with boiler. Attach to boiler before testing.
 - a) **NPS 2 (DN 50)** and Smaller: Threaded ends according to ASME B1.20.1.
 - b) **NPS 2-1/2 (DN 65)** and Larger: Flanged ends according to ASME B16.5 for steel and stainless-steel flanges, and according to ASME B16.24 for copper and copper-alloy flanges.
- c. Boiler Appurtenances:
 - 1) Insulation: Comply with ASHRAE/IESNA 90.1. Surround entire boiler except connections and controls.
 - 2) Jacket: Steel with enameled finish.
 - 3) Burner: For use with grid-type, finned-tube water heaters and for natural-gas **OR** LP-gas, **as directed**, fuel.
 - 4) Temperature Control: Adjustable, storage tank temperature-control fitting and flow switch, interlocked with circulator and burner.
 - 5) Safety Control: Automatic, high-temperature-limit cutoff device or system.
 - 6) Automatic Ignition: Intermittent electronic ignition complying with ANSI Z21.20.
- d. Building Automation System Interface: Normally closed dry contacts for enabling and disabling water heater.
- e. Support: Steel base or skids.
- f. Draft Hood: Draft diverter; complying with ANSI Z21.12.
- g. Automatic Damper: ANSI Z21.66, electrically operated **OR** mechanically activated **OR** thermally activated, **as directed**, automatic-vent-damper device with size matching draft hood.
- h. Hot-Water Storage Tank: Connected with piping to circulating pump and water heater.
 - 1) Construction: According to ASME Boiler and Pressure Vessel Code: Section VIII, steel with **150-psig (1035-kPa)** **OR** **125-psig (860-kPa)**, **as directed**, working-pressure rating.
 - 2) Tappings: Factory fabricated of materials compatible with tank. Attach tappings to tank before testing.
 - a) **NPS 2 (DN 50)** and Smaller: Threaded ends according to ASME B1.20.1.
 - b) **NPS 2-1/2 (DN 65)** and Larger: Flanged ends according to ASME B16.5 for steel and stainless-steel flanges, and according to ASME B16.24 for copper and copper-alloy flanges.
 - 3) Interior Finish: Comply with NSF 61 barrier materials for potable-water tank linings, including extending finish into and through tank fittings and outlets.
 - 4) Insulation: Comply with ASHRAE/IESNA 90.1. Surround entire storage tank except connections and controls.
 - 5) Jacket: Steel with enameled finish.
 - 6) Anode Rods: Factory installed, magnesium.
 - 7) Drain Valve: Corrosion-resistant metal complying with ASSE 1005, factory installed.
 - 8) Combination Temperature and Pressure Relief Valves: ANSI Z21.22/CSA 4.4. Include one or more relief valves with total relieving capacity at least as great as heat input, and include pressure setting less than water heater working-pressure rating. Select one relief valve with sensing element that extends into storage tank.
- i. Circulating Pump: UL 778, all-bronze, centrifugal, overhung-impeller, separately-coupled, in-line pump as defined in HI 1.1-1.2 and HI 1.3. Include mechanical seals, **125-psig (860-kPa)** minimum working-pressure rating, and **225 deg F (107 deg C)** continuous-water-temperature rating.
- j. Piping: Copper tubing; copper, solder-joint fittings; and brazed or flanged joints.
- k. Mounting: Water heater, tank, and accessories factory mounted on skids.

D. Oil-Fired Water Heaters

1. Household, Oil-Fired Water Heaters: Comply with UL 732 for storage water heaters.
 - a. Storage-Tank Construction: Steel.
 - 1) Tappings: ASME B1.20.1 pipe thread.
 - 2) Pressure Rating: **150 psig (1035 kPa)**.
 - 3) Interior Finish: Comply with NSF 61 barrier materials for potable-water tank linings, including extending lining material into tappings.
 - b. Factory-Installed, Storage-Tank Appurtenances:
 - 1) Anode Rod: Replaceable magnesium.
 - 2) Dip Tube: Provide unless cold-water inlet is near bottom of tank.
 - 3) Drain Valve: ASSE 1005.
 - 4) Insulation: Comply with ASHRAE/IESNA 90.1 or ASHRAE 90.2, **as directed**.
 - 5) Jacket: Steel with enameled finish.
 - 6) Temperature Control: Adjustable thermostat.
 - 7) Heat Trap Fittings: Inlet type in cold-water inlet and outlet type in hot-water outlet.
 - 8) Relief Valves: ASME rated and stamped and complying with ASME PTC 25.3, for combination temperature and pressure relief valves. Include one or more relief valves with total relieving capacity at least as great as heat input, and include pressure setting less than water heater working-pressure rating. Select one relief valve with sensing element that extends into storage tank.
 - c. Oil Burner: Comply with UL 296 for use with No. 2 fuel oil.
 - d. Draft Regulator: Barometric type or adjustable-damper device.
2. Commercial, Oil-Fired Water Heaters: Comply with UL 732 for storage water heaters.
 - a. Storage-Tank Construction: ASME-code **OR** Non-ASME-code, **as directed**, steel with **150-psig (1035-kPa)** minimum working-pressure rating.
 - 1) Tappings: Factory fabricated of materials compatible with tank. Attach tappings to tank before testing.
 - a) **NPS 2 (DN 50)** and Smaller: Threaded ends according to ASME B1.20.1.
 - b) **NPS 2-1/2 (DN 65)** and Larger: Flanged ends according to ASME B16.5 for steel and stainless-steel flanges, and according to ASME B16.24 for copper and copper-alloy flanges.
 - 2) Interior Finish: Comply with NSF 61 barrier materials for potable-water tank linings, including extending finish into and through tank fittings and outlets.
 - 3) Lining: Cement **OR** Glass **OR** Nickel plate **OR** Phenolic coating **OR** Sheet copper, **as directed**, complying with NSF 61 barrier materials for potable-water tank linings, including extending lining into and through tank fittings and outlets.
 - b. Factory-Installed, Storage-Tank Appurtenances:
 - 1) Anode Rod: Replaceable magnesium.
 - 2) Dip Tube: Provide unless cold-water inlet is near bottom of tank.
 - 3) Drain Valve: Corrosion-resistant metal complying with ASSE 1005.
 - 4) Insulation: Comply with ASHRAE/IESNA 90.1 or ASHRAE 90.2, **as directed**.
 - 5) Jacket: Steel with enameled finish.
 - 6) Temperature Control: Adjustable thermostat.
 - 7) Relief Valves: ASME rated and stamped and complying with ASME PTC 25.3, for combination temperature and pressure relief valves. Include one or more relief valves with total relieving capacity at least as great as heat input, and include pressure setting less than water heater working-pressure rating. Select one relief valve with sensing element that extends into storage tank.
 - c. Oil Burners: Comply with UL 296 for use with No. 2 fuel oil.
 - d. Safety Control: Automatic, high-temperature-limit cutoff device or system.
 - e. Draft Regulator: Barometric type or adjustable-damper device.
 - f. Building Automation System Interface: Normally closed dry contacts for enabling and disabling water heater.
3. Large-Capacity, Oil-Fired Water Heaters: Comply with UL 732 for storage water heaters except when capacity is greater than **120 gal. (454 L)**.
 - a. Storage-Tank Construction: ASME-code steel with **150-psig (1035-kPa)** minimum working-pressure rating.

- 1) Tappings: Factory fabricated of materials compatible with tank. Attach tappings to tank before testing.
 - a) **NPS 2 (DN 50)** and Smaller: Threaded ends according to ASME B1.20.1.
 - b) **NPS 2-1/2 (DN 65)** and Larger: Flanged ends according to ASME B16.5 for steel and stainless-steel flanges, and according to ASME B16.24 for copper and copper-alloy flanges.
 - 2) Interior Finish: Comply with NSF 61 barrier materials for potable-water tank linings, including extending finish into and through tank fittings and outlets.
 - 3) Lining: Cement **OR** Glass **OR** Nickel plate **OR** Phenolic coating **OR** Sheet copper, **as directed**, complying with NSF 61 barrier materials for potable-water tank linings, including extending lining into and through tank fittings and outlets.
 - b. Factory-Installed, Storage-Tank Appurtenances:
 - 1) Anode Rod: Replaceable magnesium.
 - 2) Dip Tube: Provide unless cold-water inlet is near bottom of tank.
 - 3) Drain Valve: Corrosion-resistant metal complying with ASSE 1005.
 - 4) Insulation: Comply with ASHRAE/IESNA 90.1 or ASHRAE 90.2, **as directed**.
 - 5) Jacket: Steel with enameled finish.
 - 6) Temperature Control: Adjustable thermostat.
 - 7) Safety Control: Automatic, high-temperature-limit cutoff device or system.
 - 8) Relief Valves: ASME rated and stamped and complying with ASME PTC 25.3, for combination temperature and pressure relief valves. Include one or more relief valves with total relieving capacity at least as great as heat input, and include pressure setting less than water heater working-pressure rating. Select one relief valve with sensing element that extends into storage tank.
 - c. Oil Burner: Comply with UL 296 for use with No. 2 fuel oil.
 - d. Safety Controls: Automatic, high-temperature-limit and low-water cutoff devices or systems.
 - e. Draft Regulator: Barometric type or adjustable-damper device.
 - f. Building Automation System Interface: Normally closed dry contacts for enabling and disabling water heater.
- E. Dual-Fuel Water Heaters
1. Description: Comply with ANSI Z21.10.3/CSA 4.3 or UL 732 requirements appropriate for dual-fuel, gas and oil-fired water heaters.
 - a. Storage-Tank Construction: ASME-code steel with **150-psig (1035-kPa)** minimum working-pressure rating.
 - 1) Tappings: Factory fabricated of materials compatible with tank. Attach tappings to tank before testing.
 - a) **NPS 2 (DN 50)** and Smaller: Threaded ends according to ASME B1.20.1.
 - b) **NPS 2-1/2 (DN 65)** and Larger: Flanged ends according to ASME B16.5 for steel and stainless-steel flanges, and according to ASME B16.24 for copper and copper-alloy flanges.
 - 2) Interior Finish: Comply with NSF 61 barrier materials for potable-water tank linings, including extending finish into and through tank fittings and outlets.
 - 3) Lining: Cement **OR** Glass **OR** Nickel plate **OR** Phenolic coating **OR** Sheet copper, **as directed**, complying with NSF 61 barrier materials for potable-water tank linings, including extending lining into and through tank fittings and outlets.
 - b. Factory-Installed, Storage-Tank Appurtenances:
 - 1) Anode Rod: Replaceable magnesium.
 - 2) Dip Tube: Provide unless cold-water inlet is near bottom of tank.
 - 3) Drain Valve: Corrosion-resistant metal complying with ASSE 1005.
 - 4) Insulation: Comply with ASHRAE/IESNA 90.1 or ASHRAE 90.2, **as directed**.
 - 5) Jacket: Steel with enameled finish.
 - 6) Temperature Control: Adjustable thermostat.

- 7) Relief Valves: ASME rated and stamped and complying with ASME PTC 25.3, for combination temperature and pressure relief valves. Include one or more relief valves with total relieving capacity at least as great as heat input, and include pressure setting less than water heater working-pressure rating. Select one relief valve with sensing element that extends into storage tank.
 - c. Dual-Fuel Burners: Combination gas-oil burner assembly, complying with appropriate requirements of UL 795; or comply with UL 296 for oil burners for No. 2 fuel oil and UL 795 for natural-gas **OR** LP-gas, **as directed**, fuel.
 - d. Safety Control: Automatic, high-temperature-limit cutoff device or system.
 - e. Vent Connection: According to standards of authorities having jurisdiction for dual-fuel water heaters.
 - f. Building Automation System Interface: Normally closed dry contacts for enabling and disabling water heater.
- F. Compression Tanks
1. Description: Steel, pressure-rated tank constructed with welded joints and factory-installed, butyl-rubber diaphragm. Include air precharge to minimum system-operating pressure at tank.
 - a. Construction:
 - 1) Tappings: Factory-fabricated steel, welded to tank before testing and labeling. Include ASME B1.20.1 pipe thread.
 - 2) Interior Finish: Comply with NSF 61 barrier materials for potable-water tank linings, including extending finish into and through tank fittings and outlets.
 - 3) Air-Charging Valve: Factory installed.
- G. Water Heater Accessories
1. Gas Shutoff Valves: ANSI Z21.15/CGA 9.1, manually operated. Furnish for installation in piping.
 2. Gas Pressure Regulators: ANSI Z21.18, appliance type. Include pressure rating, capacity, and pressure differential required between gas supply and water heater.
 3. Gas Automatic Valves: ANSI Z21.21, appliance, electrically operated, on-off automatic valve.
 4. Combination Temperature and Pressure Relief Valves: Include relieving capacity at least as great as heat input, and include pressure setting less than water heater working-pressure rating. Select each relief valve with sensing element that extends into storage tank.
 - a. Gas Water Heaters: ANSI Z21.22/CSA 4.4.
 - b. Oil-Fired Water Heaters: ASME rated and stamped and complying with ASME PTC 25.3.
 5. Pressure Relief Valves: Include pressure setting less than working-pressure rating of water heater.
 - a. Gas Water Heaters: ANSI Z21.22/CSA 4.4.
 - b. Oil-Fired Water Heaters: ASME rated and stamped and complying with ASME PTC 25.3.
 6. Water Heater Stand and Drain Pan Units: High-density-polyethylene-plastic, **18-inch- (457-mm-)** high, enclosed-base stand complying with IAPMO PS 103 and IAS No. 2. Include integral or separate drain pan with raised edge and **NPS 1 (DN 25)** drain outlet with ASME B1.20.1 pipe thread.
 7. Water Heater Stands: Water heater manufacturer's factory-fabricated steel stand for floor mounting and capable of supporting water heater and water. Provide dimension that will support bottom of water heater a minimum of **18 inches (457 mm)** above the floor.
 8. Water Heater Mounting Brackets: Water heater manufacturer's factory-fabricated steel bracket for wall mounting and capable of supporting water heater and water.
 9. Drain Pans: Corrosion-resistant metal with raised edge. Provide dimensions not less than base of water heater and include drain outlet not less than **NPS 3/4 (DN 20)**.
 10. Piping Manifold Kits: Water heater manufacturer's factory-fabricated inlet and outlet piping arrangement for multiple-unit installation. Include piping and valves for field assembly that is capable of isolating each water heater and of providing balanced flow through each water heater.
 11. Piping-Type Heat Traps: Field-fabricated piping arrangement according to ASHRAE/IESNA 90.1 or ASHRAE 90.2, **as directed**.
- H. Source Quality Control

1. Test and inspect water heater storage tanks, specified to be ASME-code construction, according to ASME Boiler and Pressure Vessel Code.
2. Hydrostatically test commercial water heater storage tanks before shipment to minimum of one and one-half times pressure rating.
3. Prepare test reports.

1.3 EXECUTION

A. Water Heater Installation

1. Install commercial water heaters on concrete bases.
 - a. Exception: Omit concrete bases for commercial water heaters if installation on stand, bracket, suspended platform, or direct on floor is indicated.
 - b. Concrete base construction requirements are specified in Division 22 Section "Common Work Results For Plumbing".
2. Install water heaters level and plumb, according to layout drawings, original design, and referenced standards. Maintain manufacturer's recommended clearances. Arrange units so controls and devices needing service are accessible.
3. Install seismic restraints for commercial water heaters. Anchor to substrate.
4. Install gas water heaters according to NFPA 54.
5. Install gas shutoff valves on gas supplies to gas water heaters without shutoff valves.
6. Install gas pressure regulators on gas supplies to gas water heaters without gas pressure regulators if gas pressure regulators are required to reduce gas pressure at burner.
7. Install automatic gas valves on gas supplies to gas water heaters, if required for operation of safety control.
8. Install oil-fired water heaters according to NFPA 31.
9. Install combination temperature and pressure relief valves in top portion of storage tanks. Use relief valves with sensing elements that extend into tanks. Extend commercial-water-heater, relief-valve outlet, with drain piping same as domestic water piping in continuous downward pitch, and discharge by positive air gap onto closest floor drain.
10. Install combination temperature and pressure relief valves in water piping for water heaters without storage. Extend commercial-water-heater relief-valve outlet, with drain piping same as domestic water piping in continuous downward pitch, and discharge by positive air gap onto closest floor drain.
11. Install water heater drain piping as indirect waste to spill by positive air gap into open drains or over floor drains. Install hose-end drain valves at low points in water piping for water heaters that do not have tank drains. Refer to Division 22 Section "Domestic Water Piping Specialties" for hose-end drain valves.
12. Install thermometer on outlet piping of water heaters. Refer to Division 22 Section "Meters And Gages For Plumbing Piping" for thermometers.
13. Install pressure gage(s) on inlet and outlet piping of commercial, fuel-fired water heater piping. Refer to Division 22 Section "Meters And Gages For Plumbing Piping" for pressure gages.
14. Assemble and install inlet and outlet piping manifold kits for multiple water heaters. Fabricate, modify, or arrange manifolds for balanced water flow through each water heater. Include shutoff valve and thermometer in each water heater inlet and outlet, and throttling valve in each water heater outlet. Refer to Division 22 Section "General-duty Valves For Plumbing Piping" for general-duty valves and to Division 22 Section "Meters And Gages For Plumbing Piping" for thermometers.
15. Install piping-type heat traps on inlet and outlet piping of water heater storage tanks without integral or fitting-type heat traps.
16. Fill water heaters with water.
17. Charge compression tanks with air.

B. Connections

1. Piping installation requirements are specified in other Division 14. Drawings indicate general arrangement of piping, fittings, and specialties.
 2. Install piping adjacent to water heaters to allow service and maintenance. Arrange piping for easy removal of water heaters.
 3. Ground equipment according to Division 26 Section "Grounding And Bonding For Electrical Systems".
 4. Connect wiring according to Division 26 Section "Low-voltage Electrical Power Conductors And Cables".
- C. Field Quality Control
1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust field-assembled components and equipment installation, including connections, and to assist in field testing. Report results in writing.
 2. Perform the following field tests and inspections and prepare test reports:
 - a. Leak Test: After installation, test for leaks. Repair leaks and retest until no leaks exist.
 - b. Operational Test: After electrical circuitry has been energized, confirm proper operation.
 - c. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
 3. Remove and replace water heaters that do not pass tests and inspections and retest as specified above.
- D. Demonstration
1. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain instantaneous and commercial water heaters.

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SECTION 22 12 23 26 - UNDERGROUND STORAGE TANKS

1.1 GENERAL

A. Description Of Work

1. This specification covers the furnishing and installation of underground storage tanks. Products shall be as follows or as directed by the Owner. Installation procedures shall be in accordance with the product manufacturer's recommendations. Demolition and removal of materials shall be as required to support the work.

B. Intent of Work

1. It is the intent of this specification to ensure that the work, as completed, shall meet or exceed all applicable codes, ordinances, rules and regulations of every authority having jurisdiction in the area.
2. The installation shall include all necessary equipment, controls, valves and fittings, excavation, backfill as described or called for on the plans. In some cases, the Contractor shall prepare the plans. In any case, the Contractor shall obtain all permits at its expense.
3. The Contractor shall install equipment in accordance with manufacturer's recommendations. Where drawings (if any) and specification conflict with manufacturer's recommendations, it shall be the Contractor's responsibility to bring this to the attention of the Owner before installation.
4. The overall intent shall be that the Contractor shall provide everything required to make a complete and operational job in every respect.

C. Codes And Standards

1. Reference is to the latest edition of the code or standard unless otherwise noted. Comply with the latest EPA requirements.
2. The codes and standards referred to are the minimum standards. Where the requirements of these specifications and the accompanying drawings (if any) exceed those of the codes and standards, the drawings and specifications shall supersede.
3. The installation shall conform to provisions of the NFPA requirement with latest amendments.
4. The entire installation including all equipment shall conform to The Occupational and Safety Health Act of 1970, and all EPA regulations.

D. Visit To Site: Bidders are advised to visit the site and carefully examine the existing conditions before submitting bids, as no allowance will be made for lack of knowledge of existing conditions where such conditions may reasonably be determined by observation.

E. Permits

1. Obtain all permits required for the installation of this work and pay all fees in connection therewith. Permits and fees involved in removal of any item from the site shall be included.
2. Provide copies of inspection and testing certificates from all agencies and authorities having jurisdiction.

F. Layout Basis

1. The layout, which must be stamped by an Engineer registered in the State in which the Project is located, is based upon the use of particular items of equipment, identified by manufacturer's make and model number. Dimensions, arrangements, efficiency and service connections required for these particular items have been considered in making the layout. Contractor shall submit any deviations proposed with its bid.
2. The Contractor may use the equipment of any manufacturer listed as approved for substitution provided they have the proper connections, capacities, efficiency and dimensions. Variances from the requirements stated herein shall be sustainable reasons for disapproval of the submitted equipment. All costs arising from variances in substituted items shall be paid for by the Contractor.



3. Equivalent products by other manufacturers must be submitted to the the Owner for prior approval at least ten (10) days prior to bid date.

G. Submittals

1. All submittals shall bear a stamp or notation indicating that the Contractor has reviewed the submittals for compliance with drawings, governing authorities and specifications.
2. All submittals shall bear sufficient notations to clearly indicate the specific make, model number, accessories, capacities, options, and specification paragraph numbers.
3. All submittals shall indicate complete compliance with all performance and specification requirements as herein specified and/or indicated or shall specifically list any exceptions. Exceptions shall be subject to approval by the the Owner.
4. The review (by the the Owner) of equipment does not relieve the Contractor of the responsibility for compliance with the contract documents or authorities as specified.
5. Contractor shall coordinate electrical characteristics of equipment with electrical specifications and the available power characteristics.
6. Materials requiring shop drawing submittals shall not be installed prior to shop drawings being reviewed by the the Owner. The Contractor agrees that failure to conform to the above may result in removal of all installed materials that have been disapproved from the project. Installation of specified equipment will be mandatory. Removal of disapproved equipment shall be at the sole expense of the Contractor.
7. Submit the following for review via shop drawings (to be approved or disapproved):
 - a. Xerxes or approved equal, double wall (do not unload manually). Size and capacity.
 - b. Bury depth.
 - c. Bed and backfill (not over 7'-0" traffic and no traffic).
 - d. Double walls when continuous vacuum pump and monitor are used require a maximum burial depth of three (3) feet from tank top to grade.
 - e. When not subjected to traffic loads, use 24" backfill or 12" minimum backfill plus 4" re-bar reinforced concrete on top.
 - f. When subjected to traffic loads, use 36" backfill or 18" minimum backfill plus 6" of re-bar reinforced concrete.
 - g. If tank is 12'-0" in diameter (actually, 7'-11" is manufactured for large gallonage) then, no traffic shall be provided with 42" minimum cover, or 38" backfill plus 4" re-bar reinforced concrete. With traffic, use 38" backfill plus 6" of asphalt or 6" of re-bar reinforced concrete.
 - h. Monitoring fittings, fiberglass reservoir, vapor sensor 4" tank fittings, tank fill tube insert, venting, stage two vapor recovery system, manway and manway extensions, manway risers, site monitoring wells, barricades, installation check list, hydrostatic tank monitoring.
 - i. Job site safety precautions.
 - j. Reservoir fiberglass sensor.
 - k. Reservoir leak detection.
 - l. Electronic control panels, sensor circuit, transmission contact switch power source circuit, alarm bell, alarm bell silence button, control panel false alarms, etc.
 - m. Piping sump bottom, usually 28 3/8" x 30".
 - n. Flex connectors to piping.
 - o. Unions, nipples, manway cover, FRP fitting, opening for stage II vapor recovery line if required.
 - p. 3" pipe sump fitting.
 - q. When using piping sump sensor equal to Owens Corning fiberglass model PSS, submit system including electrical power supply and signal wiring.
 - r. Control panel equal to Owens Corning fiberglass model SB-0011B (single circuit) or SB-0014B (4 circuit) as applicable.
 - s. Fiberglass pipe and fittings equal to "Ameron" type Dualoy 3000/L pressure rated and with chemically resistant epoxy resin for the service intended. The Dualoy 3000/L shall be a secondary containment system. No other product piping will be acceptable.

H. Guarantee

1. Contractor shall guarantee that if any materials or workmanship covered by these specifications proves defective within one (1) year, such defects shall be corrected by the Contractor at once without charge to the Owner.

1.2 PRODUCTS:

A. Single-Wall Fiberglass Underground Storage Tanks

1. The tank shall comply with the following governing standards:
 - a. Underwriters Laboratories, Inc. (UL) Standard 1316. A UL certification plate shall be attached to each tank.
 - b. National Sanitation Foundation Standard, NSF Standard 61.
 - c. ANSI/AWWA D120-02 Thermosetting Fiberglass-Reinforced Plastic Tanks.
 - d. Military Specification No. MIL-T-52777(A)
2. The Contractor shall provide and install the "fiberglass" underground storage tanks. Tanks shall be as manufactured by Xerxes Corporation, Minneapolis, MN or approved equal as judged by the Owner. Follow manufacturer's instructions for installation and testing.
3. Loading Conditions: Tank shall meet the following design criteria:
 - a. Internal Load: Tank shall be designed to withstand a 5-psig air-pressure test with 5:1 safety factor. When tank is designed for on-site testing, contractor shall individually test tank for leakage prior to installation. Maximum test pressure is 5 psig (3 psig for a 12-foot diameter tank).
 - b. Vacuum Test: Tanks 10-foot diameter and smaller shall be designed to withstand a vacuum test to 11.5 inches of mercury.
 - c. Surface Loads: Tank shall withstand surface H-20 axle loads when properly installed according to tank manufacturer's current Installation Manual and Operating Guidelines.
 - d. External Hydrostatic Pressure: Tank shall be capable of being buried in ground with 7 feet of overburden over the top of the tank, the hole fully flooded and a safety factor of 5:1 against general buckling.
 - e. Tank shall support accessory equipment- such as internal pump platforms, drop/fill tubes, submersible pumps and ladders- when installed according to tank manufacturer's current Installation Manual and Operating Guidelines.
4. Product Storage:
 - a. Tank shall be capable of storing water products with specific gravity up to 1.1.
 - b. Tank shall be vented to atmospheric pressure.
 - c. Tank shall be capable of storing products identified in the manufacturer's current standard limited warranty.
5. Materials:
 - a. Tank shall be manufactured with 100% resin and glass-fiber reinforcement No sand fillers.
 - b. The laminate materials used in the internal coating system of a portable water tank shall conform to the requirements of NSF Standard 61.
 - c. Tank Dimensions: as directed by the Owner.
6. Manways (Required for Potable Water Tanks): Shall be flanged and 22-inch I.D. **OR** 30-inch I.D. (for larger tanks), **as directed**, complete with gasket, bolting hardware and cover. Optional manway extensions shall be FRP.

B. Double-Wall Fiberglass Underground Storage Tanks

1. The Contractor shall provide and install the "fiberglass" underground storage tanks of the specified volume and diameter.
2. The tank shall be of fiberglass. Tank laminates shall be constructed of 100% resin and fiberglass reinforcements without sand fillers. Ribs are to be integrally cast into tank body. Tanks shall bear the listing mark of Underwriters' Laboratories, Inc. Tank shall have an annular space between the primary and secondary shell walls to allow for free flow and containment of all leaked product from primary tank. This space shall be filled at the factory with a brine solution for hydrostatic monitoring. Tanks shall be as manufactured by Xerxes Corporation, Minneapolis, MN or approved equal as judged by the Owner.



3. The tank shall comply with the following governing standards:
 - a. ASTM Standard Document No. 4021-81
 - b. Underwriters' Laboratories, Inc. (UL.) File #MH-9061 (N) for underground storage of flammable liquids. A UL certification plate shall be attached to each tank.
 - c. Military Specification No. MIL-T-52777(A)
 - d. Factory Mutual Systems approval J.I. IG4AO.AF
 - e. National Sanitation Foundation, Standard 14
 - f. National Fire Protection Association (NFPA-30), (NFPA-30A) Flammable and Combustible Liquid Code and (NFPA-31) Standard for Installation of Oil Burning Equipment.
 4. The tank shall be capable of the following loading conditions:
 - a. Internal load: Tank shall withstand 5 psi air pressure test with 5 to 1 safety factor. Contractor shall test prior to installation as this is to test for leakage. Maximum test pressure is 5 psi.
 - b. Vacuum Test: Every tank shall be tested to 11.5 inches (primary tank) and 9.5 inches (secondary tank) mercury vacuum by the tank manufacturer to assure structural integrity.
 - c. Surface Loads: Tank shall withstand surface H-20 axle load when properly installed according to current manufacturer's installation instruction (32,000 lbs.).
 - d. External hydrostatic pressure: Tank shall withstand 7' of overburden with the hole fully flooded with 7:1 safety factor against buckling.
 5. Provide glass fiber-reinforced plastic straps for the tank shown. Provide number and location of straps as specified by the manufacturer. Each strap shall be capable of withstanding the buoyancy load of 25,000 lbs. for 8' tank diameter. Straps shall be standard as supplied by the tank manufacturer. A concrete pad or concrete deadman must be used with anchor straps as recommended by tank manufacturer.
 6. The Contractor shall provide fiberglass piping sump with fittings as indicated. The piping sump shall be manufactured by Xerxes Corporation or approved equal and supplied with tanks.
 - a. The piping sump shall be installed so that it is suitable for monitoring the double-wall piping system and containment of its product. Piping sump shall be located on tanks 22" minimum manway.
 7. All tank fittings shall be standard (proofed tight) as supplied by the tank manufacturer. The tank shall have an opening for one each of the following:
 - a. Fill/Manual Gauging
 - b. Vent/Overfill/Stage One Vapor Recovery
 - c. Pump (pressure system) or supply and return (suction system)
 - d. In tank gauging automatic inventory control
 - e. Others as shown or required by the operating agency
 8. The tank shall have a factory filled brine interstitial and reservoir for continuous monitoring of both inner and outer walls.
 9. Tank to be installed per manufacturer installation instructions which will be inspected as it progresses.
- C. Spill Protection
1. Universal model 70CD, or approved equal, spill containment shall be used as containment basin for spills during filling. A manual valve, if so required, shall be used to return any spilled product back to tank.
- D. Overfill Prevention
1. Universal model 37, or approved equal, float valve is to be used for overfill prevention. The automatic shut off device must stop the flow of product being delivered when tank is 90% full. Access must be provided.
- E. Stage One Vapor Recovery
1. Stage one vapor recovery is incorporated into the access assembly of the overfill prevention access way. See drawing for details. (Less than 10,000 gales per month through flow)

- F. Stage Two Vapor Recover
1. Piping for stage two vapor recovery will be installed for future use. Required for gasoline motor fuel only. (More than 10,000 gales per month through flow)
- G. Tank Trim
1. Surface manholes shall have all cast iron rim and minimum 10" galvanized steel skirt. Tank trim shall have Universal Valve.
- H. Submersible Turbine Pump Specifications
1. General Pump Specifications: The pump shall be designed to pump gasoline, diesel, kerosene and jet fuel. The entire pumping assembly shall have UL listing and shall meet all requirements of UL79. The pump discharge head and manifold assembly shall be manufactured from ASTM A 48 Class 30 grey iron. The pump shall be available in 1/3, 3/4, and 1-1/2 hp sizes and shall be manufactured to the proper length as determined by the tank diameter, type of tank, and bury depth. The pump motor shall have a thermal over current overload protector with automatic reset. The pump motor assembly shall be clearly marked with pertinent information including Model, Horsepower, Voltage, Phase, and Manufacturer. The pump motor shall be a permanent split phase capacitor type, and shall incorporate a 15 mfd capacitor. The pumping unit shall not incorporate any flexible diaphragms and all sealing shall be accomplished with "o" ring or UL recognized fiber gaskets. The pump shall have a removable intake screen with openings no greater than 3/32 inch. The pump shall be manufactured by FE Petro, Inc., McFarland, WI. or approved equal as judged by the the Owner.
 2. Installation and Maintenance Specifications: The pump shall have a two-wire field connection and an easy access ground wire terminal, and shall incorporate a wire seal plug which will accommodate three wires. The pump shall incorporate a port for line pressure testing that shall be sealed with a 1/4 NPT pipe plug. The pump unit shall have a fully extractable head in order to permit removal of the pump motor assembly without disturbing the discharge piping or the electrical wiring. The product in the pipelines shall be held in place by a line check valve that shall have a minimum sealing of 170 lbs when the pump is not running. The line check valve shall be independent of the removable head and shall be easily accessible. The removal of the extractable portion of the pump shall not disturb product in the pipelines downstream of the check valve. During the removal of the extractable portion of the pump, product contained in the discharge manifold of the pump shall drain automatically into the storage tank. The pump motor shall be interchangeable by horsepower with different manufacturers' product.
 3. Operation Specifications: The pump shall have an air/vapor elimination system that returns air or vapors to the underground storage tank through a tube discharging near the top of the pump motor assembly. The pump unit shall contain a built-in expansion relief valve that relieves pressure above pumping pressure but below 50 psi. The pump motor shall utilize the product being pumped for lubrication of the motor bearings and for cooling the stator, and this fluid shall discharge into the underground storage tank at the top of the motor. The pump shall have siphon capability built into the pump as standard.
- I. Piping System
1. All piping fittings and adhesives shall be UL listed made of fiberglass double wall. Pipe shall be in compliance with ASTM D 2996 and classified by designation code RTRP-11AF-3111. Pipe shall be filament wind of continuous glass filament. Pipe must have a minimum bend radius of 50 feet on 2" primary (80 feet on 3" secondary) to allow settling of tank. Pipe shall have maximum tensile loads of 1160 lbs, compressive loads 2210 lbs at 75 degrees Fahrenheit on 2" primary. 3" pipe shall have tensile load of 2020 lbs at 75 degrees and compressive loads of 3850 lbs. Pipe to be factory proof tested at 1000 psig-2", 700 psig-3". Pipe shall be Smith Fiberglass Red thread II, or approved equal as judged by the Owner.
 2. Vent piping shall not have secondary containment. Vent shall not be sloped less than 1/4" per foot downward to tank.
 3. Product piping shall have secondary containment. Product piping shall not be sloped less than 1/8" per foot downward toward tank.
 4. All piping must slope back toward tank.



5. All piping must be installed as per manufacturer installation instructions. the Owner shall monitor each installation daily.

J. Leak Detection

1. Tank shall have a Pollulert FD241RRA, or approved equal, float probe mounted on the brine filled hydrostatic reservoir. The system shall monitor both the inner and outer walls of the tank.
 - a. Alarm Conditions:
 - 1) Hydrocarbons in hydrostatic reservoir
 - 2) A loss of fluid in reservoir
2. Piping shall have a Pollulert FD241RRA, or approved equal, float probe mounted in the piping sump. System shall monitor the piping sump compartment that has to be designed to catch any leaked product from the primary piping system. This probe shall distinguish the difference between water and hydrocarbons and alarm on any one or both conditions.
3. Remote monitoring piping sumps shall be installed only if piping can not be sloped toward tank. The Contractor shall use as many remote monitoring piping sumps as needed to assure that all sections of piping are monitored. All monitoring sumps shall have a Pollulert FD241RRA or approved equal probe for leak detection.
4. Control panel shall have probe status for wet, dry, or hydrocarbon. Alarm conditions are to be selectable. Control panel must have installed relay or provision for installing relays for remote alarms. Control panel shall have both visual and audible alarm. System shall have a two year warranty from date of manufacture. Ground water probes shall be adjustable 1/8" to 2" for product detection. Probes shall be wired by a single cable run. Systems must be UL listed for Class 1, Division 1, Group D locations and meet all existing EPA regulations. Leak detection shall be Pollulert systems or approved equal.
5. Submersible pump shall have a mechanical in-line leak detector with a free floating check valve. Leak detector shall be vaporless LD2000 or approved equal.

K. In Tank Gauging System

1. Gauging system shall provide inventory management designed to continuously monitor underground storage tanks. System must provide information on inventory, delivery of fuel, and product through-put. System must measure fuel levels, water level and fuel temperature. This is to ensure proper compensated level readings. System shall have five temperature sensors, two floats, one for product level, one for water interface. System shall have a 48 character LCD display and internal thermal printer. System shall utilize a magnetostrictive probe and have visual, audible alarm with automatic printout. The system shall be designed to have 16 input on/off devices, RS232 port full duplex with adjustable baud rate. Tank gauging system shall be Pollulert system or approved equal.

L. Test For Pipe

1. Test of the piping system shall be made per manufacturer's recommendations.
2. Furnish the Owner with a certificate stating that all piping has been tested as specified and has been shown to be tight.
3. The piping systems may be tested in sections if necessary, but a final test may be required of the entire piping system at the completion of the system. The final test shall be made while pipe is exposed to view where possible.
4. Both primary and secondary pipe must be tested.

M. Test For Tank

1. Pre-installation: All Xerxes or approved equal tanks shall be tested prior to shipment, but it is required that all tanks be tested by the Contractor prior to installation. After installation and before final backfilling to grade, the tank must be retested to assure that no damage occurred during installation.
2. Hose/Valve Assembly: In order to test the tank, the hose/valve assembly must be connected from the reservoir to a service fitting. The hose/valve assembly will already be connected from the reservoir to a service fitting when the tank is shipped. If the hose/valve assembly is not connected

when the tank is delivered, contact the Customer Service Representative at the Xerxes or other plant nearest you, before attempting to test the tank.

3. Primary (Internal) Tank Test: Prior to installation, check to see that all service and monitor fittings are plugged and tightened, except the service fitting with a temporary plastic plug. Close the valve on the hose/valve assembly. Remove the temporary plastic plug and connect the pressure source to the service fitting. Pressure test the primary (internal) tank to 5 psig for 60 minutes.
4. Secondary (External) Tank Test:
 - a. CAUTION: Never pressurize the secondary tank or (annular space) without connecting it to the primary tank. The secondary tank and primary tank will be properly connected if the hose/valve assembly is in place as shipped. Failure to have the secondary tank and primary tank properly connected could potentially result in tank failure and personal injury, and will void all warranties.
 - b. While the primary tank is still under pressure, open the valve on the hose/valve assembly until the pressure stabilizes. Once the pressure has stabilized, either add or subtract air pressure to stabilize the pressure at 5 psig. Observe the tank for any liquid on the exterior surface and check the gauge at the pressure source for any drop in pressure.
 - c. After completing the test, relieve the pressure at the source.

N. Product Dispenser

1. A fiberglass containment box shall be installed with each product dispenser. Containment box shall be as manufactured by Petro Fiberglass or approved equal. Double wall pipe shall terminate inside containment box. A flex connector as manufactured by Dana Everflex or approved equal shall be used to connect product pipe to the shear valve within the containment box. The shear valve shall be air tested at the factory and shall not lose its seal when its top is removed for service. Shear valve shall be Universal model 521 or approved equal. Each product dispensing hose shall be equipped with a re-connectable breakaway featuring a pressure balancing chamber to prevent nuisance breaks and shall disconnect at 200 lbs. A hose coupling shall separate the breakaway and hose swivel. The nozzle shall have a means of automatically stopping flow if the nozzle is not at the proper dispensing angle. Nozzle shall be of die-cast construction UL listed and have a flow equalizer to maintain 10 GPM flow. Breakaway, hose coupling, hose swivel, and nozzle shall be as manufactured by Husky or approved equal. Dispenser shall be compatible with vapor recovery systems.

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Task	Specification	Specification Description
22 12 23 26	21 05 23 00	Piped Utilities Basic Materials And Methods
22 13 16 00	21 05 23 00	Piped Utilities Basic Materials And Methods
22 13 16 00	22 11 23 23	Water Supply Wells
22 13 16 00	22 05 76 00	Sanitary Sewerage
22 13 16 00	07 63 00 00	Common Work Results for Fire Suppression
22 13 16 00	07 63 00 00a	Common Work Results for Plumbing
22 13 16 00	07 63 00 00b	Common Work Results for HVAC
22 13 16 00	22 11 16 00a	Sanitary Waste And Vent Piping
22 13 16 00	22 11 16 00b	Storm Drainage Piping

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SECTION 22 13 19 00 - HIGH-EFFICIENCY PARTICULATE FILTRATION

1.1 GENERAL

A. Description Of Work

1. This specification covers the furnishing and installation of materials for high-efficiency particulate filtration. Products shall be as follows or as directed by the Owner. Installation procedures shall be in accordance with the product manufacturer's recommendations. Demolition and removal of materials shall be as required to support the work.

B. Summary

1. Section Includes:
 - a. HEPA rigid-cell box filters.
 - b. HEPA V-bank cell filters.
 - c. HEPA filter diffusers.
 - d. HEPA filter fan modules.
 - e. ULPA filters.
 - f. 95 percent DOP filters.
 - g. Front- and rear-access filter frames.
 - h. Side-service housings.
 - i. Filter gages.

C. Submittals

1. Product Data: For each type of product indicated. Include dimensions; operating characteristics; required clearances and access; rated flow capacity, including initial and final pressure drop at rated airflow; efficiency and test method; fire classification; furnished specialties; and accessories for each model indicated.
2. LEED Submittals:
 - a. Product Data for Prerequisite EQ 1: Documentation indicating that units comply with applicable requirements in ASHRAE 62.1, Section 5, "Systems and Equipment."
3. Shop Drawings: For air filters. Include plans, elevations, sections, details, and attachments to other work.
 - a. Show filter rack assembly, dimensions, materials, and methods of assembly of components.
 - b. Include setting drawings, templates, and requirements for installing anchor bolts and anchorages.
 - c. Wiring Diagrams: For power, signal, and control wiring.
4. Field quality-control reports.
5. Operation and Maintenance Data: For each type of filter and rack to include in emergency, operation, and maintenance manuals.

D. Quality Assurance

1. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended use.
2. ASHRAE Compliance:
 - a. Finish of Interior Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.
3. Comply with IEST-RP-CC001.3.
4. Comply with UL 586.
5. Comply with IEST-RP-CC007.1.
6. Comply with NFPA 90A and NFPA 90B.

E. Coordination

1. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases.

1.2 PRODUCTS

A. HEPA Rigid-Cell Box Filters

1. Description: Factory-fabricated, disposable, packaged air filters with media perpendicular to airflow and with holding frames.
2. Filter Unit Class: UL 900, Class 1 **OR** Class 2, **as directed**.
3. Media: Fibrous material, constructed so individual pleats are maintained under rated-airflow conditions.
 - a. Internal Separators: None **OR** Aluminum in media folds, **as directed**.
 - b. Gasket Material: None **OR** Neoprene **OR** Blue gel, **as directed**.
 - c. Gasket Location: None **OR** Upstream **OR** Upstream and Downstream **OR** Downstream, **as directed**.
 - d. Faceguard Material: Aluminum **OR** Stainless steel, **as directed**.
 - e. Faceguard Location: None **OR** Upstream **OR** Upstream and Downstream **OR** Downstream, **as directed**.
4. Filter-Media Frames:
 - a. Finish of Interior Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.
 - b. Materials: Stainless steel **OR** Fire-retardant plywood **OR** Fabricated aluminum **OR** Fire-retardant particleboard **OR** Galvanized sheet **OR** Non-fire-retardant particleboard, **as directed**.
 - c. Style: Box **OR** Double-turned flange **OR** Deep channel **OR** Double-turned flange, one side, **as directed**.
5. Mounting Frames: Welded galvanized steel with gaskets and fasteners; suitable for bolting together into built-up filter banks.

B. HEPA V-Bank Cell Filters

1. Description: Factory-fabricated, disposable, packaged air filters with media at an angle to airflow and with holding frames.
2. Filter Unit Class: UL 900, Class 1 **OR** Class 2, **as directed**.
3. Media: Fibrous material, constructed so individual pleats are maintained under rated-airflow conditions.
 - a. Internal Separators: None **OR** Aluminum in media folds, **as directed**.
 - b. Gasket Material: None **OR** Neoprene **OR** Blue gel, **as directed**.
 - c. Gasket Location: None **OR** Upstream **OR** Upstream and Downstream **OR** Downstream, **as directed**.
 - d. Faceguard Material: Aluminum **OR** Stainless steel, **as directed**.
 - e. Faceguard Location: None **OR** Upstream **OR** Upstream and Downstream **OR** Downstream, **as directed**.
4. Filter-Media Frames:
 - a. Finish of Interior Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.
 - b. Materials: Stainless steel **OR** Fire-retardant plywood **OR** Fabricated aluminum **OR** Fire-retardant particleboard **OR** Galvanized sheet **OR** Non-fire-retardant particleboard, **as directed**.
 - c. Style: Box **OR** Double-turned flange **OR** Deep channel **OR** Double-turned flange, one side, **as directed**.
5. Mounting Frames: Welded galvanized steel with gaskets and fasteners; suitable for bolting together into built-up filter banks.

C. HEPA Filter Diffusers

1. Description: Factory-fabricated, individually ducted, HEPA filter-holding ceiling modules.
2. Media: Fibrous glass, constructed of continuous sheets with closely spaced pleats with glass filament separators.
 - a. Media to Module Side Bond: Urethane sealant.

- b. Media to Frame Side Bond: Polyurethane foam **OR** Silicone **OR** Neoprene adhesive **OR** Fiberglass-mat packing **OR** Thermosetting sealant **OR** Knife edge in fluid-filled channel, **as directed**.
 - c. Application: Class 100 **OR** Class 10 **OR** Class 1, **as directed**, clean room.
 - 3. Casing:
 - a. Configuration: Ducted inlet **OR** Plenum inlet **OR** Plenum inlet with prefilter, **as directed**.
 - b. Module Material: Extruded aluminum, 16 gage with mill finish.
 - c. Suspension: Ceiling grid.
 - 4. Accessories:
 - a. Diffusion damper.
 - b. Diffusion-damper adjustment port.
 - c. Filter test port.
- D. HEPA Filter Fan Modules
 - 1. Description: Factory-fabricated, HEPA filter ceiling module with fan.
 - 2. Casing:
 - a. Configuration: Ducted inlet **OR** Plenum inlet **OR** Plenum inlet with prefilter, **as directed**.
 - b. Module Material: Extruded aluminum, 16 gage with mill finish.
 - c. Suspension: Ceiling grid **OR** Independent, **as directed**.
 - 3. Media: Fibrous glass, constructed of continuous sheets with closely spaced pleats with aluminum separators **OR** vinyl-coated aluminum separators **OR** separators of ribbons of filter media, **as directed**.
 - a. Frame Material: **3/4-inch- (19-mm-)** thick, fire-retardant plywood **OR** **3/4-inch- (19-mm-)** thick, fire-retardant particleboard **OR** **3/4-inch- (19-mm-)** thick plywood **OR** **3/4-inch- (19-mm-)** thick particleboard **OR** Galvanized steel **OR** Aluminized steel **OR** Cadmium-plated steel **OR** Stainless steel **OR** Aluminum, **as directed**.
 - b. Media to Frame Side Bond: Polyurethane foam **OR** Silicone **OR** Neoprene adhesive **OR** Fiberglass-mat packing **OR** Thermosetting sealant **OR** Knife edge in fluid-filled channel, **as directed**.
 - c. Face Gasket: Neoprene expanded rubber **OR** Ceramic fiber **OR** Silicone, **as directed**.
 - d. Faceguard: Plastic **OR** Stainless steel, **as directed**.
 - 4. Accessories: Filter test port.
 - 5. Control: Variable speed.
 - 6. Motor:
 - a. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in Division 23 Section "Common Motor Requirements For Hvac Equipment".
 - b. Controllers, Electrical Devices, and Wiring: Comply with requirements for electrical devices and connections specified in Division 22.
 - c. Type: Permanent-split capacitor with SCR for speed adjustment **OR** Electronically commutated motor, **as directed**.
 - d. Fan-Motor Assembly Isolation: Rubber isolators.
 - e. Enclosure: Open dripproof **OR** Totally enclosed, fan cooled **OR** Totally enclosed, air over **OR** Open, externally ventilated **OR** Totally enclosed, nonventilated **OR** Severe duty **OR** Explosion proof **OR** Dust-ignition-proof machine, **as directed**.
 - f. Enclosure Materials: Cast iron **OR** Cast aluminum **OR** Rolled steel, **as directed**.
 - g. Motor Bearings: **<Insert special requirements>**.
 - h. Unusual Service Conditions:
 - 1) Ambient Temperature: **<Insert deg F (deg C)>**.
 - 2) Altitude: **<Insert feet (m)>** above sea level.
 - 3) High humidity.
 - i. Efficiency: Premium efficient.
 - j. NEMA Design: **<Insert designation>**.
 - k. Service Factor: **<Insert value>**.
 - l. Motor Speed: Single speed **OR** Multispeed, **as directed**.
 - 1) Speed Control: Infinitely adjustable with pneumatic-electric and electronic controls.

E. ULPA Filters

1. Description: Factory-fabricated, ULPA filters with holding casing.
2. Media: Fibrous glass, constructed of continuous sheets with closely spaced pleats with aluminum separators **OR** vinyl-coated aluminum separators **OR** separators of ribbons of filter media, **as directed**.
3. Frame Material: **3/4-inch- (19-mm-)** thick, fire-retardant plywood **OR** **3/4-inch- (19-mm-)** thick, fire-retardant particleboard **OR** **3/4-inch- (19-mm-)** thick plywood **OR** **3/4-inch- (19-mm-)** thick particleboard **OR** Galvanized steel **OR** Aluminized steel **OR** Cadmium-plated steel **OR** Stainless steel **OR** Aluminum, **as directed**.
4. Media to Frame Side Bond: Polyurethane foam **OR** Silicone **OR** Neoprene adhesive **OR** Fiberglass-mat packing **OR** Thermosetting sealant **OR** Knife-edge in fluid-filled channel, **as directed**.
5. Face Gasket: Neoprene expanded rubber **OR** Ceramic fiber **OR** Silicone, **as directed**.
6. Mounting Frames: Construct downstream corners of holding device with cushion pads to protect media. Provide bolted filter-sealing mechanism to mount and continuously seal each individual filter.

F. 95 Percent DOP Filters

1. Description: Factory-fabricated, 95 percent DOP filters with holding casing.
2. Media: Fibrous glass, constructed of continuous sheets with closely spaced pleats with aluminum separators **OR** vinyl-coated aluminum separators **OR** separators of ribbons of filter media, **as directed**.
3. Frame Material: **3/4-inch- (19-mm-)** thick, fire-retardant plywood **OR** **3/4-inch- (19-mm-)** thick, fire-retardant particleboard **OR** **3/4-inch- (19-mm-)** thick plywood **OR** **3/4-inch- (19-mm-)** thick particleboard **OR** Galvanized steel **OR** Aluminized steel **OR** Cadmium-plated steel **OR** Stainless steel **OR** Aluminum, **as directed**.
4. Frame Style: Box single header **OR** Double header **OR** Double turned flange **OR** **3/4-inch- (19-mm-)** deep channel, **as directed**.
5. Media to Frame Side Bond: Polyurethane foam **OR** Silicone **OR** Neoprene adhesive **OR** Fiberglass-mat packing **OR** Thermosetting sealant **OR** Knife edge in fluid-filled channel, **as directed**.
6. Face Guard Material: Galvanized **OR** Aluminum, **as directed**, mesh.
7. Face Guard Location: Upstream **OR** Upstream and Downstream **OR** Downstream, **as directed**.
8. Gasket Material: Neoprene expanded rubber **OR** Ceramic fiber **OR** Silicone, **as directed**.
9. Gasket Location: Upstream **OR** Upstream and Downstream **OR** Downstream, **as directed**.
10. Mounting Frames: Construct downstream corners of holding device with cushion pads to protect media. Provide bolted filter-sealing mechanism to mount and continuously seal each individual filter.

G. Front- And Rear-Access Filter Frames

1. Framing System: Aluminum framing members with access for either upstream (front) or downstream (rear) filter servicing, cut to size and prepunched for assembly into modules. Vertically support filters to prevent deflection of horizontal members without interfering with either filter installation or operation.
2. Prefilters: Incorporate a separate track, removable from front or back.
3. Sealing: Factory-installed, positive-sealing device for each row of filters to ensure seal between gasketed filter elements to prevent bypass of unfiltered air.
4. Finish of Interior Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.

H. Side-Service Housings

1. Description: Factory-assembled, side-service housings, constructed of **0.064-inch- (1.6-mm-)** thick, galvanized steel **OR** stainless steel **OR** double-wall casing with **1-inch (25-mm)** insulation, **as directed**, to hold filters. Side servicing is through gasketed access doors on one side, and

housings are capable of connection to other housings. Equip housings with metal slide channel tracks with clamping mechanisms to hold filters, and the following:

- a. Pressure tap and fitting.
- b. DOP/freon test ports.
- c. Decontamination ports.
- d. Isolation dampers.
- e. Lifting lugs.
2. Prefilters: Integral tracks to accommodate **2-, 4-, and 6-inch- (50-, 100-, and 150-mm-)** thick, disposable filters.
3. Access Doors: Continuous gaskets on perimeter and positive-locking swivel, **as directed**, devices. Provide ribbed bagging rim behind access door and PVC bags for bag-in, bag-out arrangement, **as directed**. Arrange so filter cartridges can be loaded from an access door for each tier and section of the following:
 - a. Combination prefilter and HEPA filter.
OR
Prefilter.
OR
HEPA filter.
 - b. Upstream and downstream test section.
4. Sealing: Incorporate positive-sealing gasket material on channels to seal top and bottom of filter cartridge frames to prevent bypass of unfiltered air.
5. Accessories:
 - a. Filter change-out trays.
 - b. Document-storage pocket.
 - c. Filter removal rod.
6. Finish of Interior Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.

I. Filter Gages

1. Diaphragm type with dial and pointer in metal case, vent valves, black figures on white background, and front recalibration adjustment.
 - a. Diameter: **4-1/2 inches (115 mm) OR 2 inches (50 mm), as directed.**
 - b. Scale Range for Filter Media Having a Recommended Final Resistance of **0.5-Inch wg (125 Pa)** or Less: **0- to 0.5-inch wg (0 to 125 Pa).**
 - c. Scale Range for Filter Media Having a Recommended Final Resistance of **0.5- to 1.0-Inch wg (125 to 250 Pa)** or Less: **0- to 1.0-inch wg (0 to 250 Pa).**
 - d. Scale Range for Filter Media Having a Recommended Final Resistance of **1.0- to 2.0-Inch wg (250 to 500 Pa)** or Less: **0- to 2.0-inch wg (0 to 500 Pa).**
 - e. Scale Range for Filter Media Having a Recommended Final Resistance of **2.0- to 3.0-Inch wg (500 to 750 Pa)** or Less: **0- to 3.0-inch wg (0 to 750 Pa).**
 - f. Scale Range for Filter Media Having a Recommended Final Resistance of **3.0- to 4.0-Inch wg (750 to 1000 Pa)** or Less: **0- to 4.0-inch wg (0 to 1000 Pa).**
2. Manometer-Type Filter Gage: Molded plastic, with epoxy-coated aluminum scale, logarithmic-curve tube gage with integral leveling gage; graduated to read from **0- to 3.0-inch wg (0 to 750 Pa)** and accurate within 3 percent of full-scale range.
3. Accessories: Static-pressure tips, tubing, gage connections, and mounting bracket.

1.3 EXECUTION

A. Installation

1. Position each filter unit with clearance for normal service and maintenance. Anchor filter holding frames to substrate.
2. Install filters in position to prevent passage of unfiltered air.
3. Install filter gage for each filter bank.

4. Do not operate fan system until filters (temporary or permanent) are in place. Replace temporary filters that were used during construction and testing with new, clean filters.
5. Install filter-gage static-pressure taps upstream and downstream from filters. Install filter gages on filter banks with separate static-pressure taps upstream and downstream from filters. Mount filter gages on outside of filter housing or filter plenum in an accessible position. Adjust and level inclined gages.
6. Coordinate filter installations with duct and air-handling unit installations.

B. Field Quality Control

1. Perform tests and inspections.
2. Tests and Inspections:
 - a. Operate automatic roll filters to demonstrate compliance with requirements.
 - b. Test for leakage of unfiltered air while system is operating.
 - c. HEPA Filters: Pressurize housing to a minimum of 3.0-inch wg (750 Pa) or to designed operating pressure, whichever is higher; test housing joints, door seals, and sealing edges of filter with soapy water to check for air leaks.
 - d. HEPA Filters: Pressurize housing to a minimum of 3.0-inch wg (750 Pa) or to designed operating pressure, whichever is higher; and test housing joints, door seals, and sealing edges of filter for air leaks according to pressure-decay method in ASME N510.
3. Air filter will be considered defective if it does not pass tests and inspections.
4. Prepare test and inspection reports.

C. Cleaning

1. After completing system installation and testing, adjusting, and balancing air-handling and air-distribution systems, clean filter housings and install new filter media.

END OF SECTION 22 13 19 00



Task	Specification	Specification Description
22 13 19 13	22 13 19 00	High-Efficiency Particulate Filtration

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SECTION 22 13 19 26 - INTERCEPTORS

1.1 GENERAL

A. Description Of Work

1. This specification covers the furnishing and installation of materials for interceptors. Products shall be as follows or as directed by the Owner. Installation procedures shall be in accordance with the product manufacturer's recommendations. Demolition and removal of materials shall be as required to support the work.

B. Summary

1. Section Includes:
 - a. Grease interceptors.
 - b. Oil interceptors.
 - c. Sand interceptors.

C. Definitions

1. FRP: Fiberglass-reinforced plastic.
2. PP: Polypropylene plastic.

D. Submittals

1. Product Data: For each type of metal and plastic interceptor indicated. Include materials of fabrication, dimensions, rated capacities, retention capacities, operating characteristics, size and location of each pipe connection, furnished specialties, and accessories.
2. Shop Drawings: For each type and size of precast-concrete interceptor indicated.
 - a. Include materials of construction, dimensions, rated capacities, retention capacities, location and size of each pipe connection, furnished specialties, and accessories.
3. Coordination Drawings: Interceptors, drawn to scale, on which the following items are shown and coordinated with each other, based on input from Installers of the items involved:
 - a. Interceptors.
 - b. Piping connections. Include size, location, and elevation of each.
 - c. Interface with underground structures and utility services.

E. Project Conditions

1. Interruption of Existing Sewer Services: Do not interrupt services to facilities occupied by the Owner or others unless permitted under the following conditions and then only after arranging to provide temporary sewer services according to requirements indicated:
 - a. Notify the Owner no fewer than seven days in advance of proposed interruption of service.
 - b. Do not proceed with interruption of sewer services without the Owner's written permission.

1.2 PRODUCTS

A. Grease Interceptors

1. Grease Interceptors: Precast concrete complying with ASTM C 913.
 - a. Include rubber-gasketed joints, vent connections (if required), manholes, compartments or baffles, and piping or openings to retain grease and to permit wastewater flow, unless directed otherwise.
 - b. Structural Design Loads:
 - 1) Light-Traffic Load: Comply with ASTM C 890, A-8 (ASSHTO HS10-44).
 - 2) Medium-Traffic Load: Comply with ASTM C 890, A-12 (ASSHTO HS15-44).
 - 3) Heavy-Traffic Load: Comply with ASTM C 890, A-16 (ASSHTO HS20-44).
 - 4) Walkway Load: Comply with ASTM C 890, A-03.

- c. Resilient Pipe Connectors (if required): **ASTM C 923 (ASTM C 923M)**, cast or fitted into interceptor walls, for each pipe connection.
- d. Steps: Individual FRP steps or FRP ladder **OR** Individual FRP steps, FRP ladder, or ASTM A 615/A 615M, deformed, **1/2-inch (13-mm)** steel reinforcing rods encased in ASTM D 4101, PP **OR** ASTM A 615/A 615M, deformed, **1/2-inch (13-mm)** steel reinforcing rods encased in ASTM D 4101, PP, **as directed**, wide enough to allow worker to place both feet on one step and designed to prevent lateral slippage off step. Cast or anchor steps into sidewalls at **12- to 16-inch (300- to 400-mm)** intervals. Omit steps if total depth from floor of interceptor to finished grade is less than **60 inches (1500 mm)**.
- e. Grade Rings (if required): Reinforced-concrete rings, **6- to 9-inch (150- to 225-mm)** total thickness, to match diameter of manhole frame and cover.
- f. Manhole Frames and Covers: Ferrous; **24-inch (610-mm)** ID by **7- to 9-inch (175- to 225-mm)** riser with **4-inch- (100-mm-)** minimum width flange and **26-inch- (660-mm-)** diameter cover.
 - 1) Ductile Iron: ASTM A 536, Grade 60-40-18, unless otherwise indicated.
 - 2) Gray Iron: ASTM A 48, Class 35, unless otherwise indicated.
 - 3) Include indented top design with lettering cast into cover, using wording equivalent to "INTERCEPTOR," or "GREASE INTERCEPTOR," or "SANITARY SEWER."

B. Oil Interceptors

1. Oil Interceptors: Precast concrete comply with ASTM C 913.
 - a. Include rubber-gasketed joints, vent connections, manholes, compartments or baffles, and piping or openings to retain grease and to permit wastewater flow.
 - b. Structural Design Loads:
 - 1) Light-Traffic Load: Comply with ASTM C 890, A-8 (ASSHTO HS10-44).
 - 2) Medium-Traffic Load: Comply with ASTM C 890, A-12 (ASSHTO HS15-44).
 - 3) Heavy-Traffic Load: Comply with ASTM C 890, A-16 (ASSHTO HS20-44).
 - 4) Walkway Load: Comply with ASTM C 890, A-03.
 - c. Resilient Pipe Connectors (if required): **ASTM C 923 (ASTM C 923M)**, cast or fitted into interceptor walls, for each pipe connection.
 - d. Steps: Individual FRP steps or FRP ladder **OR** Individual FRP steps, FRP ladder, or ASTM A 615/A 615M, deformed, **1/2-inch (13-mm)** steel reinforcing rods encased in ASTM D 4101, PP **OR** ASTM A 615/A 615M, deformed, **1/2-inch (13-mm)** steel reinforcing rods encased in ASTM D 4101, PP, **as directed**, wide enough to allow worker to place both feet on one step and designed to prevent lateral slippage off step. Cast or anchor steps into sidewalls at **12- to 16-inch (300- to 400-mm)** intervals. Omit steps if total depth from floor of interceptor to finished grade is less than **60 inches (1500 mm)**.
 - e. Grade Rings (if required): Reinforced-concrete rings, **6- to 9-inch (150- to 225-mm)** total thickness, to match diameter of manhole frame and cover.
 - f. Manhole Frames and Covers: Ferrous; **24-inch (610-mm)** ID by **7- to 9-inch (175- to 225-mm)** riser with **4-inch- (100-mm-)** minimum width flange and **26-inch- (660-mm-)** diameter cover.
 - 1) Ductile Iron: ASTM A 536, Grade 60-40-18, unless otherwise indicated.
 - 2) Gray Iron: ASTM A 48, Class 35, unless otherwise indicated.
 - 3) Include indented top design with lettering cast into cover, using wording equivalent to "INTERCEPTOR," or "OIL INTERCEPTOR," or "SANITARY SEWER."
 - g. Waste-oil storage tank and piping are specified in Division 23 Section "Facility Fuel-oil Piping".
2. Oil Interceptors: Factory-fabricated, cast-iron or steel body; with removable sediment bucket or strainer, baffles, vents, and flow-control fitting on inlet.
 - a. Inlet, Outlet, Vent, and Waste-Oil Outlet Piping Connections: Hub, hubless, or threaded, unless otherwise indicated.
 - b. Extension (if required): Cast-iron or steel shroud, full size of interceptor, extending from top of interceptor to grade.

- c. Cover: Cast iron or steel, with steel reinforcement to provide ASTM C 890, A-03, walkway load, **as directed**.
 - d. Comply with requirements in Division 23 Section "Facility Fuel-oil Piping" for waste-oil storage tank and piping
 3. Oil Interceptors: Plastic body; with removable sediment bucket or strainer, baffles, vents, and flow-control fitting on inlet.
 - a. Inlet, Outlet, Vent, and Waste-Oil Outlet Piping Connections: Hub, hubless, or threaded, unless otherwise indicated.
 - b. Extension (if required): Plastic shroud, full size of interceptor, extending from top of interceptor to grade.
 - c. Cover: Plastic with steel reinforcement to provide ASTM C 890, A-03, walkway load, **as directed**.
 - d. Waste-oil storage tank and piping are specified in Division 23 Section "Facility Fuel-oil Piping".
- C. Sand Interceptors
 1. Description: Factory-fabricated, cast-iron or steel body and inlet grate; with settlement chamber and removable basket or strainer.
 2. Outlet Piping Connection: Hub, hubless, or threaded, unless otherwise indicated.
 3. Grate: Cast iron or steel with reinforcement to provide ASTM C 890, A-03, walkway load, **as directed**.
- D. Precast-Concrete Manhole Risers
 1. Precast-Concrete Manhole Risers: **ASTM C 478 (ASTM C 478M) OR** ASTM C 913, **as directed**, with rubber-gasket joints.
 - a. Structural Design Loads:
 - 1) Light-Traffic Load: Comply with ASTM C 890, A-8 (ASSHTO HS10-44).
 - 2) Medium-Traffic Load: Comply with ASTM C 890, A-12 (ASSHTO HS15-44).
 - 3) Heavy-Traffic Load: Comply with ASTM C 890, A-16 (ASSHTO HS20-44).
 - 4) Walkway Load: Comply with ASTM C 890, A-03.
 - b. Length: From top of underground concrete structure to grade.
 - c. Riser Sections: **3-inch (75-mm)** minimum thickness and **36-inch (915-mm)** diameter.
 - d. Top Section: Eccentric cone, unless otherwise indicated. Include top of cone to match grade ring size.
 - e. Gaskets: **ASTM C 443 (ASTM C 443M)**, rubber.
 - f. Steps: Individual FRP steps or FRP ladder **OR** Individual FRP steps, FRP ladder, or ASTM A 615/A 615M, deformed, **1/2-inch (13-mm)** steel reinforcing rods encased in ASTM D 4101, PP **OR** ASTM A 615/A 615M, deformed, **1/2-inch (13-mm)** steel reinforcing rods encased in ASTM D 4101, PP, **as directed**, wide enough to allow worker to place both feet on one step and designed to prevent lateral slippage off step. Cast or anchor steps into sidewalls at **12- to 16-inch (300- to 400-mm)** intervals.
 2. Grade Rings: Reinforced-concrete rings, **6- to 9-inch (150- to 225-mm)** total thickness, diameter matching manhole frame and cover, and height as required to adjust the manhole frame and cover to indicated elevation and slope.
 3. Manhole Frames and Covers (if required): Ferrous; **24-inch (610-mm)** ID by **7- to 9-inch (175- to 225-mm)** riser with **4-inch- (100-mm-)** minimum width flange and **26-inch- (660-mm-)** diameter cover.
 - a. Ductile Iron: ASTM A 536, Grade 60-40-18, unless otherwise indicated.
 - b. Gray Iron: ASTM A 48, Class 35, unless otherwise indicated.
 - c. Include indented top design with lettering cast into cover, using wording equivalent to the following:
 - 1) Grease Interceptors in Sanitary Sewerage System: "INTERCEPTOR" **OR** "GREASE INTERCEPTOR" **OR** "SANITARY SEWER", **as directed**.
 - 2) Oil Interceptors in Sanitary Sewerage System: "INTERCEPTOR" **OR** "OIL INTERCEPTOR" **OR** "SANITARY SEWER", **as directed**.

1.3 EXECUTION

A. Earthwork

1. Excavating, trenching, and backfilling are specified in Division 31 Section "Earth Moving".

B. Installation

1. Install precast-concrete interceptors according to ASTM C 891. Set level and plumb.
2. Install manhole risers from top of underground concrete interceptors to manholes and gratings at finished grade.
3. Set tops of manhole frames and covers flush with finished surface in pavements. Set tops **3 inches (75 mm)** above finish surface elsewhere, unless otherwise indicated.
4. Set tops of grating frames and grates flush with finished surface.
5. Set metal and plastic interceptors level and plumb.
6. Set tops of metal interceptor covers flush with finished surface in pavements. Set tops **3 inches (75 mm)** above finish surface elsewhere, unless otherwise indicated.
7. Install piping and oil storage tanks according to Division 23 Section "Facility Fuel-oil Piping".

C. Connections

1. Piping installation requirements are specified in other Division 22. Drawings indicate general arrangement of piping, fittings, and specialties.
2. Make piping connections between interceptors and piping systems.

D. Identification

1. Identification materials and installation are specified in Division 31 Section "Earth Moving". Arrange for installation of green warning tapes directly over piping and at outside edges of underground interceptors.
 - a. Use warning tapes or detectable warning tape over ferrous piping.
 - b. Use detectable warning tape over nonferrous piping and over edges of underground structures.

END OF SECTION 22 13 19 26

Task	Specification	Specification Description
22 13 19 26	22 13 19 00	High-Efficiency Particulate Filtration
22 13 19 33	21 05 23 00	Piped Utilities Basic Materials And Methods
22 13 19 33	22 05 76 00	Sanitary Sewerage
22 13 19 33	21 05 23 00a	General-Duty Valves for Plumbing Piping
22 13 19 33	21 05 23 00b	General-Duty Valves for HVAC Piping
22 13 19 33	22 13 19 00	High-Efficiency Particulate Filtration
22 13 19 36	22 13 19 00	High-Efficiency Particulate Filtration
22 13 23 00	22 13 19 26	Interceptors

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SECTION 22 13 29 13 - PACKAGED SEWAGE PUMPING STATIONS

1.1 GENERAL

A. Description Of Work

1. This specification covers the furnishing and installation of materials for packaged sewage pumping stations. Products shall be as follows or as directed by the Owner. Installation procedures shall be in accordance with the product manufacturer's recommendations. Demolition and removal of materials shall be as required to support the work.

B. Summary

1. This Section includes dry-well, packaged pumping stations with dry-well or vacuum-primed sewage pumps.
2. This Section includes wet-well, packaged pumping stations with submersible or submersible grinder or wet-well-mounting sewage pumps.

C. Performance Requirements

1. Pressure Rating of Sewage Pumps and Discharge Piping Components: At least equal to sewage pump discharge pressure, but not less than **125 psig (860 kPa)**.
2. Pressure Rating of Other Piping Components: At least equal to system operating pressure.

D. Submittals

1. Product Data: Include rated capacities; shipping, installed, and operating weights; furnished specialties; and accessories.
2. Shop Drawings: Show fabrication and installation details for each packaged pumping station. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
 - a. Wiring Diagrams: Power, signal, and control wiring.
3. Product Certificates: For sewage pumps, signed by product manufacturer.
4. Manufacturer Seismic Qualification Certification
5. Field quality-control test reports.
6. Maintenance Data: For packaged pumping stations to include in maintenance manuals.

E. Quality Assurance

1. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for installation of units required for this Project.
2. Testing Agency Qualifications: Nationally recognized testing laboratory (NRTL) as defined by OSHA in 29 CFR 1910.7.
3. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
4. Comply with HI 1.1-1.2, "Centrifugal Pumps for Nomenclature and Definitions"; HI 1.3, "Centrifugal Pumps for Design and Application"; and HI 1.4, "Centrifugal Pumps for Installation, Operation and Maintenance," for sewage and sump pumps.
5. Comply with UL 778, "Motor-Operated Water Pumps," for sewage and sump pumps.

F. Project Conditions

1. Interruption of Existing Sanitary Sewer Service: Do not interrupt sanitary sewer service to facilities occupied by the Owner or others unless permitted under the following conditions and then only after arranging to provide temporary sanitary sewer service according to requirements indicated:
 - a. Notify the Owner no fewer than two days in advance of proposed interruption of sanitary sewer service.



- b. Do not proceed with interruption of sanitary sewer service without the Owner's written permission.

1.2 PRODUCTS

A. Dry-Well, Packaged Sewage Pumping Stations

1. Dry-Well, Packaged Sewage Pumping Stations with Dry-Well Sewage Pumps:

- a. Description: Factory fabricated, assembled, and tested with wet well for comminutor and collection of sanitary sewage and with dry equipment chamber for sewage pumps, controls, and accessories.
 - 1) Orientation: Shell underground with dry equipment chamber underground with top flush with grade **OR** partially recessed underground **OR** above grade **OR** underground with entrance tube to grade, **as directed**.
 - 2) Shell: Factory fabricated from structural-steel plate **OR** fiberglass, **as directed**.
 - 3) Entrance Tube: From dry compartment to entrance at grade, and of size required to replace largest piece of equipment, but not smaller than **36 inches (914 mm)** in diameter.
 - 4) Cathodic Protection: as directed by the Owner, exterior magnesium anode(s).
 - 5) Comminutor: Full size of sewage inlet pipe.
 - 6) Sewage Pumps: Two **OR** Three, **as directed**, dry-well-type, nonclog sewage pumps with controls and piping. Include ASTM A 48/A 48M, Class 25, nonclog, cast-iron impeller capable of passing solids of **3-inch (76-mm)** minimum diameter; mechanical or stuffing-box seals; and pedestal-mounted motor.

2. Dry-Well, Packaged Sewage Pumping Stations with Vacuum-Primed Sewage Pumps:

- a. Description: Factory fabricated, assembled, and tested with wet well for comminutor and collection of sanitary sewage and with dry equipment chamber for sewage pumps, vacuum pumps, controls, and accessories.
 - 1) Orientation: Shell underground with dry equipment chamber underground with top flush with grade **OR** partially recessed underground **OR** above grade **OR** underground with entrance tube to grade, **as directed**.
 - 2) Shell: Factory fabricated from structural-steel plate **OR** fiberglass, **as directed**.
 - 3) Entrance Tube: From dry compartment to entrance at grade, and of size required to replace largest piece of equipment, but not smaller than **36 inches (914 mm)** in diameter.
 - 4) Cathodic Protection: as directed by the Owner, exterior magnesium anode(s).
 - 5) Comminutor: Full size of sewage inlet pipe.
 - 6) Sewage Pumps: Two **OR** Three, **as directed**, dry-chamber-mounting, vacuum-primed, nonclog sewage pumps located in dry compartment above wet pit, with controls and piping. Include ASTM A 48/A 48M, Class 25, nonclog, cast-iron impeller capable of passing solids of **3-inch (76-mm)** minimum diameter; mechanical or stuffing-box seals; pedestal-mounted motor; and suction piping extending to bottom of wet pit.
 - 7) Vacuum Pumps: Duplex arrangement with controls, vacuum piping, and vent piping of size and capacity required for system. Include automatic alternator, with manual disconnect switch, to change sequence of lead-lag vacuum pumps at completion of each cycle.

B. Wet-Well, Packaged Sewage Pumping Stations

1. Wet-Well, Packaged Sewage Pumping Stations with Submersible Sewage Pumps:

- a. Description: Factory fabricated, assembled, and tested with wet well for comminutor, sewage pumps and collection of sanitary sewage and with sewage pumps and dry equipment chamber for controls and accessories.

- 1) Orientation: Shell underground with dry equipment chamber underground with top flush with grade **OR** partially recessed underground **OR** above grade **OR** underground with entrance tube to grade, **as directed**.
 - 2) Shell: Factory fabricated from structural-steel plate **OR** fiberglass, **as directed**.
 - 3) Entrance Tube: From dry compartment to entrance at grade, and of size required to replace largest piece of equipment, but not smaller than **36 inches (914 mm)** in diameter.
 - 4) Cathodic Protection: as directed by the Owner, exterior magnesium anode(s).
 - 5) Comminutor: Full size of sewage inlet pipe.
 - 6) Sewage Pumps: Two **OR** Three, **as directed**, submersible-type sewage pumps, with guide rail, quick-disconnect system, controls, and piping. Include ASTM A 48/A 48M, Class 25, nonclog, cast-iron impeller capable of passing solids of **3-inch (76-mm)** minimum diameter; and hermetically sealed motor with moisture-sensing probe, mechanical seals, and waterproof power cable.
2. Wet-Well, Packaged Sewage Pumping Stations with Submersible Grinder Sewage Pumps:
- a. Description: Factory fabricated, assembled, and tested with wet well for sewage pumps and collection of sanitary sewage and with dry equipment chamber for controls and accessories.
 - 1) Orientation: Shell underground with dry equipment chamber underground with top flush with grade **OR** partially recessed underground **OR** above grade **OR** underground with entrance tube to grade, **as directed**.
 - 2) Shell: Factory fabricated from structural-steel plate **OR** fiberglass, **as directed**.
 - 3) Entrance Tube: From dry compartment to entrance at grade, and of size required to replace largest piece of equipment, but not smaller than **36 inches (914 mm)** in diameter.
 - 4) Cathodic Protection: as directed by the Owner, exterior magnesium anode(s).
 - 5) Sewage Pumps: Two **OR** Three, **as directed**, submersible grinder-type sewage pumps, with guide rail, quick-disconnect system, controls, and piping. Include stainless-steel grinder impeller and hermetically sealed motor with moisture-sensing probe, mechanical seals, and waterproof power cable.
 - a) If Project has more than one wet-well, packaged sewage pumping station with submersible grinder sewage pumps,
3. Wet-Well, Packaged Sewage Pumping Stations with Wet-Well-Mounting Sewage Pumps:
- a. Description: Factory fabricated, assembled, and tested with wet well for comminutor, sewage pumps and collection of sanitary sewage and with suspended sewage pumps and dry equipment chamber for pump motors, controls, and accessories.
 - 1) Orientation: Shell underground with dry equipment chamber underground with top flush with grade **OR** partially recessed underground **OR** above grade **OR** underground with entrance tube to grade, **as directed**.
 - 2) Shell: Factory fabricated from structural-steel plate **OR** fiberglass, **as directed**.
 - 3) Entrance Tube: From dry compartment to entrance at grade, and of size required to replace largest piece of equipment, but not smaller than **36 inches (914 mm)** in diameter.
 - 4) Cathodic Protection: as directed by XXXXcontractingpositiontheXXX, exterior magnesium anode(s).
 - 5) Comminutor: Full size of sewage inlet pipe.
 - 6) Sewage Pumps: Two **OR** Three, **as directed**, wet-well-mounting-type, nonclog sewage pumps suspended from dry-compartment floor, with controls and piping. Include ASTM A 48/A 48M, Class 25, nonclog, cast-iron impeller capable of passing solids of **3-inch (76-mm)** minimum diameter; grease-lubricated bearings and stuffing-box seal; shaft coupling; and pedestal-mounted motor.
- C. Comminutors:
1. Description: Motor-operated, single- or twin-shaft, cutter- or grinder-design unit with controls; for pipeline installation.
 - a. Body: Stainless steel or ductile iron with flanged ends and access plate.



- b. Cutting Elements: Motor-driven rotor and stationary cutters or grinders of hardened stainless or heat-treated steel.
- c. Motor: Explosion proof, directly connected to body.
- d. Control Panel: NEMA 250, Type 12 enclosure for installation in dry equipment chamber.

D. Controls

1. Control Sequence of Operation: Cycle each sewage pump on and off automatically to maintain wet-well sewage level. Automatic control operates both pumps in parallel if wet-well level rises above starting point of low-level pump, until shutoff level is reached. Automatic alternator, with manual disconnect switch, changes sequence of lead-lag sewage pumps at completion of each pumping cycle.
2. Self-Purging, Air-Bubbler System: Senses variations of sewage level in wet well. Include duplex-arrangement oilless air compressors to furnish bubbler air; filters; air-storage reservoir; piping; airflow meter with needle valve adjustment for airflow regulation; sewage depth gage; air-bubbler piping to wet well; and pressure-sensing, dustproof mercury switches.
3. Electrode **OR** Float-Switch **OR** Pressure-Switch **OR** Ultrasonic, **as directed**, System: Senses variations of sewage level in wet well. Include high and low adjustments capable of operating on **6-inch (150-mm)** minimum differential of liquid level.
4. Motor Controllers: Magnetic, full voltage, nonreversing. Include undervoltage release, thermal-overload heaters in each phase, manual reset buttons, and hand-automatic selector switches. Include circuit breakers to provide branch-circuit protection for each controller.
5. 120-V accessory controls with 15-A, single-phase circuit breakers or fuses for each item.
6. Control Panel: Enclosure complying with UL 508A and with UL 508A, Supplement SB, **as directed**, with separate compartments and covers for controllers, circuit breakers, transformers, alternators, and single-phase controls. Include 20-A duplex receptacle in NEMA WD 1, Configuration 5-20R mounted on exterior of control panel.
 - a. Mounting: Inside, on dry-chamber wall **OR** Outside, on pedestal, at grade, **as directed**.
 - b. Enclosure: NEMA 250, Type 1 **OR** 4 **OR** 4X, **as directed**.
7. Install labels on panel face to identify switches and controls.
8. Wiring: Tin-copper wiring.
9. Connection for Portable Generator: Nonautomatic (manual) transfer switch with receptacle matching generator electrical power requirements. Nonautomatic transfer switches are specified in Division 26 Section "Transfer Switches" and receptacles are specified in Division 26 Section "Wiring Devices".

E. Accessories

1. Lighting: Minimum of 2, UL 1571, heavy-duty, cast-metal, wet-location-type fixtures with 100-W bulbs and guards in service area. Locate switches, with pilot lights, at chamber entrance.
2. Submersible Sump Pump:
 - a. Discharge Size: **NPS 1-1/4 (DN 32)** minimum.
 - b. Pump End Bell and Motor Shell: Cast iron.
 - c. Motor: 1/3 hp, 1750-rpm, hermetically sealed, capacitor-start, with built-in overload protection.
 - d. Impeller: ASTM B 584, cast bronze or ASTM B 36/B 36M, brass.
 - e. Shaft: Stainless steel.
 - f. Bearings: Grease-lubricated, factory-sealed ball bearings.
 - g. Seals: Mechanical.
 - h. Accessories: Inlet strainer.
 - i. Controls: Float switch.
3. Dehumidifier: Electric refrigeration system, adjustable humidistat, reverse-acting thermostat for low-temperature cutoff controls, and condensate pump with drain piping to sump.
 - a. Dehumidification system capacity adequate to remove at least **15 pints (7 L)** of water per day from service area air that is **80 deg F (27 deg C)** with a relative humidity of 60 percent.
4. Ventilation: Electrically powered ventilation system. Include centrifugal blower with **4-inch- (100-mm-)** round exhaust vent designed to keep out rain, insects, and other foreign matter; limit switch

- to start blower if entrance door or lid is opened; 0- to 15-minute timer; and separate manual switch.
 - a. Ventilating system capacity to change air in dry equipment chamber every two minutes.
5. Heater: Electric, 1.5 kW minimum, with fan and thermostat control.
6. High-Water Audio Alarm: Horn for audio indication of station high-water level, energized by separate level-detecting device. Include alarm silencer switch and relay in station.
7. Remote Alarm Circuit: Include contacts for connection to remote alarm panel.
- F. Motors
 1. General requirements for motors are specified in Division 22 Section "Common Motor Requirements For Plumbing Equipment".
- G. Miscellaneous Materials
 1. Structural Steel: ASTM A 6/A 6M, W or HP shapes, or ASTM A 36/A 36M, plates or beams.
 2. Grout: ASTM C 1107, Grade B, nonshrink cement grout.
 - a. Design Mix: **5000-psi (34.5-MPa)**, 28-day compressive strength.
 3. Concrete: Concrete is specified in Division 03 Section "Cast-in-place Concrete".
- H. Packaged Sewage Pumping Station Fabrication
 1. Fabricate shell from structural-steel plate with continuous welds to make watertight and gastight construction.
 - a. Walls: **1/4-inch (6.4-mm)** minimum thickness.
 - b. Top and Bottom Heads: **3/8-inch (9.5-mm)** minimum thickness. Weld reinforcing steel to top and bottom heads.
 - c. Entrance-Tube Walls: **1/4-inch (6.4-mm)** minimum thickness.
 - d. Weld steel access ladder and air vent to shell and entrance tube, **as directed**.
 - e. Apply three coats of epoxy resin to interior and exterior surfaces.
 - f. Include at least two **OR** four, **as directed**, exterior magnesium anode(s) for cathodic protection.
 2. Fabricate shell from fiberglass with structural-steel reinforcement.
 - a. Attach structural-steel reinforcement to top and bottom heads.
 - b. Fabricate shell with continuous joints to make watertight and gastight construction.
 - c. Attach air vent to pump chamber and entrance tube, **as directed**.
 - d. Ladder: Steel **OR** Fiberglass, **as directed**.
 3. Install sump, **18 inches (450 mm)** in diameter by **10 inches (254 mm)** deep in dry-chamber floor. Slope floor toward sump and fasten rubber mat to floor walkway with cement.
 4. Entrance tube may be furnished separately for field installation.
 5. Entrance Cover: Waterproof and corrosion resistant, with lock. Include way to open cover from inside tube if cover is locked.
 6. Air Vent: Duct fabricated from corrosion-resistant material, extended to above grade, outlet turned down, and with insect screen in outlet.
 7. Factory fabricate piping between unit components.
 - a. Use galvanized-steel pipe and cast-iron fittings or ductile-iron pipe and fittings.
 - b. Use fittings for changes in direction and branch connections.
 - c. Flanged and union joints may be used instead of joints specified.
 - d. Use dielectric fittings for connections between ferrous- and copper-alloy piping.
 8. Piping Connections: Unless otherwise indicated, make the following piping connections:
 - a. Install unions, in piping **NPS 2 (DN 50)** and smaller, adjacent to each valve and at final connection to each piece of equipment having **NPS 2 (DN 50)** or smaller threaded pipe connection.
 - b. Install flanges, in piping **NPS 2-1/2 (DN 65)** and larger, adjacent to flanged valves and at final connection to each piece of equipment having flanged pipe connection.
 9. Valves: Ferrous alloy.
 - a. Sewage Pump Piping: Include gate valve on each pump inlet and gate and check valves on each discharge pipe.
 - b. Sump Pump Piping: Include ball or gate and check valves on discharge pipe.



- c. Compressed-Air Piping: Include ball and check valves on discharge pipe from each air compressor.
- d. Vacuum Piping: Include ball and check valves on inlet pipe to each vacuum pump.
- 10. Wiring: Tin-coated copper.

I. Source Quality Control

- 1. Test and inspect sewage and sump, **as directed**, pumps according to HI 1.6, "Centrifugal Pump Tests." Include test recordings that substantiate correct performance of pumps at design head, capacity, suction lift, speed, and horsepower.
- 2. Test accessories and controls through complete cycle. Include test recordings that substantiate correct performance.

1.3 EXECUTION

A. Earthwork

- 1. Excavation, trenching, and backfilling are specified in Division 31 Section "Earth Moving".

B. Installation

- 1. Install packaged sewage pumping station components where indicated, according to specific equipment and piping arrangement indicated.
- 2. Shell Base Supports: Form from structural-steel beams, of number and lengths required to support bottom of shell and to anchor beams to concrete foundation.
 - a. Use elevator blocks attached to bottom of shell to slope station floor **1 inch in 10 feet (25.4 mm in 3 m)** down toward sump.
- 3. Grout under and around shell. Ensure that there are no voids between foundation slab and underslab of pumping station.
- 4. Fill voids between shell sidewalls, sleeves, and piping and make watertight seal with grout.
- 5. Connect anode conductors to grounding lugs on steel housing.
- 6. Join separate sections of housing by field welding.
- 7. Field weld entrance tube to housing.

C. Connections

- 1. Sanitary sewer piping installation requirements are specified in Division 22 Section "Facility Sanitary Sewers". Drawings indicate general arrangement of piping.
- 2. Install piping adjacent to machine to allow service and maintenance.
- 3. Ground equipment according to Division 26 Section "Grounding And Bonding For Electrical Systems".
- 4. Connect wiring according to Division 26 Section "Low-voltage Electrical Power Conductors And Cables".

D. Identification

- 1. Install identifying labels permanently attached to equipment.
- 2. Install operating instruction signs permanently attached to equipment or on pumping station wall near equipment.
- 3. Arrange for installing green warning tape or detectable warning tape over outside edges of underground packaged sewage pumping stations. Tape materials and their installation are specified in Division 31 Section "Earth Moving".

E. Painting

- 1. Prepare and paint ferrous piping in wet wells, structural-steel supports, and anchor devices with coal-tar epoxy-polyamide paint according to SSPC-Paint 16.
- 2. Paint field-welded areas to match factory coating.

F. Field Quality Control

1. Testing Agency: Engage a qualified testing agency to perform field tests and inspections and prepare test reports.
 2. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.. Report results in writing.
 3. Perform tests and inspections and prepare test reports.
 - a. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.
 4. Tests and Inspections:
 - a. After installing packaged sewage pumping stations and after electrical circuitry has been energized, test for compliance with requirements. Furnish water required for pump tests.
 - b. Leak Test: After installation, charge systems and test for leaks. Repair leaks and retest until no leaks exist.
 - c. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
 - d. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
 5. Remove and replace packaged sewage pumping stations that do not pass tests and inspections and retest as specified above.
- G. Startup Service
1. Engage a factory-authorized service representative to perform startup service.
 - a. Complete installation and startup checks according to manufacturer's written instructions.
 - b. Adjust pump, accessory, and control settings, and safety and alarm devices.
- H. Demonstration
1. Engage a factory-authorized service representative to train the Owner's maintenance personnel to adjust, operate, and maintain packaged sewage pumping stations.

END OF SECTION 22 13 29 13

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SECTION 22 13 29 13a - LIFT STATION

1.1 GENERAL

A. Description Of Work

1. This Specification covers the furnishing and installation of sewage lift stations. Work includes but is not limited to earthwork, installation of watertight precast concrete sump basin, basin access cover, submersible sewage pumps, pump guide rail system, pump control system, valves and piping and electrical connections as required. Specific sizes of basins, pumps, and piping shall be as follows or as directed by the Owner.

B. Submittals

1. Product Data: For each type of product indicated.
 - a. Pipe and fittings
 - b. Check valves
 - c. Gate valves
 - d. Submersible sewage grinder pumps
 - e. Pump motor
 - f. Flexible flanged coupling
2. Operation and Maintenance Data: Include pumps, alarms, and motors. Data for submersible sewage grinder pump station data shall include all information on all equipment, alarm panel and controls, pumps and pump performance curves, and station layout.

C. Delivery, Storage, and Handling of Materials

1. Delivery and Storage: Inspect materials delivered to site for damage. Unload and store with minimum handling. Store materials in enclosures or under protective covering. Store rubber gaskets not to be installed immediately under cover, out of direct sunlight. Do not store materials directly on the ground. Keep interior of pipes and fittings free of dirt and debris.
2. Handling: Handle pipe, fittings, valves, and other accessories in such manner as to ensure delivery to the trench in sound, undamaged condition. Avoid injury to coatings and linings on pipe and fittings; make satisfactory repairs if coatings or linings are damaged. Carry pipe to the trench; do not drag it.

1.2 PRODUCTS

A. Precast Concrete Sump Basin(s)

1. Precast Concrete Sump Basin shall be constructed in conformance with Division 26 Section "Underground Ducts And Raceways For Electrical Systems". Basin shall have an integral bottom base section.
2. Joint Sealant: Seal all joints with EZ Stik Butyl Gasket as manufactured by Concrete Products Supply Co., or approved equal. Install in accordance with manufacturer's recommendations.
3. Pipe Opening Seals.
4. Waterproofing: Waterproof interior of concrete sump with one coat of Koppers Coal Tar Bitumastic Black or approved equal. Repair all damaged coating before final backfill. Do not coat cover of basin.
5. Access Hatch - Aluminum Hinged Frame and Cover Model EC-3HD by Syracuse Castings, Cicero, NY (315) 699-2601, or approved equal. Frame and cover shall be heavy duty, rated for H-20 Loadings. Frame shall be angle style frame. Material shall be 6061-T6 aluminum for bars, angles and extrusions. 1/4" diamond plate shall be 5086 aluminum. Unit designed heavy duty, for H-20 wheel loads where not subject to high density traffic. Unit supplied with a heavy duty pneu-spring, for ease of operation when opening cover. Each hatch shall be equipped with a hold open arm. Door shall lock open in the 90 degree position. Hinges shall be of heavy duty design. Material shall be a brass alloy with a 65,000 psi tensile strength. Each hinge shall have

a Grade 316 Stainless Steel, 3/8" diameter hinge pin. Exterior of frame, which comes in contact with concrete shall have one coat black bituminous paint. Unit supplied with a recessed stainless steel slamlock. Angle frame must be completely encased in concrete. Both bearing plates must be fully supported by a bed of concrete.

6. The unit shall be supplied with aluminum safety grate. Safety Grate shall be made of 6061-T6 aluminum with a minimum ultimate strength of 38,000 psi and a minimum yield strength of 35,000 psi as per ASTM B221. Grate design shall use safety factors as defined in the "Specifications for Aluminum Structures", by the Aluminum Association, Inc., 5th edition, DEC. 1986 for "Bridge Type Structures."
 - a. Grating shall be designed to withstand a minimum live load of 300 pounds per square foot. Deflection shall not exceed 1/150th of the span.
 - b. Grate openings shall be 4" x 4", which will allow for visual inspection of the pit once the access hatch is open.
 - c. Each grate shall be provided with a stainless steel, safety check chain. Chain will prevent the grating from falling into the pit.
 - d. Welding shall be in accordance with ANSI/AWS D1.2 "Structural Welding Code for Aluminum."

B. Submersible Sewage Pump System

1. Submersible sewage effluent pumps shall be sized as directed by the Owner and specified herein. Pump shall be heavy duty cast iron with stainless steel fasteners. The impeller shall be semi-open, non-clog, engineered plastic capable of passing 3/4" solids. Pump motor shall be oil filled. Pumps shall be equal to SHEF Series as manufactured by Hydromatic or approved equal. Specific pump performance data shall conform to the following:

1/2 HP Pumps 230 volt/single phase/60 Hz/2" NPT/ 3450 rpm

40 gpm @ 42 ft.	TDH
50 gpm @ 32 ft.	TDH
60 gpm @ 18 ft.	TDH

1 HP Pumps 230 volt/single phase/60 Hz/2" NPT/3450 rpm

20 gpm @ 80 ft.	TDH
30 gpm @ 76 ft.	TDH
40 gpm @ 71 ft.	TDH
50 gpm @ 65 ft.	TDH

C. Duplex Guide Rail System: Complete package system shall be as manufactured by Moran Manufacturing Inc., or approved equal, as follows.

1. The guide rail assembly shall be constructed of Type 304 stainless steel and shall consist of a minimum of two rails, a bottom base plate, a minimum of one cross brace every 18 inches between the rails and a wall brace, all welded together to provide the maximum structural integrity. The rails shall be round to provide a non-binding surface during installation and removal of the pump. The guide rail assembly shall be installed as a one piece unit and shall be bolted with stainless anchor bolts to the basin bottom and the basin wall a minimum of two places each.
2. The pump bracket assembly shall consist of a top bracket and a bottom bracket. The brackets shall be fabricated of 1/4" steel material and shall be painted with coal tar epoxy paint at such rate as to provide a minimum 10 mil thickness. The top bracket shall be attached to the discharge piping above the pump disconnect and shall be constructed in such a manner that pump cannot be removed from the guide rail assembly except when removing pump out the top of the sump basin. The bottom bracket shall be attached to the pump at the discharge connection and shall guide the pump along the guide rail assembly to ensure proper alignment of the pump.

3. A 3/16" min. (7 x 9) stainless steel lifting cable, 10 ft. longer than the sump depth, shall be furnished for lifting and lowering the pump in the sump basin. The stainless steel lifting cable shall be of the 18-8 type 302/304 stainless steel and shall have minimum nominal breaking strength of 15 times the weight of the pump. It shall be substantially attached to the top of the pump and shall have a formed loop at the other end.
4. The discharge piping shall include a cast iron ball check valve, with a natural rubber ball and clean out port with plug for easy access, a brass quick disconnect fitting, with an O-ring stem brass gate valve, per pump. All other piping shall be schedule 40 stainless steel.
5. The station shall have a gate valve extension handle per valve which will allow the gate valve to be operated from a maximum of 6" below the basin cover. The handle shall be constructed of a minimum of 3/8" dia. Type 304 stainless steel. The handle shall be held in place by being attached to the gate valve and by the guide rail wall brace.
6. All internal metal parts that are not brass, galvanized steel, or stainless steel shall be painted with coal-tar epoxy paint to resist corrosion, unless otherwise noted.
7. Mercury level control switches shall be provided for lead pump on, lag pump on and high level alarm, pumps off and low level alarm.
8. The mercury switch shall be encapsulated in polyurethane foam for corrosion and shock resistance. Level switches shall be weighted to hold position in the sump. The cord connecting the control shall be No. 16-2, rated for 13 amps, and shall be type C-SJO. To ensure optimum longevity, mercury contacts shall be of the mercury-to-mercury type and encapsulated in a glass tube and shall be rated for 20 amps at 115 VAC.
9. The manufacturer of the lift station shall furnish a limited warranty for 18 months from the date of shipment or 12 months from start-up (whichever occurs first), that all equipment shall be free from defects in design, materials and workmanship. The lift station manufacturer shall furnish replacement parts for any component proven defective whether of its or other manufacturer during the warranty period, excepting only those items which are normally consumed in service, such as (but not limited to) light bulbs, oil, grease, packing, etc.
10. Installation instructions shall be furnished with the station.

D. Control System

1. This system shall be controlled and protected by a packaged system as manufactured by Rombus, or approved equal. The control shall provide automatic start, stop and alternation of 2 pumps, and shall provide an audible alarm as well as visual indication of high level conditions.
2. The control panel shall be pre-wired in a NEMA 3R weatherproof enclosure, and all necessary components including the following: single phase lightning arrestor for protection of the pumps, NEMA rated contractor and thermal magnetic circuit breaker for each pump, a main control/alarm circuit fused disconnect switch, separately fused control and alarm circuits, panel mounted duplex alternating relays, control relays, and terminal blocks for the connection on all external wiring. Provide a 20 amp/115v convenience outlet in each panel on its own GFCI circuit breaker. Multi-colored circuitry is to be used within the control panel to facilitate trouble shooting.
3. Mounted inside the enclosure shall be hand-off-auto switches and run pilot lights for each pump circuit; normal-off-test switch and alarm pilot light for high level alarm; float test toggle switches for each float to override floats to simulate operation; non-resettable elapsed time meters for each pump.
4. Mounted remotely from the Control Panel shall be a 4" 120V alarm bell and a flashing alarm light.

E. System Operation: As the level in the sump rises to the lead pump on level, the pump selected as lead by the alternator will come on line, and will pump the level down to the pump off level. The pump will then turn off, and the alternator will cycle, selecting the other pump as lead for the next cycle. If, with the lead pump running, the level in the tank continues to rise to the lag pump on level, the lag pump will come on line, alarms will sound, and will run with the lead pump until the pumps off level has been reached. The pumps will then be turned off, and the alternator will cycle. If level continues to drop to the low level alarm float, alarm circuits will be activated.

1. Placing the T-O-N switch into the off position will de-energize the alarm bell and flashing light, but the alarm pilot light will remain illuminated until the alarm condition has been cleared. When the

alarm pilot light is extinguished, the T-O-N switch may be reset to the normal position, and the alarm will stand ready for the next alarm.

1.3 EXECUTION

- A. The Contractor shall excavate the station site to the elevations as required to meet project requirements. Compact the subgrade and install crushed stone.
- B. Install lift station in accordance with manufacturer's recommendations. Perform additional exterior waterproofing as required to repair original coating and to achieve a watertight sump basin. The discharge piping shall be extended and connected to the sewage force mains. Backfill material shall be approved by the Owner. No backfill material shall have any dimension greater than 6". Backfill material within 15" of basin shall not have a dimension greater than 2".
- C. The Lift Station control panel shall be mounted to the building nearby and shall have sufficient cord supplied by the Lift Station manufacturer to avoid any splices. All necessary electrical connections between pumps, flow controls and control panel shall be made in accordance with manufacturer's recommendations. No splices shall be made in the basin. Lightning protection shall be provided in the panel.
- D. Install pump power conductors in rigid steel conduit between Lift Station and Control Panel.
- E. Upon completion, the Lift Station shall be tested to assure there is no leakage and that the pumps, controls and alarm are operating satisfactorily. The Lift Station manufacturer's representative shall be present during initial start up and testing. Three (3) Lift Station operation and maintenance manuals shall be provided.

END OF SECTION 22 13 29 13a

SECTION 22 13 29 13b - SEWAGE PUMPS

1.1 GENERAL

A. Description Of Work

1. This specification covers the furnishing and installation of materials for sewage pumps. Products shall be as follows or as directed by the Owner. Installation procedures shall be in accordance with the products manufacturer's recommendations. Demolition and removal of materials shall be as required to support the work.

B. Summary

1. Section Includes:
 - a. Submersible effluent pumps.
 - b. Submersible sewage pumps.
 - c. Wet-pit-volute sewage pumps.
 - d. Sewage-pump, reverse-flow assemblies.
 - e. Sewage-pump basins and basin covers.
 - f. Progressing-cavity sewage pumps.
 - g. Packaged, submersible sewage-pump units.
 - h. Packaged wastewater-pump units.

C. Submittals

1. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
2. Wiring Diagrams: For power, signal, and control wiring.
3. Operation and Maintenance Data: For pumps and controls, to include in operation and maintenance manuals.

D. Quality Assurance

1. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
2. UL Compliance: Comply with UL 778 for motor-operated water pumps.

E. Delivery, Storage, And Handling

1. Retain shipping flange protective covers and protective coatings during storage.
2. Protect bearings and couplings against damage.
3. Comply with pump manufacturer's written rigging instructions for handling.

F. Coordination

1. Coordinate sizes and locations of concrete bases with actual equipment provided.

1.2 PRODUCTS

A. Submersible Effluent Pumps

1. Submersible, Fixed-Position, Single-Seal Effluent Pumps:
 - a. Description: Factory-assembled and -tested effluent-pump unit.
 - b. Pump Type: Submersible, end-suction, single-stage, close-coupled, overhung-impeller, centrifugal effluent pump as defined in HI 1.1-1.2 and HI 1.3.
 - c. Pump Casing: Cast iron, with open inlet, legs that elevate pump to permit flow into impeller, and vertical discharge for piping connection.
 - d. Impeller: Statically and dynamically balanced, ASTM A 48/A 48M, Class No. 25 A cast iron **OR** ASTM A 532/A 532M, abrasion-resistant cast iron **OR** ASTM B 584, cast bronze, **as**

- directed**, and stainless steel, **as directed**, closed or semiopen design for clear wastewater, and keyed and secured to shaft.
- e. Pump and Motor Shaft: Stainless steel **OR** steel, **as directed**, with factory-sealed, grease-lubricated ball bearings.
 - f. Seal: Mechanical.
 - g. Motor: Hermetically sealed, capacitor-start type; with built-in overload protection; lifting eye or lug; and three-conductor, waterproof power cable of length required and with grounding plug and cable-sealing assembly for connection at pump.
 - 1) Motor Housing Fluid: Air **OR** Oil, **as directed**.
 - h. Controls (rod-and-float type):
 - 1) Enclosure: NEMA 250, Type 1 **OR** Type 4X, **as directed**.
 - 2) Switch Type: Pedestal-mounted float switch with float rods and rod buttons.
 - 3) Automatic Alternator: Start pumps on successive cycles and start multiple pumps if one cannot handle load.
 - 4) Float Guides: Pipe or other restraint for floats and rods in basins of depth greater than **60 inches (1500 mm)**.
 - 5) High-Water Alarm: Cover-mounted, compression-probe alarm, with electric bell; 120-V ac, with transformer and contacts for remote alarm bell.
 - i. Controls (float- and pressure-switch types):
 - 1) Enclosure: NEMA 250, Type 1 **OR** Type 4X, **as directed**; pedestal-mounted **OR** wall-mounted, **as directed**.
 - 2) Switch Type: Mechanical-float **OR** Mercury-float **OR** Pressure, **as directed**, type, in NEMA 250, Type 6 enclosures with mounting rod and electric cables.
 - 3) Automatic Alternator: Start pumps on successive cycles and start multiple pumps if one cannot handle load.
 - 4) High-Water Alarm: Rod-mounted, NEMA 250, Type 6 enclosure with mechanical-float, mercury-float, or pressure switch matching control and electric bell; 120-V ac, with transformer and contacts for remote alarm bell.
 - j. Control-Interface Features:
 - 1) Remote Alarm Contacts: For remote alarm interface.
 - 2) Building Automation System Interface: Auxiliary contacts in pump controls for interface to building automation system and capable of providing the following:
 - a) On-off status of pump.
 - b) Alarm status.
2. Submersible, Fixed-Position, Double-Seal Effluent Pumps:
- a. Description: Factory-assembled and -tested effluent-pump unit.
 - b. Pump Type: Submersible, end-suction, single-stage, close-coupled, overhung-impeller, centrifugal effluent pump as defined in HI 1.1-1.2 and HI 1.3.
 - c. Pump Casing: Cast iron, with open inlet, legs that elevate pump to permit flow into impeller, and vertical discharge for piping connection.
 - d. Impeller: Statically and dynamically balanced, ASTM A 48/A 48M, Class No. 25 A cast iron **OR** ASTM A 532/A 532M, abrasion-resistant cast iron **OR** ASTM B 584, cast bronze, **as directed**, and stainless steel, **as directed**, closed or semiopen design for clear wastewater, and keyed and secured to shaft.
 - e. Pump and Motor Shaft: Stainless steel **OR** steel, **as directed**, with factory-sealed, grease-lubricated ball bearings.
 - f. Seals: Mechanical.
 - g. Moisture-Sensing Probe: Internal moisture sensor and moisture alarm.
 - h. Motor: Hermetically sealed, capacitor-start type; with built-in overload protection; lifting eye or lug; and three-conductor, waterproof power cable of length required and with grounding plug and cable-sealing assembly for connection at pump.
 - 1) Motor Housing Fluid: Air **OR** Oil, **as directed**.
 - i. Controls (rod-and-float type):
 - 1) Enclosure: NEMA 250, Type 1 **OR** Type 4X, **as directed**.
 - 2) Switch Type: Pedestal-mounted float switch with float rods and rod buttons.

- 3) Automatic Alternator: Start pumps on successive cycles and start multiple pumps if one cannot handle load.
- 4) Float Guides: Pipe or other restraint for floats and rods in basins of depth greater than **60 inches (1500 mm)**.
- 5) High-Water Alarm: Cover-mounted, compression-probe alarm, with electric bell; 120-V ac, with transformer and contacts for remote alarm bell.
- j. Controls (float- and pressure-switch types):
 - 1) Enclosure: NEMA 250, Type 1 **OR** Type 4X, **as directed**; pedestal-mounted **OR** wall-mounted, **as directed**.
 - 2) Switch Type: Mechanical-float **OR** Mercury-float **OR** Pressure, **as directed**, type, in NEMA 250, Type 6 enclosures with mounting rod and electric cables.
 - 3) Automatic Alternator: Start pumps on successive cycles and start multiple pumps if one cannot handle load.
 - 4) High-Water Alarm: Rod-mounted, NEMA 250, Type 6 enclosure with mechanical-float, mercury-float, or pressure switch matching control and electric bell; 120-V ac, with transformer and contacts for remote alarm bell.
- k. Control-Interface Features:
 - 1) Remote Alarm Contacts: For remote alarm interface.
 - 2) Building Automation System Interface: Auxiliary contacts in pump controls for interface to building automation system and capable of providing the following:
 - a) On-off status of pump.
 - b) Alarm status.
3. Submersible, Quick-Disconnect, Single-Seal Effluent Pumps:
 - a. Description: Factory-assembled and -tested effluent-pump unit with guide-rail supports.
 - b. Pump Type: Submersible, end-suction, single-stage, close-coupled, overhung-impeller, centrifugal effluent pump as defined in HI 1.1-1.2 and HI 1.3.
 - c. Pump Casing: Cast iron, with open inlet, and discharge fittings for connection to guide-rail support.
 - d. Impeller: Statically and dynamically balanced, ASTM A 48/A 48M, Class No. 25 A cast iron **OR** ASTM A 532/A 532M, abrasion-resistant cast iron **OR** ASTM B 584, cast bronze, **as directed**, and stainless steel, **as directed**, closed or semiopen design for clear wastewater, and keyed and secured to shaft.
 - e. Pump and Motor Shaft: Stainless steel **OR** steel, **as directed**, with factory-sealed, grease-lubricated ball bearings.
 - f. Seal: Mechanical.
 - g. Motor: Hermetically sealed, capacitor-start type; with built-in overload protection; lifting eye or lug; and three-conductor, waterproof power cable of length required and with grounding plug and cable-sealing assembly for connection at pump.
 - 1) Motor Housing Fluid: Air **OR** Oil, **as directed**.
 - h. Controls (rod-and-float type):
 - 1) Enclosure: NEMA 250, Type 1 **OR** Type 4X, **as directed**.
 - 2) Switch Type: Pedestal-mounted float switch with float rods and rod buttons.
 - 3) Automatic Alternator: Start pumps on successive cycles and start multiple pumps if one cannot handle load.
 - 4) Float Guides: Pipe or other restraint for floats and rods in basins of depth greater than **60 inches (1500 mm)**.
 - 5) High-Water Alarm: Cover-mounted, compression-probe alarm, with electric bell; 120-V ac, with transformer and contacts for remote alarm bell.
 - i. Controls (float- and pressure-switch types):
 - 1) Enclosure: NEMA 250, Type 1 **OR** Type 4X, **as directed**; pedestal-mounted **OR** wall-mounted, **as directed**.
 - 2) Switch Type: Mechanical-float **OR** Mercury-float **OR** Pressure, **as directed**, type, in NEMA 250, Type 6 enclosures with mounting rod and electric cables.
 - 3) Automatic Alternator: Start pumps on successive cycles and start multiple pumps if one cannot handle load.

- 4) High-Water Alarm: Rod-mounted, NEMA 250, Type 6 enclosure with mechanical-float, mercury-float, or pressure switch matching control and electric bell; 120-V ac, with transformer and contacts for remote alarm bell.
- j. Control-Interface Features:
 - 1) Remote Alarm Contacts: For remote alarm interface.
 - 2) Building Automation System Interface: Auxiliary contacts in pump controls for interface to building automation system and capable of providing the following:
 - a) On-off status of pump.
 - b) Alarm status.
- k. Guide-Rail Supports:
 - 1) Standard: SWPA's "Submersible Sewage Pumping Systems (SWPA) Handbook."
 - 2) Guide Rails: Vertical pipes or structural members, made of galvanized steel or other corrosion-resistant metal, attached to baseplate and basin sidewall or cover.
 - 3) Baseplate: Corrosion-resistant metal plate, attached to basin floor, supporting guide rails and stationary elbow.
 - 4) Pump Yoke: Motor-mounted or casing-mounted yokes or other attachments for aligning pump during connection of flanges.
 - 5) Movable Elbow: Pump discharge-elbow fitting with flange, seal, and positioning device.
 - 6) Stationary Elbow: Fixed discharge-elbow fitting with flange that mates to movable-elbow flange and support attached to baseplate.
 - 7) Lifting Cable: Stainless steel; attached to pump and cover at manhole.
4. Submersible, Quick-Disconnect, Double-Seal Effluent Pumps:
 - a. Description: Factory-assembled and -tested effluent-pump unit with guide-rail supports.
 - b. Pump Type: Submersible, end-suction, single-stage, close-coupled, overhung-impeller, centrifugal effluent pump as defined in HI 1.1-1.2 and HI 1.3.
 - c. Pump Casing: Cast iron, with open inlet, and discharge fittings for connection to guide-rail support.
 - d. Impeller: Statically and dynamically balanced, ASTM A 48/A 48M, Class No. 25 A cast iron **OR** ASTM A 532/A 532M, abrasion-resistant cast iron **OR** ASTM B 584, cast bronze, **as directed**, and stainless steel, **as directed**, closed or semiopen design for clear wastewater, and keyed and secured to shaft.
 - e. Pump and Motor Shaft: Stainless steel **OR** steel, **as directed**, with factory-sealed, grease-lubricated ball bearings.
 - f. Seals: Mechanical.
 - g. Moisture-Sensing Probe: Internal moisture sensor and moisture alarm.
 - h. Motor: Hermetically sealed, capacitor-start type; with built-in overload protection; lifting eye or lug; and three-conductor, waterproof power cable of length required and with grounding plug and cable-sealing assembly for connection at pump.
 - 1) Motor Housing Fluid: Air **OR** Oil, **as directed**.
 - i. Controls (rod-and-float type):
 - 1) Enclosure: NEMA 250, Type 1 **OR** Type 4X, **as directed**.
 - 2) Switch Type: Pedestal-mounted float switch with float rods and rod buttons.
 - 3) Automatic Alternator: Start pumps on successive cycles and start multiple pumps if one cannot handle load.
 - 4) Float Guides: Pipe or other restraint for floats and rods in basins of depth greater than **60 inches (1500 mm)**.
 - 5) High-Water Alarm: Cover-mounted, compression-probe alarm, with electric bell; 120-V ac, with transformer and contacts for remote alarm bell.
 - j. Controls (float- and pressure-switch types):
 - 1) Enclosure: NEMA 250, Type 1 **OR** Type 4X, **as directed**; pedestal-mounted **OR** wall-mounted, **as directed**.
 - 2) Switch Type: Mechanical-float **OR** Mercury-float **OR** Pressure, **as directed**, type, in NEMA 250, Type 6 enclosures with mounting rod and electric cables.

- 3) Automatic Alternator: Start pumps on successive cycles and start multiple pumps if one cannot handle load.
 - 4) High-Water Alarm: Rod-mounted, NEMA 250, Type 6 enclosure with mechanical-float, mercury-float, or pressure switch matching control and electric bell; 120-V ac, with transformer and contacts for remote alarm bell.
 - k. Control-Interface Features:
 - 1) Remote Alarm Contacts: For remote alarm interface.
 - 2) Building Automation System Interface: Auxiliary contacts in pump controls for interface to building automation system and capable of providing the following:
 - a) On-off status of pump.
 - b) Alarm status.
 - l. Guide-Rail Supports:
 - 1) Standard: SWPA's "Submersible Sewage Pumping Systems (SWPA) Handbook."
 - 2) Guide Rails: Vertical pipes or structural members, made of galvanized steel or other corrosion-resistant metal, attached to baseplate and basin sidewall or cover.
 - 3) Baseplate: Corrosion-resistant metal plate, attached to basin floor, supporting guide rails and stationary elbow.
 - 4) Pump Yoke: Motor-mounted or casing-mounted yokes or other attachments for aligning pump during connection of flanges.
 - 5) Movable Elbow: Pump discharge-elbow fitting with flange, seal, and positioning device.
 - 6) Stationary Elbow: Fixed discharge-elbow fitting with flange that mates to movable-elbow flange and support attached to baseplate.
 - 7) Lifting Cable: Stainless steel; attached to pump and cover at manhole.
- B. Submersible Sewage Pumps
1. Submersible, Fixed-Position, Single-Seal Sewage Pumps:
 - a. Description: Factory-assembled and -tested sewage-pump unit.
 - b. Pump Type: Submersible, end-suction, single-stage, close-coupled, overhung-impeller, centrifugal sewage pump as defined in HI 1.1-1.2 and HI 1.3.
 - c. Pump Casing: Cast iron, with open inlet, legs that elevate pump to permit flow into impeller, and vertical discharge for piping connection.
 - d. Impeller: Statically and dynamically balanced, ASTM A 48/A 48M, Class No. 25 A cast iron **OR** ASTM A 532/A 532M, abrasion-resistant cast iron **OR** ASTM B 584, cast bronze, **as directed**, and stainless steel, **as directed**, nonclog, open, or semiopen design for solids handling, and keyed and secured to shaft.
 - e. Pump and Motor Shaft: Stainless steel **OR** steel, **as directed**, with factory-sealed, grease-lubricated ball bearings.
 - f. Seal: Mechanical.
 - g. Motor: Hermetically sealed, capacitor-start type; with built-in overload protection; lifting eye or lug; and three-conductor, waterproof power cable of length required and with grounding plug and cable-sealing assembly for connection at pump.
 - 1) Motor Housing Fluid: Air **OR** Oil, **as directed**.
 - h. Controls (rod-and-float type):
 - 1) Enclosure: NEMA 250, Type 1 **OR** Type 4X, **as directed**.
 - 2) Switch Type: Pedestal-mounted float switch with float rods and rod buttons.
 - 3) Automatic Alternator: Start pumps on successive cycles and start multiple pumps if one cannot handle load.
 - 4) Float Guides: Pipe or other restraint for floats and rods in basins of depth greater than **60 inches (1500 mm)**.
 - 5) High-Water Alarm: Cover-mounted, compression-probe alarm, with electric bell; 120-V ac, with transformer and contacts for remote alarm bell.
 - i. Controls (float- and pressure-switch types):
 - 1) Enclosure: NEMA 250, Type 1 **OR** Type 4X, **as directed**; pedestal-mounted **OR** wall-mounted, **as directed**.

- 2) Switch Type: Mechanical-float **OR** Mercury-float **OR** Pressure, **as directed**, type, in NEMA 250, Type 6 enclosures with mounting rod and electric cables.
- 3) Automatic Alternator: Start pumps on successive cycles and start multiple pumps if one cannot handle load.
- 4) High-Water Alarm: Rod-mounted, NEMA 250, Type 6 enclosure with mechanical-float, mercury-float, or pressure switch matching control and electric bell; 120-V ac, with transformer and contacts for remote alarm bell.
- j. Control-Interface Features:
 - 1) Remote Alarm Contacts: For remote alarm interface.
 - 2) Building Automation System Interface: Auxiliary contacts in pump controls for interface to building automation system and capable of providing the following:
 - a) On-off status of pump.
 - b) Alarm status.
2. Submersible, Fixed-Position, Double-Seal Sewage Pumps:
 - a. Description: Factory-assembled and -tested sewage-pump unit.
 - b. Pump Type: Submersible, end-suction, single-stage, close-coupled, overhung-impeller, centrifugal sewage pump as defined in HI 1.1-1.2 and HI 1.3.
 - c. Pump Casing: Cast iron, with open inlet, legs that elevate pump to permit flow into impeller, and vertical discharge for piping connection.
 - d. Impeller: Statically and dynamically balanced, ASTM A 48/A 48M, Class No. 25 A cast iron **OR** ASTM A 532/A 532M, abrasion-resistant cast iron **OR** ASTM B 584, cast bronze, **as directed**, and stainless steel, **as directed**, nonclog, open, or semiopen design for solids handling, and keyed and secured to shaft.
 - e. Pump and Motor Shaft: Stainless steel **OR** steel, **as directed**, with factory-sealed, grease-lubricated ball bearings.
 - f. Seals: Mechanical.
 - g. Moisture-Sensing Probe: Internal moisture sensor and moisture alarm.
 - h. Motor: Hermetically sealed, capacitor-start type; with built-in overload protection; lifting eye or lug; and three-conductor, waterproof power cable of length required and with grounding plug and cable-sealing assembly for connection at pump.
 - 1) Motor Housing Fluid: Air **OR** Oil, **as directed**.
 - i. Controls (rod-and-float type):
 - 1) Enclosure: NEMA 250, Type 1 **OR** Type 4X, **as directed**.
 - 2) Switch Type: Pedestal-mounted float switch with float rods and rod buttons.
 - 3) Automatic Alternator: Start pumps on successive cycles and start multiple pumps if one cannot handle load.
 - 4) Float Guides: Pipe or other restraint for floats and rods in basins of depth greater than **60 inches (1500 mm)**.
 - 5) High-Water Alarm: Cover-mounted, compression-probe alarm, with electric bell; 120-V ac, with transformer and contacts for remote alarm bell.
 - j. Controls (float- and pressure-switch types):
 - 1) Enclosure: NEMA 250, Type 1 **OR** Type 4X, **as directed**; pedestal-mounted **OR** wall-mounted, **as directed**.
 - 2) Switch Type: Mechanical-float **OR** Mercury-float **OR** Pressure, **as directed**, type, in NEMA 250, Type 6 enclosures with mounting rod and electric cables.
 - 3) Automatic Alternator: Start pumps on successive cycles and start multiple pumps if one cannot handle load.
 - 4) High-Water Alarm: Rod-mounted, NEMA 250, Type 6 enclosure with mechanical-float, mercury-float, or pressure switch matching control and electric bell; 120-V ac, with transformer and contacts for remote alarm bell.
 - k. Control-Interface Features:
 - 1) Remote Alarm Contacts: For remote alarm interface.
 - 2) Building Automation System Interface: Auxiliary contacts in pump controls for interface to building automation system and capable of providing the following:
 - a) On-off status of pump.

- b) Alarm status.
3. Submersible, Quick-Disconnect, Single-Seal Sewage Pumps:
- a. Description: Factory-assembled and -tested sewage-pump unit with guide-rail supports.
 - b. Pump Type: Submersible, end-suction, single-stage, close-coupled, overhung-impeller, centrifugal sewage pump as defined in HI 1.1-1.2 and HI 1.3.
 - c. Pump Casing: Cast iron, with open inlet, and discharge fittings for connection to guide-rail support.
 - d. Impeller: Statically and dynamically balanced, ASTM A 48/A 48M, Class No. 25 A cast iron **OR** ASTM A 532/A 532M, abrasion-resistant cast iron **OR** ASTM B 584, cast bronze, **as directed**, and stainless steel, **as directed**, nonclog, open, or semiopen design for solids handling, and keyed and secured to shaft.
 - e. Pump and Motor Shaft: Stainless steel **OR** steel, **as directed**, with factory-sealed, grease-lubricated ball bearings.
 - f. Seal: Mechanical.
 - g. Motor: Hermetically sealed, capacitor-start type; with built-in overload protection; lifting eye or lug; and three-conductor, waterproof power cable of length required and with grounding plug and cable-sealing assembly for connection at pump.
 - 1) Motor Housing Fluid: Air **OR** Oil, **as directed**.
 - h. Controls (rod-and-float type):
 - 1) Enclosure: NEMA 250, Type 1 **OR** Type 4X, **as directed**.
 - 2) Switch Type: Pedestal-mounted float switch with float rods and rod buttons.
 - 3) Automatic Alternator: Start pumps on successive cycles and start multiple pumps if one cannot handle load.
 - 4) Float Guides: Pipe or other restraint for floats and rods in basins of depth greater than **60 inches (1500 mm)**.
 - 5) High-Water Alarm: Cover-mounted, compression-probe alarm, with electric bell; 120-V ac, with transformer and contacts for remote alarm bell.
 - i. Controls (float- and pressure-switch types):
 - 1) Enclosure: NEMA 250, Type 1 **OR** Type 4X, **as directed**; pedestal-mounted **OR** wall-mounted, **as directed**.
 - 2) Switch Type: Mechanical-float **OR** Mercury-float **OR** Pressure, **as directed**, type, in NEMA 250, Type 6 enclosures with mounting rod and electric cables.
 - 3) Automatic Alternator: Start pumps on successive cycles and start multiple pumps if one cannot handle load.
 - 4) High-Water Alarm: Rod-mounted, NEMA 250, Type 6 enclosure with mechanical-float, mercury-float, or pressure switch matching control and electric bell; 120-V ac, with transformer and contacts for remote alarm bell.
 - j. Control-Interface Features:
 - 1) Remote Alarm Contacts: For remote alarm interface.
 - 2) Building Automation System Interface: Auxiliary contacts in pump controls for interface to building automation system and capable of providing the following:
 - a) On-off status of pump.
 - b) Alarm status.
 - k. Guide-Rail Supports:
 - 1) Standard: SWPA's "Submersible Sewage Pumping Systems (SWPA) Handbook."
 - 2) Guide Rails: Vertical pipes or structural members, made of galvanized steel or other corrosion-resistant metal, attached to baseplate and basin sidewall or cover.
 - 3) Baseplate: Corrosion-resistant metal plate, attached to basin floor, supporting guide rails and stationary elbow.
 - 4) Pump Yoke: Motor-mounted or casing-mounted yokes or other attachments for aligning pump during connection of flanges.
 - 5) Movable Elbow: Pump discharge-elbow fitting with flange, seal, and positioning device.
 - 6) Stationary Elbow: Fixed discharge-elbow fitting with flange that mates to movable-elbow flange and support attached to baseplate.
 - 7) Lifting Cable: Stainless steel; attached to pump and cover at manhole.

4. Submersible, Quick-Disconnect, Double-Seal Sewage Pumps:
 - a. Description: Factory-assembled and -tested sewage-pump unit with guide-rail supports.
 - b. Pump type: Submersible, end-suction, single-stage, close-coupled, overhung-impeller, centrifugal sewage pump as defined in HI 1.1-1.2 and HI 1.3.
 - c. Pump Casing: Cast iron, with open inlet, and discharge fittings for connection to guide-rail support.
 - d. Impeller: Statically and dynamically balanced, ASTM A 48/A 48M, Class No. 25 A cast iron **OR** ASTM A 532/A 532M, abrasion-resistant cast iron **OR** ASTM B 584, cast bronze, **as directed**, and stainless steel, **as directed**, nonclog, open, or semiopen design for solids handling, and keyed and secured to shaft.
 - e. Pump and Motor Shaft: Stainless steel **OR** steel, **as directed**, with factory-sealed, grease-lubricated ball bearings.
 - f. Seals: Mechanical.
 - g. Moisture-Sensing Probe: Internal moisture sensor and moisture alarm.
 - h. Motor: Hermetically sealed, capacitor-start type; with built-in overload protection; lifting eye or lug; and three-conductor, waterproof power cable of length required and with grounding plug and cable-sealing assembly for connection at pump.
 - 1) Motor Housing Fluid: Air **OR** Oil, **as directed**.
 - i. Controls (rod-and-float type):
 - 1) Enclosure: NEMA 250, Type 1 **OR** Type 4X, **as directed**.
 - 2) Switch Type: Pedestal-mounted float switch with float rods and rod buttons.
 - 3) Automatic Alternator: Start pumps on successive cycles and start multiple pumps if one cannot handle load.
 - 4) Float Guides: Pipe or other restraint for floats and rods in basins of depth greater than **60 inches (1500 mm)**.
 - 5) High-Water Alarm: Cover-mounted, compression-probe alarm, with electric bell; 120-V ac, with transformer and contacts for remote alarm bell.
 - j. Controls (float- and pressure-switch types):
 - 1) Enclosure: NEMA 250, Type 1 **OR** Type 4X, **as directed**; pedestal-mounted **OR** wall-mounted, **as directed**.
 - 2) Switch Type: Mechanical-float **OR** Mercury-float **OR** Pressure, **as directed**, type, in NEMA 250, Type 6 enclosures with mounting rod and electric cables.
 - 3) Automatic Alternator: Start pumps on successive cycles and start multiple pumps if one cannot handle load.
 - 4) High-Water Alarm: Rod-mounted, NEMA 250, Type 6 enclosure with mechanical-float, mercury-float, or pressure switch matching control and electric bell; 120-V ac, with transformer and contacts for remote alarm bell.
 - k. Control-Interface Features:
 - 1) Remote Alarm Contacts: For remote alarm interface.
 - 2) Building Automation System Interface: Auxiliary contacts in pump controls for interface to building automation system and capable of providing the following:
 - a) On-off status of pump.
 - b) Alarm status.
 - l. Guide-Rail Supports:
 - 1) Standard: SWPA's "Submersible Sewage Pumping Systems (SWPA) Handbook."
 - 2) Guide Rails: Vertical pipes or structural members, made of galvanized steel or other corrosion-resistant metal, attached to baseplate and basin sidewall or cover.
 - 3) Baseplate: Corrosion-resistant metal plate, attached to basin floor, supporting guide rails and stationary elbow.
 - 4) Pump Yoke: Motor-mounted or casing-mounted yokes or other attachments for aligning pump during connection of flanges.
 - 5) Movable Elbow: Pump discharge-elbow fitting with flange, seal, and positioning device.
 - 6) Stationary Elbow: Fixed discharge-elbow fitting with flange that mates to movable-elbow flange and support attached to baseplate.

- 7) Lifting Cable: Stainless steel; attached to pump and cover at manhole.
5. Submersible, Quick-Disconnect, Grinder Sewage Pumps:
 - a. Description: Factory-assembled and -tested, grinder sewage-pump unit with guide-rail supports.
 - b. Pump Type: Submersible, end-suction, single-stage, close-coupled, overhung-impeller, centrifugal sewage pump as defined in HI 1.1-1.2 and HI 1.3.
 - c. Pump Casing: Cast iron, with open inlet, and discharge fittings for connection to guide-rail supports.
 - d. Impeller: Bronze or stainless steel; statically and dynamically balanced, with stainless-steel cutter, grinder, or slicer assembly; capable of handling solids; and keyed and secured to shaft.
 - e. Pump and Motor Shaft: Stainless steel **OR** steel, **as directed**, with factory-sealed, grease-lubricated ball bearings.
 - f. Seal: Mechanical.
 - g. Motor: Hermetically sealed, capacitor-start type; with built-in overload protection; lifting eye or lug; and three-conductor, waterproof power cable of length required and with grounding plug and cable-sealing assembly for connection at pump.
 - 1) Motor Housing Fluid: Air **OR** Oil, **as directed**.
 - h. Controls (rod-and-float type):
 - 1) Enclosure: NEMA 250, Type 1 **OR** Type 4X, **as directed**.
 - 2) Switch Type: Pedestal-mounted float switch with float rods and rod buttons.
 - 3) Automatic Alternator: Start pumps on successive cycles and start multiple pumps if one cannot handle load.
 - 4) Float Guides: Pipe or other restraint for floats and rods in basins of depth greater than **60 inches (1500 mm)**.
 - 5) High-Water Alarm: Cover-mounted, compression-probe alarm, with electric bell; 120-V ac, with transformer and contacts for remote alarm bell.
 - i. Controls (float- and pressure-switch types):
 - 1) Enclosure: NEMA 250, Type 1 **OR** Type 4X, **as directed**; pedestal-mounted **OR** wall-mounted, **as directed**.
 - 2) Switch Type: Mechanical-float **OR** Mercury-float **OR** Pressure, **as directed**, type, in NEMA 250, Type 6 enclosures with mounting rod and electric cables.
 - 3) Automatic Alternator: Start pumps on successive cycles and start multiple pumps if one cannot handle load.
 - 4) High-Water Alarm: Rod-mounted, NEMA 250, Type 6 enclosure with mechanical-float, mercury-float, or pressure switch matching control and electric bell; 120-V ac, with transformer and contacts for remote alarm bell.
 - j. Control-Interface Features:
 - 1) Remote Alarm Contacts: For remote alarm interface.
 - 2) Building Automation System Interface: Auxiliary contacts in pump controls for interface to building automation system and capable of providing the following:
 - a) On-off status of pump.
 - b) Alarm status.
 - k. Guide-Rail Supports:
 - 1) Standard: SWPA's "Submersible Sewage Pumping Systems (SWPA) Handbook."
 - 2) Guide Rails: Vertical pipes or structural members, made of galvanized steel or other corrosion-resistant metal, attached to baseplate and basin sidewall or cover.
 - 3) Baseplate: Corrosion-resistant metal plate, attached to basin floor, supporting guide rails and stationary elbow.
 - 4) Pump Yoke: Motor-mounted or casing-mounted yokes or other attachments for aligning pump during connection of flanges.
 - 5) Movable Elbow: Pump discharge-elbow fitting with flange, seal, and positioning device.
 - 6) Stationary Elbow: Fixed discharge-elbow fitting with flange that mates to movable-elbow flange and support attached to baseplate.
 - 7) Lifting Cable: Stainless steel; attached to pump and cover at manhole.

6. Submersible, Quick-Disconnect, Progressing-Cavity, Grinder Sewage Pumps:
- a. Description: Factory-assembled and -tested progressing-cavity, grinder sewage-pump unit with guide-rail supports.
 - b. Pump Type: Submersible, progressing-cavity, single-screw rotary, grinder sewage pump as defined in HI 3.1-3.5.
 - c. Pump Body: Cast iron.
 - d. Pump Bearings: Radial and thrust types.
 - e. Pump Shaft: Steel.
 - f. Rotor: Stainless steel.
 - g. Stator: Buna-N **OR** Natural rubber, **as directed**.
 - h. Seal: Packing gland and mechanical types.
 - i. Motor: Hermetically sealed, capacitor-start type; with built-in overload protection; lifting eye or lug; and three-conductor, waterproof power cable of length required and with grounding plug and cable-sealing assembly for connection at pump.
 - j. Controls (rod-and-float type):
 - 1) Enclosure: NEMA 250, Type 1 **OR** Type 4X, **as directed**.
 - 2) Switch Type: Pedestal-mounted float switch with float rods and rod buttons.
 - 3) Automatic Alternator: Start pumps on successive cycles and start multiple pumps if one cannot handle load.
 - 4) Float Guides: Pipe or other restraint for floats and rods in basins of depth greater than **60 inches (1500 mm)**.
 - 5) High-Water Alarm: Cover-mounted, compression-probe alarm, with electric bell; 120-V ac, with transformer and contacts for remote alarm bell.
 - k. Controls (float- and pressure-switch types):
 - 1) Enclosure: NEMA 250, Type 1 **OR** Type 4X, **as directed**; pedestal-mounted **OR** wall-mounted, **as directed**.
 - 2) Switch Type: Mechanical-float **OR** Mercury-float **OR** Pressure, **as directed**, type, in NEMA 250, Type 6 enclosures with mounting rod and electric cables.
 - 3) Automatic Alternator: Start pumps on successive cycles and start multiple pumps if one cannot handle load.
 - 4) High-Water Alarm: Rod-mounted, NEMA 250, Type 6 enclosure with mechanical-float, mercury-float, or pressure switch matching control and electric bell; 120-V ac, with transformer and contacts for remote alarm bell.
 - l. Control-Interface Features:
 - 1) Remote Alarm Contacts: For remote alarm interface.
 - 2) Building Automation System Interface: Auxiliary contacts in pump controls for interface to building automation system and capable of providing the following:
 - a) On-off status of pump.
 - b) Alarm status.
 - m. Guide-Rail Supports:
 - 1) Standard: SWPA's "Submersible Sewage Pumping Systems (SWPA) Handbook."
 - 2) Guide Rails: Vertical pipes or structural members, made of galvanized steel or other corrosion-resistant metal, attached to baseplate and basin sidewall or cover.
 - 3) Baseplate: Corrosion-resistant metal plate, attached to basin floor, supporting guide rails and stationary elbow.
 - 4) Pump Yoke: Motor-mounted or casing-mounted yokes or other attachments for aligning pump during connection of flanges.
 - 5) Movable Elbow: Pump discharge-elbow fitting with flange, seal, and positioning device.
 - 6) Stationary Elbow: Fixed discharge-elbow fitting with flange that mates to movable-elbow flange and support attached to baseplate.
 - 7) Lifting Cable: Stainless steel; attached to pump and cover at manhole.

C. Wet-Pit-Volute Sewage Pumps

1. Description: Factory-assembled and -tested sewage-pump unit.

2. Pump Type: Wet-pit-volute, single-stage, separately-coupled, overhung-impeller, centrifugal sewage pump as defined in HI 1.1-1.2 and HI 1.3.
3. Pump Casing: Cast iron, with open inlet and threaded or flanged connection for discharge piping.
4. Pump Shaft: Stainless-steel **OR** steel, **as directed**.
5. Impeller: Statically and dynamically balanced, ASTM A 48/A 48M, Class No. 25 A cast iron **OR** ASTM A 532/A 532M, abrasion-resistant cast iron **OR** ASTM B 584, cast bronze, **as directed**, nonclog, open, or semiopen design for solids handling, and keyed and secured to shaft.
6. Sleeve Bearings: Bronze. Include oil-lubricated, intermediate sleeve bearings at **48-inch (1200-mm)** maximum intervals if basin depth is more than **48 inches (1200 mm)**, and grease-lubricated, ball-type thrust bearings.
7. Pump and Motor Shaft Coupling: Flexible, capable of absorbing torsional vibration and shaft misalignment.
8. Pump Discharge Piping: Factory or field fabricated, galvanized, ASTM A 53/A 53M, Schedule 40, steel pipe with ASME B16.1, Class 125, cast-iron flanges and flanged fittings or ASME B16.4, Class 125, gray iron threaded fittings, **as directed**.
 - a. Modify piping configuration to accommodate reverse-flow assembly.
9. Support Plate: Cast iron or coated steel and strong enough to support pumps, motors, and controls. Refer to Part 1.2 "Sewage-Pump Basins and Basin Covers" Article for requirements.
10. Shaft Seal: Stuffing box, with graphite-impregnated braided-yarn rings and bronze packing gland.
11. Motor: Single-speed; grease-lubricated ball bearings and mounted on vertical, cast-iron pedestal.
12. Controls (rod-and-float type):
 - a. Enclosure: NEMA 250, Type 1 **OR** Type 4X, **as directed**.
 - b. Switch Type: Pedestal-mounted float switch with float rods and rod buttons.
 - c. Automatic Alternator: Start pumps on successive cycles and start multiple pumps if one cannot handle load.
 - d. Float Guides: Pipe or other restraint for floats and rods in basins of depth greater than **60 inches (1500 mm)**.
 - e. High-Water Alarm: Cover-mounted, compression-probe alarm, with electric bell; 120-V ac, with transformer and contacts for remote alarm bell.
13. Controls (float- and pressure-switch types):
 - a. Enclosure: NEMA 250, Type 1 **OR** Type 4X, **as directed**; pedestal-mounted **OR** wall-mounted, **as directed**.
 - b. Switch Type: Mechanical-float **OR** Mercury-float **OR** Pressure, **as directed**, type, in NEMA 250, Type 6 enclosures with mounting rod and electric cables.
 - c. Automatic Alternator: Start pumps on successive cycles and start multiple pumps if one cannot handle load.
 - d. High-Water Alarm: Rod-mounted, NEMA 250, Type 6 enclosure with mechanical-float, mercury-float, or pressure switch matching control and electric bell; 120-V ac, with transformer and contacts for remote alarm bell.
14. Control-Interface Features:
 - a. Remote Alarm Contacts: For remote alarm interface.
 - b. Building Automation System Interface: Auxiliary contacts in pump controls for interface to building automation system and capable of providing the following:
 - 1) On-off status of pump.
 - 2) Alarm status.

D. Sewage-Pump, Reverse-Flow Assemblies

1. Description: Factory-fabricated, sewage pump reverse-flow assembly for factory or field assembly and installation in sewage pump basin. Include the following corrosion-resistant-metal components:
 - a. Inlet Fitting: One combination inlet-overflow strainer fitting.
 - b. Valves: Two shutoff valves and two check valves.
 - c. Strainers: Two strainer housings with reverse-flow, self-flushing strainers.
 - d. Pipe and Fittings: Size and configuration required to connect to sewage pumps and piping.

E. Sewage-Pump Basins And Basin Covers

1. Basins: Factory-fabricated, watertight, cylindrical, basin sump with top flange and sidewall openings for pipe connections.
 - a. Material: Cast iron **OR** Fiberglass **OR** Polyethylene, **as directed**.
 - b. Reinforcement: Mounting plates for pumps, fittings, guide-rail supports if used, and accessories.
 - c. Anchor Flange: Same material as or compatible with basin sump, cast in or attached to sump, in location and of size required to anchor basin in concrete slab.
 2. Basin Covers: Fabricate metal cover with openings having gaskets, seals, and bushings; for access to pumps, pump shafts, control rods, discharge piping, vent connections, and power cables.
 - a. Reinforcement: Steel or cast iron, capable of supporting foot traffic for basins installed in foot-traffic areas.
- F. Progressing-Cavity Sewage Pumps
1. Description: Factory-assembled and -tested progressing-cavity, single-screw rotary pump as defined in HI 3.1-3.5.
 2. Pump Body: Cast iron with feet for base or floor installation.
 3. Pump Bearings: Radial and thrust types.
 4. Pump Shaft: Steel.
 5. Rotor: Chrome-plated steel.
 6. Stator: Buna-N **OR** Natural rubber, **as directed**.
 7. Seals: Packing gland and mechanical types.
 8. Coupling: Flexible.
 9. Motor: Single-speed; grease-lubricated ball bearings.
- G. Packaged, Submersible Sewage-Pump Units
1. Packaged, Submersible, Grinder, Sewage-Pump Units:
 - a. Description: Factory-assembled and -tested, automatic-operation, basin-mounted, grinder, sewage-pump unit.
 - b. Pump Type: Submersible, end-suction, single-stage, close-coupled, overhung-impeller centrifugal pump as defined in HI 1.1-1.2 and HI 1.3.
 - c. Pump Casing: Cast iron.
 - d. Impeller: Stainless-steel grinder, cutter, or slicer type with shredding ring.
 - e. Motor: Hermetically sealed, capacitor-start type; with built-in overload protection; and three-conductor, waterproof power cable of length required and with grounding plug and cable-sealing assembly for connection at pump.
 - f. Control (for simplex pump unit): Manufacturer's standard panel for one pump.
 - g. Controls (for duplex pump unit): Automatic, with mechanical- or mercury-float switches and alternator.
 - h. Pump Discharge Piping: Factory or field fabricated, galvanized, ASTM A 53/A 53M, Schedule 40, steel pipe with ASME B16.4, Class 125, gray iron threaded fittings, **as directed**.
 - i. Basin: Watertight plastic, **as directed**, and of size required for pumps, with inlet pipe connection and gastight cover with pump discharge and vent connections.
 2. Packaged, Submersible, Nonclog, Sewage-Pump Units:
 - a. Description: Factory-assembled and -tested, automatic-operation, basin-mounted, sewage-pump unit.
 - b. Pump Type: Submersible, end-suction, single-stage, close-coupled, overhung-impeller centrifugal pump as defined in HI 1.1-1.2 and HI 1.3.
 - c. Pump Casing: Cast iron.
 - d. Impeller: Brass or cast iron; statically and dynamically balanced, non-clog design, and capable of handling **2-inch (50-mm)** diameter solids.
 - e. Motor: Hermetically sealed, capacitor-start type; with built-in overload protection; lifting eye or lug; and three-conductor, waterproof power cable of length required and with grounding plug and cable-sealing assembly for connection at pump.

- f. Control (for simplex pump units): Manufacturer's standard panel for one pump.
 - g. Controls (for duplex pump unit): Automatic, with mechanical- or mercury-float switches and alternator.
 - h. Pump Discharge Piping: Factory or field fabricated, galvanized, ASTM A 53/A 53M, Schedule 40, steel pipe with ASME B16.4, Class 125, gray iron threaded fittings, **as directed**.
 - i. Basin: Watertight plastic, **as directed**, and of size required for pumps, with inlet pipe connection and gastight cover with pump discharge and vent connections.
- H. Packaged Wastewater-Pump Units
- 1. Packaged, Wet-Pit-Volute, Wastewater-Pump Units:
 - a. Description: Factory-assembled and -tested, automatic-operation, basin-mounted, effluent-pump unit.
 - b. Pump Type: Wet-pit-volute, single-stage, separately-coupled, overhung-impeller centrifugal pump as defined in HI 1.1-1.2 and HI 1.3.
 - c. Pump Body and Impeller: Corrosion-resistant materials.
 - d. Motor: With built-in overload protection and mounted vertically on basin cover.
 - e. Power Cord: Three-conductor, waterproof cable of length required but not less than **72 inches (1830 mm)** and with grounding plug and cable-sealing assembly for connection at pump.
 - f. Control: Float switch.
 - g. Pump Discharge Piping: Factory or field fabricated, galvanized, ASTM A 53/A 53M, Schedule 40, steel pipe with ASME B16.4, Class 125, gray iron threaded fittings, **as directed**.
 - h. Basin: Watertight, aluminum, plastic, or coated steel with inlet pipe connection and gastight cover with vent and pump discharge connections.
 - 2. Packaged, Submersible Wastewater-Pump Units:
 - a. Description: Factory-assembled and -tested, automatic-operation, effluent-pump unit with basin.
 - b. Pump Type: Submersible, end-suction, single-stage, overhung-impeller, centrifugal pump as defined in HI 1.1-1.2 and HI 1.3.
 - c. Pump Body and Impeller: Corrosion-resistant materials.
 - d. Pump Seals: Mechanical.
 - e. Motor: Hermetically sealed, capacitor-start type, with built-in overload protection.
 - f. Power Cord: Three-conductor, waterproof cable of length required but not less than **72 inches (1830 mm)** and with grounding plug and cable-sealing assembly for connection at pump.
 - g. Control: Float switch.
 - h. Pump Discharge Piping: Factory or field fabricated, galvanized, ASTM A 53/A 53M, Schedule 40, steel pipe with ASME B16.4, Class 125, gray iron threaded fittings, **as directed**.
 - i. Basin: Watertight plastic with inlet pipe connection and gastight cover with vent and pump discharge connections.
- I. Motors
- 1. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in Division 22 Section "Common Motor Requirements For Plumbing Equipment".
 - a. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.
 - b. Controllers, Electrical Devices, and Wiring: Comply with requirements for electrical devices and connections specified in Division 22.
 - 2. Motors for submersible pumps shall be hermetically sealed.

1.3 EXECUTION

A. Earthwork

1. Excavation and filling are specified in Division 31 Section "Earth Moving".

B. Examination

1. Examine roughing-in for plumbing piping to verify actual locations of sanitary drainage and vent piping connections before sewage pump installation.

C. Installation

1. Pump Installation Standards:
 - a. Comply with HI 1.4 for installation of centrifugal pumps.
 - b. Comply with HI 3.1-3.5 for installation of progressing-cavity sewage pumps.
2. Equipment Mounting (for equipment supported on slabs-on-grade): Install progressing-cavity sewage pumps on concrete base using elastomeric pads **OR** elastomeric mounts **OR** restrained spring isolators, **as directed**. Comply with requirements for concrete base specified in Division 03 Section "Cast-in-place Concrete".
 - a. Minimum Deflection: **1/4 inch (6 mm) OR 1 inch (25 mm), as directed**.
 - b. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on **18-inch (450-mm)** centers around the full perimeter of concrete base.
 - c. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.
 - d. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 - e. Install anchor bolts to elevations required for proper attachment to supported equipment.
3. Equipment Mounting: Install progressing-cavity sewage pumps using elastomeric pads **OR** elastomeric mounts **OR** restrained spring isolators, **as directed**. Comply with requirements for vibration isolation devices specified in Division 22 Section "Vibration And Seismic Controls For Plumbing Piping And Equipment".
 - a. Minimum Deflection: **1/4 inch (6 mm) OR 1 inch (25 mm), as directed**.
4. Equipment Mounting: Install progressing-cavity sewage pumps on vibration isolation equipment base. Comply with requirements specified in Division 22 Section "Vibration And Seismic Controls For Plumbing Piping And Equipment".
5. Wiring Method (for pumps with wall-mounted controls): Comply with requirements in Division 26 Section "Low-voltage Electrical Power Conductors And Cables".
6. Wiring within Enclosures: Bundle, lace, and train conductors to terminal points with no excess and without exceeding manufacturer's limitations on bending radii. Provide and use lacing bars and distribution spools.

D. Connections

1. Comply with requirements for piping specified in Division 22 Section "Sanitary Waste And Vent Piping". Drawings indicate general arrangement of piping, fittings, and specialties.
2. Install piping adjacent to equipment to allow service and maintenance.

E. Field Quality Control

1. Perform tests and inspections.
2. Tests and Inspections:
 - a. Perform each visual and mechanical inspection.
 - b. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
 - c. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
 - d. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
3. Pumps and controls will be considered defective if they do not pass tests and inspections.

4. Prepare test and inspection reports.
- F. Startup Service
 1. Engage a factory-authorized service representative to perform **OR** Perform, **as directed**, startup service.
 - a. Complete installation and startup checks according to manufacturer's written instructions.
- G. Adjusting
 1. Adjust pumps to function smoothly, and lubricate as recommended by manufacturer.
 2. Adjust control set points.
- H. Demonstration
 1. Train Owner's maintenance personnel to adjust, operate, and maintain controls and pumps.

END OF SECTION 22 13 29 13b

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Task	Specification	Specification Description
22 13 29 16	22 13 29 13b	Sewage Pumps
22 13 29 33	01 22 16 00	No Specification Required

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SECTION 22 14 29 13 - SUMP PUMPS

1.1 GENERAL

A. Description Of Work

1. This specification covers the furnishing and installation of materials for sump pumps. Products shall be as follows or as directed by the Owner. Installation procedures shall be in accordance with the products manufacturer's recommendations. Demolition and removal of materials shall be as required to support the work.

B. Summary

1. Section Includes:
 - a. Submersible sump pumps.
 - b. Wet-pit-volute sump pumps.
 - c. Sump-pump basins and basin covers.
 - d. Packaged drainage-pump units.

C. Submittals

1. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
2. Wiring Diagrams: For power, signal, and control wiring.
3. Operation and Maintenance Data: For pumps and controls, to include in operation and maintenance manuals.

D. Quality Assurance

1. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
2. UL Compliance: Comply with UL 778 for motor-operated water pumps.

E. Delivery, Storage, And Handling

1. Retain shipping flange protective covers and protective coatings during storage.
2. Protect bearings and couplings against damage.
3. Comply with pump manufacturer's written rigging instructions for handling.

1.2 PRODUCTS

A. Submersible Sump Pumps

1. Submersible, Fixed-Position, Single-Seal Sump Pumps:
 - a. Description: Factory-assembled and -tested sump-pump unit.
 - b. Pump Type: Submersible, end-suction, single-stage, close-coupled, overhung-impeller, centrifugal sump pump as defined in HI 1.1-1.2 and HI 1.3.
 - c. Pump Casing: Cast iron, with strainer inlet, legs that elevate pump to permit flow into impeller, and vertical discharge for piping connection.
 - d. Impeller: Statically and dynamically balanced, ASTM A 48/A 48M, Class No. 25 A cast iron **OR** ASTM A 532/A 532M, abrasion-resistant cast iron **OR** ASTM B 584, cast bronze, **as directed**, semiopen, **as directed**, design for clear wastewater handling, and keyed and secured to shaft.
 - e. Pump and Motor Shaft: Stainless steel **OR** steel, **as directed**, with factory-sealed, grease-lubricated ball bearings.
 - f. Seal: Mechanical.

- g. Motor: Hermetically sealed, capacitor-start type; with built-in overload protection; lifting eye or lug; and three-conductor, waterproof power cable of length required and with grounding plug and cable-sealing assembly for connection at pump.
 - 1) Motor Housing Fluid: Air **OR** Oil, **as directed**.
 - h. Controls (rod-and-float type):
 - 1) Enclosure: NEMA 250, Type 1 **OR** Type 4X, **as directed**.
 - 2) Switch Type: Pedestal-mounted float switch with float rods and rod buttons.
 - 3) Automatic Alternator: Start pumps on successive cycles and start multiple pumps if one cannot handle load.
 - 4) Float Guides: Pipe or other restraint for floats and rods in basins of depth greater than **60 inches (1500 mm)**.
 - 5) High-Water Alarm: Cover-mounted, compression-probe alarm, with electric bell; 120-V ac, with transformer and contacts for remote alarm bell.
 - i. Controls (float- and pressure-switch types):
 - 1) Enclosure: NEMA 250, Type 1 **OR** Type 4X, **as directed**; pedestal-mounted **OR** wall-mounted, **as directed**.
 - 2) Switch Type: Mechanical-float **OR** Mercury-float **OR** Pressure, **as directed**, type, in NEMA 250, Type 6 enclosures with mounting rod and electric cables.
 - 3) Automatic Alternator: Start pumps on successive cycles and start multiple pumps if one cannot handle load.
 - 4) High-Water Alarm: Rod-mounted, NEMA 250, Type 6 enclosure with mechanical-float, mercury-float, or pressure switch matching control and electric bell; 120-V ac, with transformer and contacts for remote alarm bell.
 - j. Control-Interface Features:
 - 1) Remote Alarm Contacts: For remote alarm interface.
 - 2) Building Automation System Interface: Auxiliary contacts in pump controls for interface to building automation system and capable of providing the following:
 - a) On-off status of pump.
 - b) Alarm status.
2. Submersible, Fixed-Position, Double-Seal Sump Pumps:
- a. Description: Factory-assembled and -tested sump-pump unit.
 - b. Pump Type: Submersible, end-suction, single-stage, close-coupled, overhung-impeller, centrifugal sump pump as defined in HI 1.1-1.2 and HI 1.3.
 - c. Pump Casing: Cast iron, with strainer inlet, legs that elevate pump to permit flow into impeller, and vertical discharge for piping connection.
 - d. Impeller: Statically and dynamically balanced, ASTM A 48/A 48M, Class No. 25 A cast iron **OR** ASTM A 532/A 532M, abrasion-resistant cast iron **OR** ASTM B 584, cast bronze, **as directed**, semiopen, **as directed**, design for clear wastewater handling, and keyed and secured to shaft.
 - e. Pump and Motor Shaft: Stainless steel **OR** steel, **as directed**, with factory-sealed, grease-lubricated ball bearings.
 - f. Seals: Mechanical.
 - g. Moisture-Sensing Probe: Internal moisture sensor and moisture alarm.
 - h. Motor: Hermetically sealed, capacitor-start type; with built-in overload protection; lifting eye or lug; and three-conductor, waterproof power cable of length required and with grounding plug and cable-sealing assembly for connection at pump.
 - 1) Motor Housing Fluid: Air **OR** Oil, **as directed**.
 - i. Controls (rod-and-float type):
 - 1) Enclosure: NEMA 250, Type 1 **OR** Type 4X, **as directed**.
 - 2) Switch Type: Pedestal-mounted float switch with float rods and rod buttons.
 - 3) Automatic Alternator: Start pumps on successive cycles and start multiple pumps if one cannot handle load.
 - 4) Float Guides: Pipe or other restraint for floats and rods in basins of depth greater than **60 inches (1500 mm)**.

- 5) High-Water Alarm: Cover-mounted, compression-probe alarm, with electric bell; 120-V ac, with transformer and contacts for remote alarm bell.
 - j. Controls (float- and pressure-switch types):
 - 1) Enclosure: NEMA 250, Type 1 **OR** Type 4X, **as directed**; pedestal-mounted **OR** wall-mounted, **as directed**.
 - 2) Switch Type: Mechanical-float **OR** Mercury-float **OR** Pressure, **as directed**, type, in NEMA 250, Type 6 enclosures with mounting rod and electric cables.
 - 3) Automatic Alternator: Start pumps on successive cycles and start multiple pumps if one cannot handle load.
 - 4) High-Water Alarm: Rod-mounted, NEMA 250, Type 6 enclosure with mechanical-float, mercury-float, or pressure switch matching control and electric bell; 120-V ac, with transformer and contacts for remote alarm bell.
 - k. Control-Interface Features:
 - 1) Remote Alarm Contacts: For remote alarm interface.
 - 2) Building Automation System Interface: Auxiliary contacts in pump controls for interface to building automation system and capable of providing the following:
 - a) On-off status of pump.
 - b) Alarm status.
- B. Wet-Pit-Volute Sump Pumps
1. Description: Factory-assembled and -tested sump-pump unit.
 2. Pump Type: Wet-pit-volute, single-stage, separately-coupled, overhung-impeller, centrifugal sump pump as defined in HI 1.1-1.2 and HI 1.3.
 3. Pump Casing: Cast iron, with strainer inlet and threaded connection for **NPS 2 (DN 50)** and smaller and flanged connection for **NPS 2-1/2 (DN 65)** and larger discharge piping.
 4. Impeller: Statically and dynamically balanced, ASTM A 48/A 48M, Class No. 25 A cast iron **OR** ASTM A 532/A 532M, abrasion-resistant cast iron **OR** ASTM B 584, cast bronze, **as directed**, semiopen, **as directed**, design for clear wastewater handling, and keyed and secured to shaft.
 5. Sleeve Bearings: Bronze. Include oil-lubricated, intermediate sleeve bearings at **48-inch (1200-mm)** maximum intervals if basin depth is more than **48 inches (1200 mm)**, and grease-lubricated, ball-type thrust bearings.
 6. Pump and Motor Shaft Coupling: Flexible, capable of absorbing torsional vibration and shaft misalignment.
 7. Pump Discharge Piping: Factory or field fabricated, galvanized, ASTM A 53/A 53M, Schedule 40, steel pipe with ASME B16.1, Class 125, cast-iron flanges and flanged fittings or ASME B16.4, Class 125, gray iron threaded fittings, **as directed**.
 8. Support Plate: Cast iron or coated steel and strong enough to support pumps, motors, and controls. Refer to Part 1.2 "Sump-Pump Basins and Basin Covers" Article for requirements.
 9. Shaft Seal: Stuffing box, with graphite-impregnated braided-yarn rings and bronze packing gland.
 10. Motor: Single-speed; grease-lubricated ball bearings and mounting on vertical, cast-iron pedestal.
 11. Controls (rod-and-float type):
 - a. Enclosure: NEMA 250, Type 1 **OR** Type 4X, **as directed**.
 - b. Switch Type: Pedestal-mounted float switch with float rods and rod buttons.
 - c. Automatic Alternator: Start pumps on successive cycles and start multiple pumps if one cannot handle load.
 - d. Float Guides: Pipe or other restraint for floats and rods in basins of depth greater than **60 inches (1500 mm)**.
 - e. High-Water Alarm: Cover-mounted, compression-probe alarm, with electric bell; 120-V ac, with transformer and contacts for remote alarm bell.
 12. Controls (float- and pressure-switch types):
 - a. Enclosure: NEMA 250, Type 1 **OR** Type 4X, **as directed**; pedestal-mounted **OR** wall-mounted, **as directed**.
 - b. Switch Type: Mechanical-float **OR** Mercury-float **OR** Pressure, **as directed**, type, in NEMA 250, Type 6 enclosures with mounting rod and electric cables.

- c. Automatic Alternator: Start pumps on successive cycles and start multiple pumps if one cannot handle load.
- d. High-Water Alarm: Rod-mounted, NEMA 250, Type 6 enclosure with mechanical-float, mercury-float, or pressure switch matching control and electric bell; 120-V ac, with transformer and contacts for remote alarm bell.
- 13. Control-Interface Features:
 - a. Remote Alarm Contacts: For remote alarm interface.
 - b. Building Automation System Interface: Auxiliary contacts in pump controls for interface to building automation system and capable of providing the following:
 - 1) On-off status of pump.
 - 2) Alarm status.
- C. Sump-Pump Basins And Basin Covers
 - 1. Basins: Factory-fabricated, watertight, cylindrical, basin sump with top flange and sidewall openings for pipe connections.
 - a. Material: Cast iron **OR** Fiberglass **OR** Polyethylene, **as directed**.
 - b. Reinforcement: Mounting plates for pumps, fittings, and accessories.
 - c. Anchor Flange: Same material as or compatible with basin sump, cast in or attached to sump, in location and of size required to anchor basin in concrete slab.
 - 2. Basin Covers: Fabricate metal cover with openings having gaskets, seals, and bushings; for access to pumps, pump shafts, control rods, discharge piping, vent connections, and power cables.
 - a. Reinforcement: Steel or cast iron, capable of supporting foot traffic for basins installed in foot-traffic areas.
- D. Packaged Drainage-Pump Units
 - 1. Packaged Pedestal Drainage-Pump Units:
 - a. Description: Factory-assembled and -tested, automatic-operation, freestanding, sump-pump unit.
 - b. Pump Type: Wet-pit-volute, single-stage, separately-coupled, overhung-impeller centrifugal pump as defined in HI 1.1-1.2 and HI 1.3.
 - c. Pump Casing: Corrosion-resistant material, with strainer inlet, design that permits flow into impeller, and vertical discharge for piping connection.
 - d. Impeller: Aluminum, brass, or plastic.
 - e. Motor: With built-in overload protection and mounted vertically on sump pump column.
 - f. Power Cord: Three-conductor, waterproof cable of length required but not less than **72 inches (1830 mm)**, with grounding plug and cable-sealing assembly for connection at pump.
 - g. Control: Float switch.
 - 2. Packaged Submersible Drainage-Pump Units:
 - a. Description: Factory-assembled and -tested, automatic-operation, basin-mounted, sump-pump unit.
 - b. Pump Type: Submersible, end-suction, single-stage, close-coupled, overhung-impeller centrifugal pump as defined in HI 1.1-1.2 and HI 1.3.
 - c. Casing: Metal.
 - d. Impeller: Brass.
 - e. Pump Seal: Mechanical.
 - f. Motor: Hermetically sealed, capacitor-start type, with built-in overload protection.
 - g. Power Cord: Three-conductor, waterproof cable of length required but not less than **72 inches (1830 mm)**, with grounding plug and cable-sealing assembly for connection at pump.
 - h. Pump Discharge Piping: Factory or field fabricated, galvanized, ASTM A 53/A 53M, Schedule 40, steel pipe with ASME B16.4, Class 125, gray iron threaded fittings, **as directed**.
 - i. Control: Motor-mounted float switch.

j. Basin: Plastic.

E. Motors

1. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in Division 22 Section "Common Motor Requirements For Plumbing Equipment".
 - a. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.
 - b. Controllers, Electrical Devices, and Wiring: Comply with requirements for electrical devices and connections specified in Division 22.
2. Motors for submersible pumps shall be hermetically sealed.

1.3 EXECUTION

A. Earthwork

1. Excavation and filling are specified in Division 31 Section "Earth Moving".

B. Examination

1. Examine roughing-in for plumbing piping to verify actual locations of storm drainage piping connections before sump pump installation.

C. Installation

1. Pump Installation Standards: Comply with HI 1.4 for installation of sump pumps.

D. Connections

1. Comply with requirements for piping specified in Division 22 Section "Facility Storm Drainage Piping". Drawings indicate general arrangement of piping, fittings, and specialties.
2. Install piping adjacent to equipment to allow service and maintenance.

E. Field Quality Control

1. Perform tests and inspections.
2. Tests and Inspections:
 - a. Perform each visual and mechanical inspection.
 - b. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
 - c. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
 - d. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
3. Pumps and controls will be considered defective if they do not pass tests and inspections.
4. Prepare test and inspection reports.

F. Startup Service

1. Engage a factory-authorized service representative to perform **OR** Perform, **as directed**, startup service.
 - a. Complete installation and startup checks according to manufacturer's written instructions.

G. Adjusting

1. Adjust pumps to function smoothly, and lubricate as recommended by manufacturer.
2. Adjust control set points.

H. Demonstration

1. Train Owner's maintenance personnel to adjust, operate, and maintain controls and pumps.

END OF SECTION 22 14 29 13

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Task	Specification	Specification Description
22 14 29 13	21 05 23 00	Piped Utilities Basic Materials And Methods

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SECTION 22 15 13 00 - GENERAL-SERVICE PACKAGED AIR COMPRESSORS AND RECEIVERS

1.1 GENERAL

A. Description Of Work

1. This specification covers the furnishing and installation of materials for general-service packaged air compressors and receivers. Products shall be as follows or as directed by the Owner. Installation procedures shall be in accordance with the product manufacturer's recommendations. Demolition and removal of materials shall be as required to support the work.

B. Summary

1. Section Includes:
 - a. Lubricated, reciprocating air compressors.
 - b. Oil-free, reciprocating air compressors.
 - c. Oilless, reciprocating air compressors.
 - d. Oil-free, rotary-screw air compressors.
 - e. Oil-flooded, rotary-screw air compressors.
 - f. Oil-free, rotary, sliding-vane air compressors.
 - g. Oil-sealed, rotary, sliding-vane air compressors.
 - h. Inlet-air filters.
 - i. Air-cooled, compressed-air aftercoolers.
 - j. Water-cooled, compressed-air aftercoolers.
 - k. Refrigerant compressed-air dryers.
 - l. Desiccant compressed-air dryers.
 - m. Computer interface cabinet.

C. Definitions

1. Actual Air: Air delivered from air compressors. Flow rate is delivered compressed air measured in **acfm (actual L/s)**.
2. Low Voltage: As defined in NFPA 70 for circuits and equipment operating at less than 50 V or for remote-control, signaling power-limited circuits.
3. Standard Air: Free air at **68 deg F (20 deg C)** and 1 atmosphere (29.92 in. Hg) before compression or expansion and measured in **scfm (standard L/s)**.

D. Performance Requirements

1. Delegated Design: Design compressed-air equipment mounting, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.
2. Seismic Performance: Compressed-air equipment shall withstand the effects of earthquake motions determined according to SEI/ASCE 7.
 - a. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."

E. Submittals

1. Product Data: For each type of product indicated.
 - a. Wiring Diagrams: For power, signal, and control wiring.
2. Delegated-Design Submittal: For compressed-air equipment mounting indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
 - a. Detail fabrication and assembly of supports.
 - b. Design Calculations: Calculate requirements for selecting vibration isolators and seismic restraints and for designing vibration isolation bases.



3. Seismic Qualification Certificates: For compressed-air equipment, accessories, and components, from manufacturers.
4. Operation and Maintenance Data.

F. Quality Assurance

1. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
2. ASME Compliance: Fabricate and label receivers to comply with ASME Boiler and Pressure Vessel Code.

1.2 PRODUCTS

A. General Requirements For Packaged Air Compressors And Receivers

1. General Description: Factory-assembled, -wired, -piped, and -tested; electric-motor-driven; air-cooled; continuous-duty air compressors and receivers that deliver air of quality equal to intake air.
2. Control Panels: Automatic control station with load control and protection functions. Comply with NEMA ICS 2 and UL 508.
 - a. Enclosure: NEMA ICS 6, Type 12 control panel unless otherwise indicated.
 - b. Motor Controllers: Full-voltage, combination magnetic type with undervoltage release feature and motor-circuit-protector-type disconnecting means and short-circuit protective device.
 - c. Control Voltage: 120-V ac or less, using integral control power transformer.
 - d. Motor Overload Protection: Overload relay in each phase.
 - e. Starting Devices: Hand-off-automatic selector switch in cover of control panel, plus pilot device for automatic control.
 - f. Automatic control switches to alternate lead-lag compressors for duplex **OR** sequence lead-lag compressors for multiplex, **as directed**, air compressors.
 - g. Instrumentation: Include discharge-air pressure gage, air-filter maintenance indicator, hour meter, compressor discharge-air and coolant temperature gages, and control transformer.
 - h. Alarm Signal Device: For connection to alarm system to indicate when backup air compressor is operating.
3. Receivers: Steel tank constructed according to ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.
 - a. Pressure Rating: At least as high as highest discharge pressure of connected compressors, and bearing appropriate code symbols.
 - b. Interior Finish: Corrosion-resistant coating.
 - c. Accessories: Include safety valve, pressure gage, drain, and pressure-reducing valve.
4. Mounting Frame: Fabricate mounting and attachment to pressure vessel with reinforcement strong enough to resist packaged equipment movement during a seismic event when base is anchored to building structure.

B. Lubricated, Reciprocating Air Compressors

1. Compressor(s): Lubricated, reciprocating-piston type with lubricated compression chamber and crankcase.
 - a. Submerged gear-type oil pump.
 - b. Oil filter.
 - c. Combined high discharge-air temperature and low lubrication-oil pressure switch.
 - d. Belt guard totally enclosing pulleys and belts.

C. Oil-Free, Reciprocating Air Compressors

1. Compressor(s): Oil-free, reciprocating-piston type with nonlubricated compression chamber, lubricated crankcase, and of construction that prohibits oil from entering compression chamber.

- a. Submerged gear-type oil pump.
 - b. Oil filter.
 - c. Combined high discharge-air temperature and low lubrication-oil pressure switch.
 - d. Belt guard totally enclosing pulleys and belts.
- D. Oilless, Reciprocating Air Compressors
 - 1. Compressor(s): Oilless (nonlubricated), reciprocating-piston type, with sealed oil-free bearings, that will deliver air of quality equal to intake air.
 - a. High discharge-air temperature switch.
 - b. Belt guard totally enclosing pulleys and belts.
- E. Oil-Free, Rotary-Screw Air Compressors
 - 1. Compressor(s): Oil-free, rotary-screw type with nonlubricated helical screws and lubricated gear box, and of construction that prohibits oil from entering compression chamber.
 - a. Coupling: Nonlubricated, flexible type.
 - b. Cooling/Lubrication System: Unit-mounted, air-cooled exchanger package prepiped to unit; with air pressure circulation system with coolant stop valve, full-flow coolant filter, and thermal bypass valve.
 - c. Air Filter: Dry type, with maintenance indicator and cleanable replaceable filter element.
 - d. Air/Coolant Receiver and Separation System: 150-psig- (1035-kPa-) rated steel tank with ASME safety valve, coolant-level gage, multistage air-coolant separator element, minimum pressure valve, blowdown valve, discharge check valve, coolant stop valve, full-flow coolant filter, and thermal bypass valve.
 - e. Capacity Control: Capacity modulation between zero and 100 percent air delivery, with operating pressures between 50 and 100 psig (345 and 690 kPa). Include necessary control to hold constant pressure. When air demand is zero, unload compressor by using pressure switch and blowdown valve.
- F. Oil-Flooded, Rotary-Screw Air Compressors
 - 1. Compressor(s): Oil-flooded, rotary-screw type with lubricated helical screws and lubricated gear box.
 - a. Coupling: Nonlubricated, flexible type.
 - b. Cooling/Lubrication System: Unit-mounted, air-cooled exchanger package prepiped to unit; with air pressure circulation system with coolant stop valve, full-flow coolant filter, and thermal bypass valve.
 - c. Air Filter: Dry type, with maintenance indicator and cleanable replaceable filter element.
 - d. Air/Coolant Receiver and Separation System: 150-psig- (1035-kPa-) rated steel tank with ASME safety valve, coolant-level gage, multistage air-coolant separator element, minimum pressure valve, blowdown valve, discharge check valve, coolant stop valve, full-flow coolant filter, and thermal bypass valve.
 - e. Capacity Control: Capacity modulation between zero and 100 percent air delivery, with operating pressures between 50 and 100 psig (345 and 690 kPa). Include necessary control to hold constant pressure. When air demand is zero, unload compressor by using pressure switch and blowdown valve.
- G. Oil-Free, Rotary, Sliding-Vane Air Compressors
 - 1. Compressor(s): Oil-free, nonpulsating, rotary, sliding-vane type with nonlubricated sliding vanes.
 - a. Cleanable inlet screens.
 - b. Outlet silencers on discharge connections.
- H. Oil-Sealed, Rotary, Sliding-Vane Air Compressors
 - 1. Compressor(s): Nonpulsating, rotary, sliding-vane type with oil-sealed sliding vanes.
 - a. Cleanable inlet screens.
 - b. Outlet silencers and oil-mist separators on discharge connections.
- I. Inlet-Air Filters

1. Description: Combination inlet-air filter-silencer, suitable for remote installation, for each air compressor.
 - a. Construction: Weatherproof housing for replaceable, dry-type filter element, with silencer tubes or other method of sound reduction.
 - b. Capacity: Match capacity of air compressor, with filter having collection efficiency of 99 percent retention of particles larger than 10 micrometers.
 2. Description: Combination inlet-air filter-silencer, suitable for remote installation, for multiple air compressors.
 - a. Construction: Weatherproof housing for replaceable, dry-type filter element, with silencer tubes or other method of sound reduction.
 - b. Capacity: Match total capacity of connected air compressors, with filter having collection efficiency of 99 percent retention of particles larger than 10 micrometers.
- J. Air-Cooled, Compressed-Air Aftercoolers
1. Description: Electric-motor-driven, fan-operation, finned-tube unit; rated at 250 psig (1725 kPa) and leak tested at 350-psig (2415-kPa) minimum air pressure; in capacities indicated. Size units to cool compressed air in compressor-rated capacities to 10 deg F (6 deg C) above summertime maximum ambient temperature. Include moisture separator and automatic drain.
- K. Water-Cooled, Compressed-Air Aftercoolers
1. Description: Shell and tube unit, rated at 250 psig (1725 kPa) and leak tested at 350-psig (2415-kPa) minimum air pressure, in capacities indicated. Include moisture separator and automatic drain.
- L. Refrigerant Compressed-Air Dryers
1. Description: Noncycling, air-cooled, electric-motor-driven unit with steel enclosure and capability to deliver 35 deg F (2 deg C), 100-psig (690-kPa) air at dew point. Include automatic ejection of condensate from airstream, step-down transformers, disconnect switches, inlet and outlet pressure gages, thermometers, automatic controls, and filters.
- M. Desiccant Compressed-Air Dryers
1. Description: Twin-tower unit with purge system, mufflers, and capability to deliver plus 10 deg F (minus 12 deg C), 100-psig (690-kPa) air at dew point. Include dew point controlled purge, step-down transformers, disconnect switches, inlet and outlet pressure gages, thermometers, automatic controls, and filters.
- N. Computer Interface Cabinet
1. Description:
 - a. Wall mounting.
 - b. Welded steel with white enamel finish.
 - c. Gasketed door.
 - d. Grounding device.
 - e. Factory-installed, signal circuit boards.
 - f. Power transformer.
 - g. Circuit breaker.
 - h. Wiring terminal board.
 - i. Internal wiring capable of interfacing 20 alarm signals.
- O. Motors
1. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in Division 22 Section "Common Motor Requirements For Plumbing Equipment".
 - a. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.

- b. Controllers, Electrical Devices, and Wiring: Comply with requirements for electrical devices and connections specified in Division 22.

1.3 EXECUTION

A. Equipment Installation

1. Equipment Mounting:

- a. Install air compressors, aftercoolers, and air dryers on concrete bases using elastomeric pads **OR** elastomeric mounts **OR** restrained spring isolators, **as directed**. Comply with requirements in Division 03 Section "Cast-in-place Concrete". Comply with requirements for vibration isolation devices specified in Division 22 Section "Vibration And Seismic Controls For Plumbing Piping And Equipment".
 - 1) Minimum Deflection: **1/4 inch (6 mm) OR 1 inch (25 mm), as directed**.
 - 2) Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on **18-inch (450-mm)** centers around the full perimeter of concrete base.
 - 3) For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.
 - 4) Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 - 5) Install anchor bolts to elevations required for proper attachment to supported equipment.
 - b. Install air compressors, aftercoolers, and air dryers using elastomeric pads **OR** elastomeric mounts **OR** restrained spring isolators, **as directed**. Comply with requirements for vibration isolation devices specified in Division 22 Section "Vibration And Seismic Controls For Plumbing Piping And Equipment".
 - 1) Minimum Deflection: **1/4 inch (6 mm) OR 1 inch (25 mm), as directed**.
 - c. Install air compressors, aftercoolers, and air dryers on vibration isolation inertia bases. Comply with requirements specified in Division 22 Section "Vibration And Seismic Controls For Plumbing Piping And Equipment".
 - d. Install air compressors, aftercoolers, and air dryers on concrete bases. Comply with requirements in Division 03 Section "Cast-in-place Concrete".
 - 1) Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on **18-inch (450-mm)** centers around the full perimeter of concrete base.
 - 2) For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.
 - 3) Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 - 4) Install anchor bolts to elevations required for proper attachment to supported equipment.
 - e. Install water-cooled, compressed-air aftercoolers and desiccant compressed-air dryers on concrete bases. Comply with requirements in Division 03 Section "Cast-in-place Concrete".
 - 1) Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on **18-inch (450-mm)** centers around the full perimeter of concrete base.
 - 2) For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.
 - 3) Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 - 4) Install anchor bolts to elevations required for proper attachment to supported equipment.
- 2. Install compressed-air equipment anchored to substrate.
 - 3. Arrange equipment so controls and devices are accessible for servicing.



4. Maintain manufacturer's recommended clearances for service and maintenance.
5. Install the following devices on compressed-air equipment:
 - a. Thermometer, Pressure Gage, and Safety Valve: Install on each compressed-air receiver.
 - b. Pressure Regulators: Install downstream from air compressors and dryers.
 - c. Automatic Drain Valves: Install on aftercoolers, receivers, and dryers. Discharge condensate over nearest floor drain.

B. Connections

1. Comply with requirements for piping specified in Division 22 Section "General-service Compressed-air Piping". Drawings indicate general arrangement of piping, fittings, and specialties.
2. Install piping adjacent to machine to allow service and maintenance.

C. Identification

1. Identify general-service air compressors and components. Comply with requirements for identification specified in Division 22 Section "Identification For Plumbing Piping And Equipment".

D. Startup Service

1. Perform startup service.
 - a. Complete installation and startup checks according to manufacturer's written instructions.
 - b. Check for lubricating oil in lubricated-type equipment.
 - c. Check belt drives for proper tension.
 - d. Verify that air-compressor inlet filters and piping are clear.
 - e. Check for equipment vibration-control supports and flexible pipe connectors and verify that equipment is properly attached to substrate.
 - f. Check safety valves for correct settings. Ensure that settings are higher than air-compressor discharge pressure but not higher than rating of system components.
 - g. Check for proper seismic restraints.
 - h. Drain receiver tanks.
 - i. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
 - j. Test and adjust controls and safeties.

E. Demonstration

1. Train Owner's maintenance personnel to adjust, operate, and maintain air compressors, aftercoolers, and air dryers.

END OF SECTION 22 15 13 00

Task	Specification	Specification Description
22 15 13 00	23 09 00 00	HVAC Instrumentation And Controls
22 15 19 13	22 15 13 00	General-Service Packaged Air Compressors and Receivers
22 15 19 13	23 09 00 00	HVAC Instrumentation And Controls
22 15 19 19	22 15 13 00	General-Service Packaged Air Compressors and Receivers
22 15 19 19	23 09 00 00	HVAC Instrumentation And Controls

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SECTION 22 31 16 00 - WATER SOFTENERS

1.1 GENERAL

A. Description Of Work

1. This specification covers the furnishing and installation of materials for water softeners. Products shall be as follows or as directed by the Owner. Installation procedures shall be in accordance with the product manufacturer's recommendations. Demolition and removal of materials shall be as required to support the work.

B. Summary

1. This Section includes household and commercial water softeners.
 - a. Chemicals.
 - b. Water testing kits.

C. Definitions

1. ABS: Acrylonitrile-butadiene-styrene plastic.
2. FRP: Fiberglass-reinforced plastic.
3. PE: Polyethylene plastic.
4. PVC: Polyvinyl chloride plastic.

D. Submittals

1. Product Data: For each type of water softener and water testing kit indicated.
2. Shop Drawings: Include plans, elevations, sections, details, and connections to piping systems.
 - a. Include wiring diagrams.
3. Manufacturer Seismic Qualification Certification
4. Field quality-control test reports.
5. Operation and Maintenance Data: For water softeners to include in emergency, operation, and maintenance manuals.
6. Warranty: Special warranty specified in this Section.

E. Quality Assurance

1. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
2. ASME Compliance for Steel Tanks: Fabricate and label mineral tanks to comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 1, where indicated.
3. ASME Compliance for FRP Tanks: Fabricate and label mineral tanks to comply with ASME Boiler and Pressure Vessel Code: Section X, where indicated.

F. Warranty

1. Manufacturer's standard form in which manufacturer agrees to repair or replace components of water softener that fail in materials or workmanship within Five years from date of Final Completion.

1.2 PRODUCTS

A. Household Water Softeners

1. Description: Factory-assembled, fully-automatic, pressure-type water softener.
 - a. Configuration: Unit with one mineral tank and one brine tank or cabinet-style, combination mineral and brine tank unit with equivalent characteristics.
 - b. Mineral Tank: Steel or FRP, with coating or liner suitable for potable-water service and 125-psig (860-kPa) minimum pressure rating.

- c. Comply with NSF 61, "Drinking Water System Components--Health Effects."
- d. Controls: For fully automatic operation.
- e. Brine Tank: Combination measuring and wet-salt storing system.
 - 1) Tank and Cover Material: FRP or molded PE.
 - 2) Brine Valve: Float operated and plastic fitted for automatic control of brine withdrawn and freshwater refill.
 - 3) Size: Large enough for at least two regenerations at full salting.
- f. Factory-Installed Accessories:
 - 1) Piping, valves, tubing, and drains.
 - 2) Sampling cock.
 - 3) Main-operating-valve position indicator.

B. Commercial Water Softeners

1. Description: Factory-assembled, pressure-type water softener.
 - a. Comply with NSF 61, "Drinking Water System Components--Health Effects."
 - b. Configuration: Single unit with one mineral tank **OR** Twin unit with two mineral tanks **OR** Triple unit with three mineral tanks, **as directed**, and one brine tank, factory mounted on skids, **unless directed otherwise**.
 - c. Mineral Tanks: FRP, pressure-vessel quality.
 - 1) Construction: Non-ASME code **OR** Fabricated and stamped to comply with ASME Boiler and Pressure Vessel Code: Section X, "Fiber-Reinforced Plastic Pressure Vessels," **as directed**.
 - 2) Pressure Rating: 100 psig (690 kPa) **OR** 125 psig (860 kPa), **as directed**, minimum.
 - 3) Wetted Components: Suitable for water temperatures from 40 to at least 100 deg F (5 to at least 38 deg C) **OR** 40 to at least 120 deg F (5 to at least 49 deg C) **OR** 40 to at least 150 deg F (5 to at least 66 deg C), **as directed**.
 - 4) Freeboard: 50 percent minimum for backwash expansion above normal resin bed level.
 - 5) Support Legs or Skirt: Constructed of structural steel, welded to tank before testing and labeling.
 - 6) Upper Distribution System: Single, point type, fabricated from galvanized-steel pipe and fittings.
 - 7) Lower Distribution System: Hub and radial-arm or header-lateral type; fabricated from nonmetallic pipe and fittings with individual, fine-slotted, nonclogging plastic strainers; arranged for even flow distribution through resin bed.
 - 8) Liner: PE, ABS, or other material suitable for potable water.
 - d. Mineral Tanks: Steel **OR** Stainless steel, **as directed**, electric welded; pressure-vessel quality.
 - 1) Fabricate supports and attachments to tank with reinforcement strong enough to resist tank movement during seismic event when tank supports are anchored to building structure.
 - 2) Construction: Non-ASME code **OR** Fabricated and stamped to comply with ASME Boiler and Pressure Vessel Code: Section VIII, "Pressure Vessels," **as directed**.
 - 3) Pressure Rating: 100 psig (690 kPa) **OR** 125 psig (860 kPa) **OR** 150 psig (1035 kPa), **as directed**, minimum.
 - 4) Wetted Components: Suitable for water temperatures from 40 to at least 100 deg F (5 to at least 38 deg C) **OR** 40 to at least 120 deg F (5 to at least 49 deg C) **OR** 40 to at least 150 deg F (5 to at least 66 deg C), **as directed**.
 - 5) Freeboard: 50 percent minimum for backwash expansion above normal resin bed level.
 - 6) Handholes: 4 inches (102 mm) round or 4 by 6 inches (102 by 152 mm) elliptical, in top head and lower sidewall of tanks 30 inches (762 mm) and smaller in diameter.
 - 7) Manhole: 11 by 15 inches (280 by 380 mm) in top head of tanks larger than 30 inches (762 mm) in diameter.

- 8) Support Legs or Skirt: Constructed of structural steel, welded to tank before testing and labeling.
- 9) Finish: Hot-dip galvanized on exterior and interior of tank after fabrication, unless tank is stainless steel.
- 10) Finish: Exterior of tank spray painted with rust-resistant prime coat, 2- to 3-mil (0.051- to 0.076-mm) dry film thickness. Interior sandblasted and lined with epoxy-polyamide coating, 8- to 10-mil (0.203- to 0.254-mm) dry film thickness.
- 11) Upper Distribution System: Single, point type, fabricated from galvanized-steel pipe and fittings.
- 12) Lower Distribution System: Hub and radial-arm or header-lateral type; fabricated from PVC pipe and fittings with individual, fine-slotted, nonclogging PE strainers; arranged for even flow distribution through resin bed.
- 13) Liner: PE, ABS, or other material suitable for potable water.
- e. Controls: Automatic; factory mounted on unit and factory wired.
 - 1) Adjustable duration of various regeneration steps.
 - 2) Push-button start and complete manual operation.
 - 3) Electric time clock and switch for automatic operation, except for manual return to service.
 - 4) Sequence of Operation: Program multiport pilot-control valve to automatically pressure-actuate main operating valve through steps of regeneration.
 - 5) Pointer on pilot-control valve shall indicate cycle of operation.
 - 6) Means of manual operation of pilot-control valve if power fails.
- f. Controls: Fully automatic; factory mounted on unit and factory wired.
 - 1) Adjustable duration of various regeneration steps.
 - 2) Push-button start and complete manual operation.
 - 3) Electric time clock and switch for fully automatic operation, adjustable to initiate regeneration at any hour of day and any day of week or at fixed intervals.
 - 4) Sequence of Operation: Program multiport pilot-control valve to automatically pressure-actuate main operating valve through steps of regeneration and return to service.
 - 5) Pointer on pilot-control valve shall indicate cycle of operation.
 - 6) Means of manual operation of pilot-control valve if power fails.
 - 7) Main Operating Valves: Industrial, automatic, multiport, diaphragm type with the following features:
 - a) Slow opening and closing, nonslam operation.
 - b) Diaphragm guiding on full perimeter from fully open to fully closed.
 - c) Isolated dissimilar metals within valve.
 - d) Self-adjusting, internal, automatic brine injector that draws brine and rinses at constant rate independent of pressure.
 - e) Valve for single mineral-tank unit with internal automatic bypass of raw water during regeneration.
 - f) Sampling cocks for soft water.
 - g) Special tools are not required for service.
 - 8) Flow Control: Automatic, to control backwash and flush rates over wide variations in operating pressures, and that does not require field adjustments.
 - a) Meter Control: Equip each mineral tank with signal-register-head water meter that will produce electrical signal indicating need for regeneration on reaching hand-set total in gallons (liters). Design so signal will continue until reset.
 - b) Demand-Initiated Control:
 - i. Equip single mineral-tank units with automatic-reset-head water meter that electrically activates cycle controller to initiate regeneration at preset total in gallons (liters). Design so head automatically resets to preset total in gallons (liters) for next service run.
 - ii. Equip each mineral tank of twin mineral-tank units with automatic-reset-head water meters that electrically activate cycle controllers to initiate regeneration at preset total in gallons (liters). Design so heads

automatically reset to preset total in **gallons (liters)** for next service run. Include electrical lockout to prevent simultaneous regeneration of both tanks.

- iii. Equip each mineral tank of twin mineral-tank units with automatic-reset-head water meter in common outlet header that electrically activates cycle controller to automatically regenerate one mineral tank at preset total in **gallons (liters)** and divert flow to other tank. Set to repeat with other tank. Include electrical lockout to prevent simultaneous regeneration of both tanks.
 - iv. Equip each mineral tank of multiple mineral-tank units with automatic-reset-head water meters that electrically activate cycle controllers to automatically regenerate at preset total in **gallons (liters)**. Design so heads automatically reset to preset total in **gallons (liters)** for next service run. Include electrical lockouts to prevent simultaneous regeneration of more than one tank.
 - v. Equip each mineral tank of multiple mineral-tank units with automatic-reset-head water meter in common outlet header that electrically activates cycle controller to automatically regenerate one mineral tank at preset total in **gallons (liters)** and divert flow to other tanks. Set to repeat with other tanks. Include electrical lockouts to prevent simultaneous regeneration of more than one tank.
- g. Brine Tank: Combination measuring and wet-salt storing system.
 - 1) Tank and Cover Material: Fiberglass, **3/16 inch (4.8 mm)** thick; or molded PE, **3/8 inch (9.5 mm)** thick.
 - 2) Brine Valve: Float operated and plastic fitted for automatic control of brine withdrawn and freshwater refill.
 - 3) Size: Large enough for at least four regenerations at full salting.
 - h. Factory-Installed Accessories:
 - 1) Piping, valves, tubing, and drains.
 - 2) Sampling cocks.
 - 3) Main-operating-valve position indicators.
 - 4) Water meters.
 - 2. Capacity and Characteristics:
 - a. Service: Cold **OR** Hot, **as directed**, water.
 - b. Number of Mineral Tanks: One **OR** Two, **as directed**.

C. Chemicals

- 1. Mineral: High-capacity, sulfonated-polystyrene ion-exchange resin that is stable over entire pH range with good resistance to bead fracture from attrition or shock.
 - a. Exchange Capacity: **30,000 grains/cu. ft. (69 kg/cu. m)** of calcium carbonate of resin when regenerated with **15 lb (6.8 kg)** of salt.
- 2. Salt for Brine Tanks: High-purity sodium chloride; free of dirt and foreign material. Rock and granulated forms are not acceptable.
 - a. Form: Processed, food-grade salt pellets **OR** plain salt pellets **OR** crystallized solar salt from shallow ponds and milled into irregular particles **OR** plain, brine block salt, **as directed**.

D. Water Testing Sets

- 1. Description: Manufacturer's standard water-hardness testing apparatus and chemicals with testing procedure instructions. Include metal container suitable for wall mounting.

1.3 EXECUTION

A. Concrete Bases

1. Install concrete bases of dimensions indicated for commercial water softeners. Refer to Division 22 Section "Common Work Results For Plumbing".
- B. Water Softener Installation
 1. Install household water softeners on floor. Anchor water softener and brine tanks to substrate.
 2. Install commercial water softener equipment on concrete bases, level and plumb. Maintain manufacturer's recommended clearances. Arrange units so controls and devices that require servicing are accessible. Anchor mineral and brine tanks and floor-mounting accessories to substrate.
 3. Install seismic restraints for tanks and floor-mounting accessories and anchor to building structure.
 4. Install brine lines and fittings furnished by equipment manufacturer but not specified to be factory installed.
 5. Prepare mineral-tank distribution system and underbed for minerals and place specified mineral into mineral tanks.
 6. Install water testing sets mounted on wall, unless otherwise indicated, and near water softeners.
- C. Connections
 1. Piping installation requirements are specified in other Division 14.. Drawings indicate general arrangement of piping, fittings, and specialties.
 2. Install piping adjacent to equipment to allow service and maintenance.
 3. Make piping connections between water-softener-unit headers and dissimilar-metal water piping with dielectric fittings. Dielectric fittings are specified in Division 22 Section "Common Work Results For Plumbing".
 4. Install shutoff valves on raw-water inlet and soft-water outlet piping of each mineral tank, and on inlet and outlet headers.
 - a. Metal general-duty valves are specified in Division 22 Section "General-duty Valves For Plumbing Piping".
 - b. Plastic valves are specified in Division 22 Section "Domestic Water Piping".
 - c. Exception: Water softeners with factory-installed shutoff valves at locations indicated.
 5. Install pressure gages on raw-water inlet and soft-water outlet piping of each mineral tank. Pressure gages are specified in Division 22 Section "Meters And Gages For Plumbing Piping".
 - a. Exception: Water softeners with factory-installed pressure gages at locations indicated.
 - b. Exception: Household water softeners.
 - c. Exception: Water softeners in hot-water service.
 6. Install valved bypass water piping around water softeners.
 - a. Metal general-duty valves are specified in Division 22 Section "General-duty Valves For Plumbing Piping".
 - b. Plastic valves are specified in Division 22 Section "Domestic Water Piping".
 - c. Water piping is specified in Division 22 Section "Domestic Water Piping".
 - d. Exception: Household water softeners.
 - e. Exception: Water softeners in hot-water service.
 7. Install drains as indirect wastes to spill into open drains or over floor drains.
 8. Ground equipment according to Division 26 Section "Grounding And Bonding For Electrical Systems".
 9. Connect wiring according to Division 26 Section "Low-voltage Electrical Power Conductors And Cables".
- D. Field Quality Control
 1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust field-assembled components and equipment installation, including connections, and to assist in field testing. Report results in writing.
 2. Perform the following field tests and inspections and prepare test reports:
 - a. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.

- b. Operational Test: After electrical circuitry has been energized, start units to confirm proper unit operation.
- c. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- 3. Remove and replace malfunctioning water softeners that do not pass tests and inspections and retest as specified above.

E. Startup Service

- 1. Engage a factory-authorized service representative to perform startup service.
 - a. Complete installation and startup checks according to manufacturer's written instructions.
- 2. Add water to brine tanks and fill with salt.
 - a. Household Water Softeners: Processed food-grade salt pellets **OR** plain salt pellets **OR** crystallized solar salt, **as directed**.
 - b. Commercial Water Softeners: Plain salt pellets **OR** Crystallized solar salt **OR** Plain, brine block salt **OR** Food-grade salt pellets, **as directed**.
- 3. Sample water softener effluent after startup and at three consecutive seven-day intervals (total of four samples), and prepare certified test reports for required water performance characteristics. Comply with the following:
 - a. ASTM D 859, "Test Method for Silica in Water."
 - b. ASTM D 1067, "Test Methods for Acidity or Alkalinity of Water."
 - c. ASTM D 1068, "Test Methods for Iron in Water."
 - d. ASTM D 1126, "Test Method for Hardness in Water."
 - e. ASTM D 1129, "Terminology Relating to Water."
 - f. ASTM D 3370, "Practices for Sampling Water from Closed Conduits."

F. Demonstration

- 1. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain commercial water softeners.

END OF SECTION 22 31 16 00

Task	Specification	Specification Description
22 33 00 00	22 12 23 13	Electric, Domestic Water Heaters
22 33 30 16	22 12 23 13	Electric, Domestic Water Heaters
22 33 30 16	22 12 23 13a	Fuel-Fired, Domestic Water Heaters
22 33 33 00	22 12 23 13	Electric, Domestic Water Heaters
22 34 00 00	22 12 23 13a	Fuel-Fired, Domestic Water Heaters
22 34 36 13	22 12 23 13	Electric, Domestic Water Heaters
22 34 46 11	22 12 23 13a	Fuel-Fired, Domestic Water Heaters

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SECTION 22 35 23 13 - DOMESTIC WATER HEAT EXCHANGERS

1.1 GENERAL

A. Description Of Work

1. This specification covers the furnishing and installation of materials for heat exchangers. Products shall be as follows or as directed by the Owner. Installation procedures shall be in accordance with the product manufacturer's recommendations. Demolition and removal of materials shall be as required to support the work.

B. Summary

1. This Section includes the following heat exchangers:
 - a. Heating-fluid-in-coil, instantaneous heat exchangers.
 - b. Domestic-water-in-coil, instantaneous heat exchangers.
 - c. Heating-fluid-in-U-tube-coil, instantaneous heat exchangers.
 - d. Circulating, compact heat exchangers.
 - e. Circulating, storage heat exchangers.
 - f. Noncirculating, compact heat exchangers.
 - g. Noncirculating, storage heat exchangers.
 - h. Brazed-plate heat exchangers.
 - i. Frame-and-plate heat exchangers.
 - j. Heat reclaimers.
 - k. Compression tanks.
 - l. Heat-exchanger accessories.

C. Submittals

1. Product Data: For each type and size of heat exchanger indicated. Include rated capacities, operating characteristics, furnished specialties, and accessories.
2. Shop Drawings: Diagram power, signal, and control wiring.
3. Manufacturer Seismic Qualification Certification
4. Source quality-control test reports.
5. Field quality-control test reports.
6. Operation and Maintenance Data: For heat exchangers to include in emergency, operation, and maintenance manuals.
7. Warranty: Special warranty specified in this Section.

D. Quality Assurance

1. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
2. ASME Compliance: Where ASME-code construction is indicated, fabricate and label heat-exchanger storage tanks to comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.
3. Comply with NSF 61, "Drinking Water System Components - Health Effects; Sections 1 through 9" for all components that will be in contact with water.

E. Warranty

1. Manufacturer's standard form in which manufacturer agrees to repair or replace components of heat exchangers that fail in materials or workmanship within specified warranty period.
 - a. Failures include, but are not limited to, the following:
 - 1) Structural failures including heat exchanger, storage tank, and supports.
 - 2) Faulty operation of controls.
 - 3) Deterioration of metals, metal finishes, and other materials beyond normal use.
 - b. Warranty Period(s): From date of Final Completion:

- 1) Instantaneous Heat Exchangers:
 - a) Tube Coil and Shell: One year.
 - b) Controls and Other Components: One year.
- 2) Circulating, Storage Heat Exchangers:
 - a) Storage Tank: Five years.
 - b) Tube Coil: Five years.
 - c) Controls and Other Components: Three years.
- 3) Noncirculating, Storage Heat Exchangers:
 - a) Storage Tank: Five years.
 - b) Tube Coil: Five years.
 - c) Controls and Other Components: Three years.
- 4) Plate Heat Exchangers:
 - a) Brazed-Plate Type: One year.
 - b) Plate-and-Frame Type: One year.
- 5) Heat Reclaimers: One year.
- 6) Compression Tanks: One year.

1.2 PRODUCTS

A. Instantaneous Heat Exchangers

1. Heating-Fluid-in-Coil, Instantaneous Heat Exchangers:
 - a. Description: Packaged assembly of tank, heat-exchanger coils, controls, and specialties for heating domestic water with heating hot water **OR** steam, **as directed**, in heat-exchanger coils.
 - b. Construction: ASME-code, negligible-capacity, copper-lined, carbon-steel shell with **150-psig (1035-kPa)** minimum working-pressure rating.
 - 1) Tappings: Factory fabricated of materials compatible with heat-exchanger shell. Attach tappings to shell before testing and labeling.
 - a) **NPS 2 (DN 50)** and Smaller: Threaded ends according to ASME B1.20.1.
 - b) **NPS 2-1/2 (DN 65)** and Larger: Flanged ends according to ASME B16.5 for steel and stainless-steel flanges, and according to ASME B16.24 for copper and copper-alloy flanges.
 - 2) Insulation: Complying with ASHRAE/IESNA 90.1, unless otherwise indicated, and suitable for operating temperature. Surround entire shell and nozzle except connections and controls.
 - 3) Heat-Exchanger Coils: Copper **OR** Copper nickel **OR** Stainless-steel, **as directed**, helix-wound coils for heating fluid with pressure rating equal to or greater than heating-fluid supply pressure.
 - 4) Temperature Control: Adjustable thermostat that operates control valve and that is capable of maintaining outlet-water temperature within **4 deg F (2 deg C)** of setting.
 - 5) Safety Control: Automatic, high-temperature-limit cutoff device or system.
 - 6) Relief Valves: ASME rated and stamped and complying with ASME PTC 25.3, for combination temperature and pressure relief valves. Include one or more relief valves with total relieving capacity at least as great as heat input, and include pressure setting less than working-pressure rating of heat exchanger. Select one relief valve with sensing element that extends into storage tank.
 - c. Miscellaneous Components for Heating Hot-Water Unit: Control valve, valves, and piping. Include components fitted for pneumatic control.
 - d. Miscellaneous Components for Steam Unit: Strainers, steam-control valve, steam trap, valves, pressure gage, thermometer, and piping. Include components fitted for pneumatic control.
 - 1) Exception: Steam trap is not required if manufacturer's written instructions direct that it not be used.
 - e. Stand: Factory fabricated for floor mounting.

2. Domestic-Water-in-Coil, Instantaneous Heat Exchangers:
 - a. Description: Tankless, packaged assembly of heat-exchanger coils, controls, and specialties for heating domestic water in coils with steam in shell.
 - b. Construction: ASME code, with cast-iron or steel shell for steam.
 - 1) Cast-Iron Shell Pressure Rating: **75 psig (517 kPa)**.
 - 2) Steel Shell Pressure Rating: **150 psig (1035 kPa)**.
 - 3) Insulation: Complying with ASHRAE/IESNA 90.1, unless otherwise indicated, and suitable for operating temperature. Surround entire shell and nozzle except connections and controls.
 - c. Heat-Exchanger Coils: Spiral-wound, copper or copper-alloy **OR** stainless-steel, **as directed**, coils for domestic water.
 - d. Temperature Control: Adjustable thermostat that operates steam-control valve and that is capable of maintaining outlet-water temperature within **3 deg F (2 deg C)** of setting.
 - e. Safety Control: Automatic, high-temperature-limit cutoff device or system.
 - f. Miscellaneous Components: Strainers, steam-control valve, steam trap, valves, and piping.
 - g. Stand: Factory fabricated for floor mounting.
3. Heating-Fluid-in-U-Tube-Coil, Instantaneous Heat Exchangers:
 - a. Description: Tankless, packaged assembly of heat-exchanger coil, controls, and specialties for heating domestic water in shell with heating hot water **OR** steam, **as directed**, in coil.
 - b. Construction: ASME-code, negligible-capacity, copper-lined, carbon-steel or copper-alloy shell with **150-psig (1035-kPa)** minimum working-pressure rating.
 - 1) Configuration: Horizontal **OR** Vertical, **as directed**.
 - 2) Shell Tappings: Factory fabricated of materials compatible with water heater shell. Attach tappings to shell before testing and labeling.
 - a) **NPS 2 (DN 50)** and Smaller: Threaded ends according to ASME B1.20.1.
 - b) **NPS 2-1/2 (DN 65)** and Larger: Flanged ends according to ASME B16.5 for steel and stainless-steel flanges, and according to ASME B16.24 for copper and copper-alloy flanges.
 - 3) Insulation: Complying with ASHRAE/IESNA 90.1, unless otherwise indicated, and suitable for operating temperature. Surround entire shell and nozzle except connections and controls.
 - 4) Heat-Exchanger Coil: Copper, double-wall **OR** single-wall, **as directed**, U tubes for heating fluid.
 - a) Tube Pressure Rating: Equal to or greater than heating-fluid supply pressure.
 - c. Temperature Control: Adjustable thermostat that operates steam-control valve and that is capable of maintaining outlet-water temperature within **5 deg F (3 deg C)** of setting.
 - d. Safety Control: Automatic, high-temperature-limit cutoff device or system.
 - e. Relief Valves: ASME rated and stamped and complying with ASME PTC 25.3, for combination temperature and pressure relief valves. Include one or more relief valves with total relieving capacity at least as great as heat input, and include pressure setting less than working-pressure rating of heat exchanger. Select one relief valve with sensing element that extends into shell.
 - f. Miscellaneous Components for Heating Hot-Water Unit: Control valve, valves, and piping. Include components fitted for pneumatic control.
 - g. Miscellaneous Components for Steam Unit: Strainers, steam-control valve, steam trap, valves, pressure gage, thermometer, and piping. Include components fitted for pneumatic control.
 - h. Stand: Factory fabricated for floor mounting.

B. Circulating, Storage Heat Exchangers

1. Circulating, Compact Heat Exchangers:
 - a. Description: Packaged, small-capacity, hot-water storage tank with heat-exchanger coil; circulator; controls; and specialties for heating domestic water with heating hot water **OR** steam, **as directed**, in coil.

- b. Flow Pattern: Standard-flow arrangement, with water from bottom of storage tank circulated across heat-exchanger coil and returned to tank. Include hot-water outlet located at top of tank and temperature sensor in tank.
- c. Storage Tank Construction: ASME-code, vertical; copper-silicon or corrosion-resistant metal with **150-psig (1035-kPa)** working-pressure rating. Include nozzle and head for heat-exchanger tube coil.
 - 1) Configuration: Vertical.
 - 2) Tappings: Factory fabricated of materials compatible with tank. Attach tappings to tank before testing and labeling.
 - a) **NPS 2 (DN 50)** and Smaller: Threaded ends according to ASME B1.20.1.
 - b) **NPS 2-1/2 (DN 65)** and Larger: Flanged ends according to ASME B16.5 for steel and stainless-steel flanges, and according to ASME B16.24 for copper and copper-alloy flanges.
 - 3) Insulation: Complying with ASHRAE/IESNA 90.1, unless otherwise indicated, and suitable for operating temperature. Surround entire storage tank and nozzle except connections and controls.
- d. Heat-Exchanger Coil: **NPS 3/4 (DN 20) OR NPS 1-1/4 (DN 32)**, **as directed**, diameter, vented, double-wall, copper or copper-alloy, U tubes with tube sheet and supporting baffles.
 - 1) Heat-Exchanger Pressure Rating: Equal to or greater than heating-fluid supply pressure.
- e. Temperature Control: Adjustable thermostat.
- f. Safety Control: Automatic, high-temperature-limit cutoff device or system. Include automatic low-water cutoff device or system.
- g. Relief Valves: ASME rated and stamped and complying with ASME PTC 25.3, for combination temperature and pressure relief valves. Include one or more relief valves with total relieving capacity at least as great as heat input, and include pressure setting less than working-pressure rating of heat exchanger. Select one relief valve with sensing element that extends into storage tank.
- h. Gages: Factory-mounted thermometer and pressure gage.
- i. Circulating Pump: UL 778, all-bronze, centrifugal, overhung-impeller, separately coupled, in-line pump as defined in HI 1.1-1.2 and HI 1.3. Include mechanical seals, **125-psig (860-kPa)** minimum working-pressure rating, and **225 deg F (107 deg C)** continuous-water-temperature rating.
 - 1) Pump Control: Sensor for operating pump and control valve.
- j. Miscellaneous Components for Heating Hot-Water Units: Control valve, valves, and piping.
- k. Miscellaneous Components for Steam Units: Strainers, steam-control valve, steam trap, valves, and piping.
- l. Support: Factory mounted on skids.
- m. Energy Management System Interface: Normally closed dry contacts for enabling and disabling heat exchanger.
- 2. Circulating, Storage Heat Exchangers:
 - a. Description: Packaged, large-capacity, hot-water storage tank with heat-exchanger coil, circulator, controls, and specialties for heating domestic water with heating hot water **OR** steam, **as directed**, in coil.
 - b. Flow Pattern: Standard-flow arrangement, with water from bottom of storage tank circulated across heat-exchanger coil and returned to tank. Include hot-water outlet located at top of tank and temperature sensor in tank.
 - c. Flow Pattern: Reverse-flow arrangement, with water from storage tank drawn across heat-exchanger coil and returned to bottom of tank. Include hot-water outlet and temperature sensor located in or at coil shell.
 - d. Storage Tank Construction: ASME-code steel with **125-psig (860-kPa) OR 150-psig (1035-kPa)**, **as directed**, working-pressure rating. Include nozzle and head for heat-exchanger tube coil.

- 1) Configuration: Horizontal **OR** Vertical, **as directed**.
- 2) Manhole: **11 by 15 inches (280 by 380 mm)** in end head of horizontal **OR** sidewall of vertical, **as directed**, storage tank shell.
- 3) Tappings: Factory fabricated of materials compatible with tank. Attach tappings to tank before testing and labeling.
 - a) **NPS 2 (DN 50)** and Smaller: Threaded ends according to ASME B1.20.1.
 - b) **NPS 2-1/2 (DN 65)** and Larger: Flanged ends according to ASME B16.5 for steel and stainless-steel flanges, and according to ASME B16.24 for copper and copper-alloy flanges.
- 4) Lining: Cement **OR** Glass **OR** Nickel plate **OR** Phenolic coating **OR** Sheet copper, **as directed**, complying with NSF 61 barrier materials for potable-water tank linings, including extending lining into and through tank fittings and outlets.
- 5) Anode Rods: Factory installed, magnesium.
- 6) Insulation: Complying with ASHRAE/IESNA 90.1, unless otherwise indicated, and suitable for operating temperature. Surround entire storage tank and nozzle except connections and controls.
- e. Heat-Exchanger Coil: **NPS 3/4 (DN 20) OR NPS 1-1/4 (DN 32)**, **as directed**, diameter, vented, double-wall, copper or copper-alloy, U tubes with tube sheet and supporting baffles.
 - 1) Heat-Exchanger Pressure Rating: Equal to or greater than heating-fluid supply pressure.
- f. Temperature Control: Adjustable temperature aquastat, mounted in storage tank shell head, unless otherwise indicated.
- g. Safety Control: Automatic, high-temperature-limit cutoff device or system. Include automatic low-water cutoff device or system.
- h. Relief Valves: ASME rated and stamped and complying with ASME PTC 25.3, for combination temperature and pressure relief valves. Include one or more relief valves with total relieving capacity at least as great as heat input, and include pressure setting less than working-pressure rating of heat exchanger. Select one relief valve with sensing element that extends into storage tank.
- i. Gages: Factory-mounted thermometer and pressure gage.
- j. Circulating Pump: UL 778, all-bronze, centrifugal, overhung-impeller, separately coupled, in-line pump as defined in HI 1.1-1.2 and HI 1.3. Include mechanical seals, **125-psig (860-kPa)** minimum working-pressure rating, and **225 deg F (107 deg C)** continuous-water-temperature rating.
 - 1) Pump Control: Sensor for operating pump and control valve.
- k. Support: Factory mounted on skids.
- l. Energy Management System Interface: Normally closed dry contacts for enabling and disabling heat exchanger.

C. Noncirculating, Storage Heat Exchangers

1. Compact Heat Exchangers:

- a. Description: Hot-water storage tank with integral heat-exchanger coil, controls, and specialties for heating domestic water with heating hot water **OR** steam, **as directed**, in coil.
- b. Storage Tank Shell Construction: Steel or stainless steel with **150-psig (1035-kPa)** working-pressure rating.
 - 1) Tappings: Factory fabricated of materials compatible with tank. Attach tappings to tank before testing and labeling. Include ASME B1.20.1 pipe thread.
 - 2) Interior Finish: Comply with NSF 61 barrier materials for potable-water tank linings, including extending finish into and through tank fittings and outlets.
 - 3) Insulation: Complying with ASHRAE/IESNA 90.1 or ASHRAE 90.2, and suitable for operating temperature. Surround entire tank except connections and controls.
 - 4) Jacket: Steel with enameled finish, unless otherwise indicated.
 - 5) Anode Rods for Steel Tanks: Factory installed, magnesium.

- c. Heat-Exchanger Coil: Copper or stainless-steel coil assembly, permanently installed inside storage tank, for heating fluid. Include working-pressure rating equal to or greater than heating-fluid supply pressure.
 - d. Temperature Control: Adjustable thermostat.
 - e. Relief Valve: ASME rated and stamped and complying with ASME PTC 25.3, for combination temperature and pressure relief valves. Include relief valve with relieving capacity at least as great as heat input, and include pressure setting less than working-pressure rating of heat exchanger. Select relief valve with sensing element that extends into storage tank.
2. Storage Heat Exchangers:
- a. Description: Assembly of hot-water storage tank with separate heat-exchanger coil; controls; and specialties for heating domestic water with heating hot water **OR** steam, **as directed**, in coil.
 - b. Storage Tank Construction: ASME-code steel with **125-psig (860-kPa) OR 150-psig (1035-kPa)**, **as directed**, working-pressure rating. Include nozzle and head for heat-exchanger tube coil.
 - 1) Configuration: Horizontal **OR** Vertical, **as directed**.
 - 2) Manhole: **11 by 15 inches (280 by 380 mm)** in end head of horizontal **OR** sidewall of vertical, **as directed**, storage tank shell.
 - 3) Tappings: Factory fabricated of materials compatible with tank. Attach tappings to tank before testing and labeling.
 - a) **NPS 2 (DN 50)** and Smaller: Threaded ends according to ASME B1.20.1.
 - b) **NPS 2-1/2 (DN 65)** and Larger: Flanged ends according to ASME B16.5 for steel and stainless-steel flanges, and according to ASME B16.24 for copper and copper-alloy flanges.
 - 4) Lining: Cement **OR** Glass **OR** Nickel plate **OR** Phenolic coating **OR** Sheet copper, **as directed**, complying with NSF 61 barrier materials for potable-water tank linings, including extending lining into and through tank fittings and outlets.
 - 5) Anode Rods: Factory installed, magnesium.
 - 6) Insulation: Complying with ASHRAE/IESNA 90.1, unless otherwise indicated, and suitable for operating temperature. Surround entire storage tank and nozzle except connections and controls.
 - c. Heat-Exchanger Coil: **NPS 3/4 (DN 20) OR NPS 1-1/4 (DN 32)**, **as directed**, diameter, vented, double-wall, copper or copper-alloy, U tubes with tube sheet and supporting baffles.
 - 1) Heat-Exchanger Pressure Rating: Equal to or greater than heating-fluid supply pressure.
 - d. Temperature Control: Adjustable temperature aquastat, mounted in storage tank shell head, unless otherwise indicated.
 - e. Relief Valves: ASME rated and stamped and complying with ASME PTC 25.3, for combination temperature and pressure relief valves. Include one or more relief valves with total relieving capacity at least as great as heat input, and include pressure setting less than working-pressure rating of heat exchanger. Select one relief valve with sensing element that extends into storage tank.
 - f. Support: Factory mounted on skids.
- D. Plate Heat Exchangers
- 1. Braze-Plate Heat Exchangers:
 - a. Description: Assembly of heat-exchanger plates, permanently brazed together, for using heating hot water **OR** steam, **as directed**, to heat domestic water.
 - b. Working-Pressure Rating: **150 psig (1035 kPa) OR 200 psig (1380 kPa) OR 250 psig (1725 kPa) OR 400 psig (2760 kPa)**, **as directed**, minimum.
 - c. Plate Construction: Single **OR** Vented, double, **as directed**, wall.
 - d. Plate Material: ASTM A 666, Type 316 stainless steel.
 - e. Connections: Stainless steel; threaded.

2. Frame-and-Plate Heat Exchangers:
 - a. Description: Assembly of nonfixed-position, heat-exchanger plates, with frame, for using heating hot water **OR** steam, **as directed**, to heat domestic water.
 - b. Working-Pressure Rating: **150 psig (1035 kPa) OR 200 psig (1380 kPa) OR 250 psig (1725 kPa) OR 400 psig (2760 kPa)**, **as directed**, minimum.
 - c. Frame:
 - 1) Carrying and Guide Bars: Carbon steel **OR** Stainless steel, **as directed**.
 - 2) Fixed, Frame Plate; Pressure Plate; Support Column; and Nuts and Bolts: Carbon steel.
 - d. Channel Plates:
 - 1) Type: Single **OR** Vented, double, **as directed**, wall.
 - 2) Material: ASTM A 666, Type 304 or 316 stainless steel.
 - 3) Gasket Material: Butyl or acrylonitrile-butadiene rubber, suitable for potable water.
 - e. Connections: Stainless steel suitable for potable water.
 - 1) **NPS 2 (DN 50)** and Smaller: Threaded.
 - 2) **NPS 2-1/2 (DN 65)** and Larger: Flanged.
 - f. Protective Shroud: Steel, covering channel plates.
 - g. Insulation: Complying with ASHRAE/IESNA 90.1, unless otherwise indicated, and suitable for operating temperature. Surround entire heat exchanger except connections.

E. Heat Reclaimers

1. Description: Waste-heat recovery device complying with and listed according to UL 207 for heat reclaimers. Device includes vertical drainage tube with helical, domestic water preheat coil around drainage tube.
 - a. Drainage Tube: ASTM B 306, Type DWV, center, copper drainage tube of size indicated.
 - b. Water Preheat Coil: **ASTM B 88, Type L (ASTM B 88M, Type B)**, copper water tube, of size indicated attached to drainage tube.
 - 1) Working-Pressure Rating: **150 psig (1035 kPa)** on potable-water supply tubing.
 - c. Capacity and Characteristics:
 - 1) **NPS 2 (DN 50)** Drainage Tube:
 - a) Domestic Water Preheat Coil: **NPS 3/8 (DN 10)**.
 - b) Unit Height: **20 inches (508 mm) OR 24 inches (610 mm) OR 30 inches (762 mm)**, **as directed**.
 - 2) **NPS 3 (DN 80)** Drainage Tube:
 - a) Domestic Water Preheat Coil: **NPS 1/2 (DN 15) OR NPS 3/4 (DN 20)**, **as directed**.
 - b) Unit Height: **30 inches (762 mm) OR 40 inches (1016 mm) OR 60 inches (1524 mm)**, **as directed**.
 - 3) **NPS 4 (DN 100)** Drainage Tube:
 - a) Domestic-Water Preheat Coil: **NPS 1/2 (DN 15) OR NPS 3/4 (DN 20)**, **as directed**.
 - b) Unit Height: **30 inches (762 mm) OR 40 inches (1016 mm) OR 60 inches (1524 mm)**, **as directed**.

F. Compression Tanks

1. Description: Steel, pressure-rated tank constructed with welded joints and factory-installed, butyl-rubber diaphragm. Include air precharge to minimum system-operating pressure at tank.
 - a. Construction:
 - 1) Tappings: Factory-fabricated steel, welded to tank before testing and labeling. Include ASME B1.20.1 pipe thread.
 - 2) Interior Finish: Comply with NSF 61 barrier materials for potable-water tank linings, including extending finish into and through tank fittings and outlets.
 - 3) Air-Charging Valve: Factory installed.
 - b. Capacity and Characteristics:
 - 1) Working-Pressure Rating: **100 psig (690 kPa) OR 150 psig (1035 kPa)**, **as directed**.



- 2) Capacity Acceptable: **2 gal. (7.6 L) OR 4 gal. (15.1 L) OR 7 gal. (26.5 L) OR 10 gal. (37.9 L), as directed**, minimum.

G. Heat-Exchanger Accessories

1. Combination Temperature and Pressure Relief Valves: ASME rated and stamped and complying with ASME PTC 25.3. Include relieving capacity at least as great as heat input, and include pressure setting less than working-pressure rating of heat exchanger. Select relief valves with sensing element that extends into heat-exchanger storage tank.
2. Pressure Relief Valves: ASME rated and stamped and complying with ASME PTC 25.3. Include pressure setting less than working-pressure rating of heat exchanger.
3. Piping-Type Heat Traps: Field-fabricated piping arrangement according to ASHRAE/IESNA 90.1 or ASHRAE 90.2.
4. Source Quality Control
5. Test and inspect heat-exchanger storage tanks, specified to be ASME-code construction, according to ASME Boiler and Pressure Vessel Code.
6. Hydrostatically test commercial heat-exchanger storage tanks before shipment to minimum of one and one-half times pressure rating.
7. Prepare test reports.

1.3 EXECUTION

A. Heat-Exchanger Installation

1. Install heat exchangers on concrete bases.
 - a. Concrete base construction requirements are specified in Division 22 Section "Common Work Results For Plumbing".
2. Install heat exchangers level and plumb, according to layout drawings, original design, and referenced standards. Maintain manufacturer's recommended clearances. Arrange units so controls and devices needing service are accessible.
3. Anchor heat exchangers to substrate.
4. Install seismic restraints for heat exchangers. Anchor to substrate.
5. Install temperature and pressure relief valves in top portion of storage tank shells of heat exchangers with domestic water storage. Use relief valves with sensing elements that extend into shells. Extend relief-valve outlet, with drain piping same as water piping in continuous downward pitch, and discharge by positive air gap onto closest floor drain.
6. Install combination temperature and pressure relief valves in water piping for heat exchangers without storage. Extend relief-valve outlet, with drain piping same as water piping in continuous downward pitch, and discharge by positive air gap onto closest floor drain.
7. Install heat-exchanger drain piping as indirect waste to spill by positive air gap into open drains or over floor drains. Install hose-end drain valves at low points in water piping for heat exchangers that do not have tank drains. Refer to Division 22 Section "Domestic Water Piping Specialties" for hose-end drain valves.
8. Install thermometer on each heat-exchanger domestic-water inlet and outlet piping, and install thermometer on each heat-exchanger heating-fluid inlet and outlet piping. Refer to Division 22 Section "Meters And Gages For Plumbing Piping" for thermometers.
9. Install pressure gages on heat-exchanger heating-fluid piping. Refer to Division 22 Section "Meters And Gages For Plumbing Piping" for pressure gages.
10. Fill heat exchangers with water.
11. Charge compression tanks with air.

B. Connections

1. Piping installation requirements are specified in other Division 14. Drawings indicate general arrangement of piping, fittings, and specialties.
2. Install piping adjacent to heat exchangers to allow service and maintenance. Arrange piping for easy removal of heat exchangers.

3. Ground equipment according to Division 26 Section "Grounding And Bonding For Electrical Systems".
 4. Connect wiring according to Division 26 Section "Low-voltage Electrical Power Conductors And Cables".
- C. Field Quality Control
1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust field-assembled components and equipment installation, including connections, and to assist in field testing. Report results in writing.
 2. Perform the following field tests and inspections and prepare test reports:
 - a. Leak Test: After installation, test for leaks. Repair leaks and retest until no leaks exist.
 - b. Operational Test: After electrical circuitry has been energized, confirm proper operation.
 - c. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
 3. Remove and replace heat exchangers that do not pass tests and inspections and retest as specified above.
- D. Demonstration
1. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain heat exchangers.

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Task	Specification	Specification Description
22 35 23 13	22 12 23 13	Electric, Domestic Water Heaters
22 40 00 00	10 28 19 16	Plumbing Fixtures
22 41 39 00	10 28 19 16	Plumbing Fixtures
22 41 39 00	22 01 40 81	Emergency Plumbing Fixtures
22 42 13 13	10 28 19 16	Plumbing Fixtures
22 42 13 13	22 01 40 81	Emergency Plumbing Fixtures
22 42 13 16	10 28 19 16	Plumbing Fixtures
22 42 13 16	22 01 40 81	Emergency Plumbing Fixtures
22 42 16 13	10 28 19 16	Plumbing Fixtures
22 42 16 13	22 01 40 81	Emergency Plumbing Fixtures
22 42 16 16	10 28 19 16	Plumbing Fixtures
22 42 16 16	22 01 40 81	Emergency Plumbing Fixtures

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SECTION 22 42 19 00 - PORCELAIN STEEL BATHTUB LINERS AND SURROUNDS

DESCRIPTION OF WORK

This specification covers the furnishing and installation of materials for porcelain steel bathtub liners and surrounds. Products shall be as directed by the Owner. Installation procedures shall be in accordance with the product manufacturer's recommendations. Demolition and removal of materials shall be as required to support the work.

GENERAL

System Description

1. Performance Requirements: Comply with following:
 - a. Porcelain Enameled Formed Steel Plumbing Fixtures: FS WWP 542b, Section 12, Porcelain Enameled Fixtures:
 - 1) Specular Gloss: Determined in accordance with ASTM C 346.
 - a) Cover Coat: 45 degree specular gloss.
 - 2) Acid Resistance: Determined in accordance with ASTM C 282.
 - a) Cover Coat: Rating of not less than Class A.
 - 3) Alkali Resistance: Determined in accordance with ASTM C 614.
 - a) Cover Coat: Weight Loss: Not exceed 20 mg/square inch.
 - 4) Abrasion Resistance: Determined in accordance with ASTM C 448.
 - a) Surface Abrasion Index of Cover Coat: 40 or higher.
 - 5) Warpage: Comply with US Dept. of Commerce Commercial Standard (CS) 77, Paragraph 7.1; and US Dept. of Commerce Product Standard (PS) 5, Paragraph 6.2.2.
 - 6) Rigidity: Comply with PS 5, Paragraph 6.6.2.

Submittals

2. Product Data:
 - a. Include porcelain enamel steel samples, backer board material, and joint sealant.
3. Shop Drawings
 - a. Indicate proposed method of panel securing method.
 - b. Templates: Furnish plumber with templates of all openings required in porcelain enamel wall system to accommodate new plumbing trim.
4. Design Drawings: If required, prepare and submit drawings for approval to applicable governmental agencies and obtain necessary permits and certificates for compliance when required.
5. Samples:
 - a. Three samples of steel proposed to be used for bathtub liner and for wall panels.
 - 1) Samples without porcelain enamel coating.
 - 2) Sample: Used to calibrate elcometer to determine amount of porcelain enamel coatings applied.
 - b. Three samples of each type of porcelain enamel finish on steel for acceptance.
 - c. the Owner will retain one set of approved samples.
 - d. Keep one set of approved samples at site throughout construction period.
6. Quality Assurance/Control Submittals:
 - a. Test Reports: Results of testing by accredited independent laboratory demonstrating compliance of porcelain enamel with Performance Requirements.
 - b. Certificates: Manufacturer's written certification that bathtub liners and surrounds meet or exceed specified requirements.



Quality Assurance

7. Materials: Been in general use and satisfactorily performed for minimum of five years. Provide list of locations where such materials have been used.
8. Certifications: Comply with ANSI Z34.2.
9. Regulatory Requirements: Comply with following:
 - a. Install bathtub liners and surrounds in accordance with applicable codes and regulations. Should any specified items or requirements conflict with such codes and regulations, consult with the Owner.
 - b. Accessibility:
 - 1) Architectural Barriers Act of 1968 as amended (42 USC 4152-4157) and HUD implementing regulations (24 CFR Part 40).
 - a) Uniform Federal Accessibility Standards (UFAS).
 - 2) Section 504 of the Rehabilitation Act of 1973 as amended (29 USC 794) and HUD implementing regulations 24 CFR Part 8.
 - 3) Fair Housing Accessibility Guidelines (24 CFR Chapter 1).
 - 4) Americans with Disabilities Act of 1990 (ADA) (28 CFR Part 35).
10. Mock-ups: Install one complete mock-up of each typical bathtub liner and surround installation. Comply with Section _____ for bathroom renovation mock-up requirements.
 - a. Locations: As directed.
 - b. Approved Mock-ups: Standard for rest of work.
 - c. Approved Mock-ups: May remain part of completed project.
11. Pre-Installation Meetings: Hold meeting with associated plumbing items installer. Notify the Owner of time and location of meeting.

Project Conditions

12. Existing Conditions:
 - a. Existing Utilities: Protect any sewer, water, gas, electric or other pipelines or conduits uncovered during work from damage.
13. Field Measurements: Field measure each bathroom before start of fabrication.

Scheduling And Sequencing

14. Scheduling: Schedule bathtub liner and surround work in coordination with associated plumbing work installer.
15. Scheduling and Completion: Comply with requirements of Detailed Scope of Work.

PRODUCTS

Bathtub Liners And Aprons

16. Description: Prefabricated customized inserts to fit existing bathtubs and provide new, substantial units, capable of supporting bather and coordinated and integrated with bathtub/shower surround system.
 - a. Bathtub Liners and Aprons: Completely and uniformly enclose existing bathtubs, obscuring them from view.
 - b. New Tub Liners and Aprons: Integrate with existing bathtubs, wall conditions, floor conditions, and plumbing connections to provide complete installation subject to individual dimensional variations in bathtub.
17. Bathtub Liner and Apron Materials: Sheet steel coated with porcelain enamel.
 - a. Sheet Steel Thickness: No. 16 gage through 20 gage as specified below:

Gage	No. 16	No. 18	No. 20
Standard Thickness, mm (inch)	1.52 (0.0598)	1.21 (0.0478)	1.01 (0.0398)
Minimum Thickness, mm (inch)	1.37 (0.054)	1.09 (0.043)	0.84 (0.0329)

Bathtub/Shower Surrounds

18. Panel System: Prefabricated panels in solid sections and continuous to cover back and side walls of bathtub/shower, coordinated and integrated with bathtub liners and aprons.
 - a. Height of Bathtub/Shower Surround: 1 500 mm (60 inches) above bathtub ledge.
 - b. Contractor's Option: One, two, or three piece back wall system.
 - c. Where window is located over bathtub, install porcelain enamel on steel on full depth of returns at full length of window stool and at jambs; from window stool to top of surround.
 - 1) Sill and Jamb System: Not interfere with easy use of and access to window pulls, handles, screen retainers, etc.
 - d. Access Panels: Provide easily removable panel to provide access to tub and shower valves. Provide panels with shallow formed edge on all four sides to receive bead of joint sealant.
 - e. Method of Securing: Not visible.
19. Panels: Coated with porcelain enamel to provide bright, hard, impervious panels.
 - a. Panels: Retain their surface characteristics and resist wear as result of abrasion or scouring, and staining due to use of ordinary household abrasive cleaners in popular use.
 - b. Material: Special purpose enameling iron or steel or low metalloid for carbon content, especially manufactured and processed for porcelain enamel units for architectural purposes.
 - 1) Thickness: 18 through 22 gage steel.
 - c. Panel Edges: 90 degree flange formed as part of face panel and of same finish.
20. Wall Clips Supporting Panels: Minimum 20 gage, hot-dipped galvanized.
21. Fastening Devices: As required and in accordance with panel manufacturer's instructions and accepted good industry practices and as approved.
 - a. Provide expansion toggle bolts, molly bolts, nylon and other plastic anchors, lead anchors as required for existing wall conditions.

Porcelain Enamel Finish

22. Porcelain Enamel Coating: Hard, impervious and durable, glass-like coating produced by fusing carefully compounded mixture of mineral substances such as Cryolite, Feldspar, Quartz, Borax, Silica, Tin and Zirconium Oxide Clays at temperatures up to 980 degrees C (1800 degrees F) in accordance with ANSI A112.19.4M.
23. Porcelain Enamel: Apply to all areas of each component, including backs and flanges.
 - a. Initial Enamel Coating: Apply to all surfaces and apply additional separately fired coating of chemically resistant porcelain enamel as face coat.
 - b. Each coat of Porcelain Enamel: 0.10 to 0.15 mm (0.004 to 0.006 inch) when measured in accordance with ASTM D1186.
 - c. Two Coatings of Porcelain Enamel on Exposed Surfaces of Panels: Thickness of 0.20 to 0.05 mm (0.008 to 0.002 inch).
 - d. Final Porcelain Enamel Coat: Chemically resistant, complying with Performance Requirements in this Section.
 - e. Installed Liner and Surround: Uniform color.
 - 1) Color: White.

Accessories

24. Bracing Strips/Filler Material/Backer Board: Fire retardant perlite or molded polystyrene material providing zero capillarity water resistance, and permanent insulation properties.
 - a. Bracing Strips: Fire retardant molded polystyrene material.
 - b. Filler Material: Sound deadening and cushioning material.
 - c. Panel Backer Board: Minimum 12.7 mm (1/2 inch) thick.
25. Joint Sealant: Mildew resistant one-component silicone; FS TT-S-001543A, Class A; ASTM C 920, Type S, Grade NS, Class 25, Uses NT, G, and A.
 - a. Color: Match color of porcelain enamel.
26. Bath Accessories: See Division 10 Section "Bath Accessories."

Fabrication



27. Shop Assembly: Shop assemble panels to greatest extent possible.
 - a. Coordinate with bath accessories provided under Division 10 Section "Bath Accessories."

EXECUTION

Examination

28. Site Verification of Conditions:
 - a. Existing Conditions: Examine bathrooms before beginning installation.
 - b. Field Measurements: Verify field measurements are as indicated on Shop Drawings.
 - c. Do not proceed with installation until conditions are satisfactory.

Preparation

29. Protection: Comply with requirements of Detailed Scope of Work.
 - a. Protect or repair utilities damaged by operations under this Section.
 - b. Protect adjacent elements from damage and disfiguration.
 - c. Repair or replace damaged elements in accordance with Detailed Scope of Work.
30. Preparation: Prepare bathtubs and surround walls as required for proper installation in accordance with Detailed Scope of Work.

Installation

31. Interface With Other Work: Coordinate installation of bathtub liner and surround wall panel system with installation of bath accessories under Division 10 Section "Bath Accessories" and plumbing work under Division 15 Section "Plumbing."
32. Bathtub Liners and Aprons:
 - a. Installation: Accomplished without removing existing bathtub fixture.
 - b. Bracing Strips/Filler Material: Partially line clearance between base of existing bathtubs and tub liner with bracing strips.
 - c. Insert new bathtub liner over and into existing bathtub, simultaneously bottoming on and compressing filler material and resting on and being supported by intimate contact with existing bathtub seat and rim on all four sides, to eliminate any movement.
 - d. Apron: Install new apron to extension to new bathtub liner ledge or seat portion; by inserting non-corrosive locating pins and/or fasteners as required between floor and roll rim of new tub liner.
 - e. Customize bathtub liner Insert in accordance with variable field dimensions into variably sized ledges and seat: both in plant fabrication and field installation as required.
 - 1) a. Verify dimensions and conditions by visiting each bathroom for work indicated and specified.
33. Tub Surround Wall Panel System: Integrate wall panels with installation of new tub liners.
 - a. Panel System: Install as extension of bathtub in upward direction bearing configuration and function of bathtub and shower enclosure.
 - b. Install window sill and jamb system where window is located over bathtub in manner not to interfere with easy use of and access to window pulls, handles, screen retainers, etc.
 - c. Existing Walls: Remove obstructions, encountered for installation of porcelain enamel panels.
 - 1) Patch and repair damaged wall board surfaces that are exposed after panel installation in accordance with Detailed Scope of Work.
 - 2) Backer Board: Provide between wall panels and existing masonry walls.
 - d. Method of Securing Panels: Mechanical and not visible.
 - 1) Provide at least two wall clips on both top and bottom flanges of each panel.
 - 2) Exposed bolts, screw heads, grommets, battens, channel moldings, or any other fastening devices not allowed.
 - e. Access Panels: Seal perimeter with joint sealant for waterproof joint.

- f. Joint Sealing: Permanently seal perimeter edges between new panels and existing walls, joints between panels, joints at window sill and jamb system, and corner joint at juncture of back wall with side walls with joint sealant .
- 34. Joint Sealants: Apply in accordance with manufacturers recommendations.
 - a. Surfaces to be Sealed: Clean, dry and free of any foreign matter that would degrade adhesion.
 - b. Prime cleaned surfaces in accordance with sealant manufacturer's recommendations.
 - c. Protect surfaces adjacent to joints by masking tape before applying sealant. Remove tape upon finishing sealing work.

Cleaning

- 35. Cleaning: Comply with requirements of Detailed Scope of Work.
 - a. Clean bathtub liners and surrounds after installation is completed with materials compatible with porcelain enamel and having no detrimental effects on porcelain enamel.

END OF SECTION 22 42 19 00

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Task	Specification	Specification Description
22 42 19 00	10 28 19 16	Plumbing Fixtures
22 42 19 00	22 01 40 81	Emergency Plumbing Fixtures
22 42 23 00	10 28 19 16	Plumbing Fixtures
22 42 23 00	22 01 40 81	Emergency Plumbing Fixtures
22 42 33 00	10 28 19 16	Plumbing Fixtures
22 42 33 00	22 01 40 81	Emergency Plumbing Fixtures
22 42 39 00	01 22 16 00	No Specification Required
22 42 39 00	10 28 19 16	Plumbing Fixtures
22 42 39 00	22 01 40 81	Emergency Plumbing Fixtures
22 42 43 00	10 28 19 16	Plumbing Fixtures
22 42 43 00	22 01 40 81	Emergency Plumbing Fixtures
22 42 46 00	10 28 19 16	Plumbing Fixtures
22 42 46 00	22 01 40 81	Emergency Plumbing Fixtures

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SECTION 22 43 00 00 - MEDICAL PLUMBING FIXTURES

1.1 GENERAL

A. Description Of Work

1. This specification covers the furnishing and installation of materials for medical plumbing fixtures. Products shall be as follows or as directed by the Owner. Installation procedures shall be in accordance with the products manufacturer's recommendations. Demolition and removal of materials shall be as required to support the work.

B. Summary

1. This Section includes the following medical plumbing fixtures and related components:
 - a. Faucets for lavatories, showers, and sinks.
 - b. Laminar-flow, faucet-spout outlets.
 - c. Flushometers.
 - d. Toilet seats.
 - e. Protective shielding guards.
 - f. Fixture supports.
 - g. Bedpan washers.
 - h. Water closets.
 - i. Lavatories.
 - j. Individual showers.
 - k. Patients' combination toilets.
 - l. Clinical sinks.
 - m. Plaster sinks.
 - n. Surgeons' scrub sinks.
 - o. Surgeons' instrument sinks.
 - p. Bathing units.
 - q. Sitz baths.
 - r. Bedpan washing equipment.
 - s. Hydrotherapy whirlpools.
 - t. Outlet boxes.
 - u. Morgue equipment.

C. Definitions

1. Accessible Medical Plumbing Fixture: Plumbing fixture that can be approached, entered, and used by people with disabilities.
2. Fitting: Device that controls the flow of water into or out of the medical plumbing fixture. Fittings specified in this Section include supplies and stops, faucets and spouts, shower heads, drains and tailpieces, and traps and waste pipes.
3. FRP: Fiberglass-reinforced plastic.
4. PMMA: Polymethyl methacrylate (acrylic) plastic.

D. Submittals

1. Product Data: For each type of medical plumbing fixture indicated.
2. LEED Submittal:
 - a. Product Data for Credit WE 2, 3.1, and 3.2: Documentation indicating flow and water consumption requirements.
3. Shop Drawings: Diagram power, signal, and control wiring.
4. Operation and maintenance data.

E. Quality Assurance

1. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
2. Regulatory Requirements: Comply with requirements in ICC A117.1, "Accessible and Usable Buildings and Facilities"; Public Law 90-480, "Architectural Barriers Act"; and Public Law 101-336, "Americans with Disabilities Act", **as directed**; for plumbing fixtures for people with disabilities.
3. Regulatory Requirements: Comply with requirements in Public Law 102-486, "Energy Policy Act," about water flow and consumption rates for plumbing fixtures.
4. NSF Standard: Comply with NSF 61, "Drinking Water System Components--Health Effects," for fixture materials that will be in contact with potable water.
5. Select combinations fixtures and trim, faucets, fittings, and other components that are compatible.
6. Comply with the following applicable standards and other requirements specified for medical plumbing fixtures:
 - a. Enameled, Cast-Iron Fixtures: ASME A112.19.1M.
 - b. Plastic Bathtubs: ANSI Z124.1.
 - c. Plastic Shower Enclosures: ANSI Z124.2.
 - d. Slip-Resistant Bathing Surfaces: ASTM F 462.
 - e. Vitreous-China Fixtures: ASME A112.19.2M.
7. Comply with the following applicable standards and other requirements specified for lavatory and sink faucets:
 - a. Backflow Protection Devices for Faucets with Hose-Thread Outlet: ASME A112.18.3M.
 - b. Diverter Valves for Faucets with Hose Spray: ASSE 1025.
 - c. Faucets: ASME A112.18.1.
 - d. Hose-Connection Vacuum Breakers: ASSE 1011.
 - e. Hose-Coupling Threads: ASME B1.20.7.
 - f. Integral, Atmospheric Vacuum Breakers: ASSE 1001.
 - g. NSF Materials: NSF 61.
 - h. Pipe Threads: ASME B1.20.1.
 - i. Sensor-Actuated Faucets and Electrical Devices: UL 1951.
 - j. Supply Fittings: ASME A112.18.1.
 - k. Brass Waste Fittings: ASME A112.18.2.
8. Comply with the following applicable standards and other requirements specified for bathtub and shower faucets:
 - a. Backflow Protection Devices for Hand-Held Showers: ASME A112.18.3M.
 - b. Combination, Pressure-Equalizing and Thermostatic-Control Antiscald Faucets: ASSE 1016.
 - c. Faucets: ASME A112.18.1.
 - d. Hand-Held Showers: ASSE 1014.
 - e. High-Temperature-Limit Controls for Thermal-Shock-Preventing Devices: ASTM F 445.
 - f. Hose-Coupling Threads: ASME B1.20.7.
 - g. Manual-Control Antiscald Faucets: ASTM F 444.
 - h. Pipe Threads: ASME B1.20.1.
 - i. Pressure-Equalizing-Control Antiscald Faucets: ASTM F 444 and ASSE 1016.
 - j. Sensor-Actuated Faucets and Electrical Devices: UL 1951.
 - k. Thermostatic-Control Antiscald Faucets: ASTM F 444 and ASSE 1016.
9. Comply with the following applicable standards and other requirements specified for miscellaneous fittings:
 - a. Atmospheric Vacuum Breakers: ASSE 1001.
 - b. Brass and Copper Supplies: ASME A112.18.1.
 - c. Flexible Water Connectors: ASME A112.18.6.
 - d. Manual-Operation Flushometers: ASSE 1037.
 - e. Sensor-Operation Flushometers: ASSE 1037 and UL 1951.
 - f. Brass Waste Fittings: ASME A112.18.2.
10. Comply with the following applicable standards and other requirements specified for miscellaneous components:

- a. Grab Bars: ASTM F 446.
- b. Hose-Coupling Threads: ASME B1.20.7.
- c. Off-Floor Fixture Supports: ASME A112.6.1M.
- d. Pipe Threads: ASME B1.20.1.
- e. Plastic Toilet Seats: ANSI Z124.5.
- f. Supply and Drain Protective Shielding Guards: ICC A117.1.

1.2 PRODUCTS

A. Lavatory Faucets

- 1. Description: Faucet for lavatory-type medical plumbing fixture. Coordinate faucet inlets with supplies, connectors, and fixture holes; coordinate outlet with spout and fixture receptor.
 - a. Maximum Flow Rate: **2.2 gpm (8.3 L/min.)**.
 - b. Body Material: Solid brass.
 - c. Finish: Polished chrome plate.
 - d. Type: Single-control mixing **OR** Single-valve nonmixing **OR** Two-handle mixing, **as directed**.
 - e. Tempering System: Not required **OR** Thermostatic **OR** Pressure balance, **as directed**.
 - f. Supply Centers: Single hole **OR 4 inches (102 mm) OR 6 inches (152 mm) OR 8 inches (203 mm) OR 12 inches (305 mm) OR Adjustable, as directed**.
 - g. Mounting: Deck, exposed **OR** Deck, concealed **OR** Back/wall, exposed **OR** Back/wall, concealed, **as directed**.
 - h. Handle(s): Single lever **OR** Cross, four arm **OR** Wrist blade, **4 inches (102 mm) OR Elbow, 6 inches (152 mm) OR Not applicable, as directed**.
 - i. Temperature Indicators: Color-coded for hot and cold water.
 - j. Inlet(s): **NPS 3/8 (DN 10) tubing, plain end OR NPS 3/8 (DN 10) tubing, with NPS 1/2 (DN 15) male adaptor OR NPS 1/2 (DN 15) male shank OR NPS 1/2 (DN 15) female shank, as directed**.
 - k. Spout: Rigid **OR** Swing **OR** Rigid gooseneck **OR** Swivel gooseneck, **as directed**, brass.
 - l. Spout Outlet: Aerator **OR** Spray **OR** Laminar flow **OR** Plain end **OR** Spray, **0.5 gpm (1.5 L/min.)**, **as directed**.
 - m. Operation: Compression, manual **OR** Noncompression, manual **OR** Automatic, hard-wired electric sensor, **as directed**.
 - n. Drain: Pop up **OR** See fixture, **as directed**.

B. Shower Faucets

- 1. Description: Faucet for shower-type medical plumbing fixtures. Include hot- and cold-water indicators; check stops; and shower head, arm, and flange. Coordinate faucet inlets with supplies.
 - a. Maximum Flow Rate: **2.5 gpm (9.5 L/min.)**, unless otherwise indicated.
 - b. Body Material: Solid brass.
 - c. Finish: Polished chrome plate.
 - d. Type: Thermostatic **OR** Pressure balance **OR** Thermostatic and pressure balance, **as directed**, with integral or field-installed check stops on hot- and cold-water supplies.
 - e. Mounting: Exposed **OR** Concealed, **as directed**.
 - f. Handle(s): Single lever **OR** Cross, four arm **OR** Not applicable, **as directed**.
 - g. Temperature Indicators: Color-coded for hot and cold water.
 - h. Diverter Valve: Not required **OR** Integral with mixing valve **OR** Not integral with mixing valve, **as directed**.
 - i. Backflow Protection Device for Hand-Held Shower: Required **OR** Not required, **as directed**.
 - j. Operation: Compression, manual **OR** Noncompression, manual **OR** Automatic, hard-wired electric sensor, **as directed**.
 - k. Antiscald Device: Integral with mixing valve **OR** Not required, **as directed**.



- l. Supply Connections: **NPS 1/2 (DN 15) OR NPS 1/2 (DN 15)**, union **OR** Sweat, **as directed**.
- m. Shower Head Material: Brass with chrome-plated finish.
- n. Head Type: Ball joint **OR** Without ball joint **OR** Hand held, slide-bar mounted **OR** Hand held, hook mounted, **as directed**.
- o. Spray Pattern: Fixed **OR** Adjustable, **as directed**.
- p. Integral Volume Control: Required **OR** Not required, **as directed**.
- q. Shower-Arm, Flow-Control Fitting: Not required **OR** **1.5 gpm (5.7 L/min.) OR 2.0 gpm (7.6 L/min.)**, **as directed**.

C. Sink Faucets

1. Description: Faucet for sink-type medical plumbing fixtures. Coordinate faucet inlets with supplies and fixture holes; coordinate outlet with spout and fixture receptor.
 - a. Maximum Flow Rate: **2.5 gpm (9.5 L/min.)**, unless otherwise indicated.
 - b. Body Material: Solid brass.
 - c. Finish: Polished chrome plate **OR** Rough chrome plate, **as directed**.
 - d. Type: Sink faucet **OR** Clinical-sink faucet with stops in shanks, vacuum breaker, hose-thread outlet, and pail hook, **as directed**.
 - e. Tempering Device: Thermostatic **OR** Pressure balance **OR** Not required, **as directed**.
 - f. Mixing Valve: Single control **OR** Two-lever handle, **as directed**.
 - g. Backflow Protection Device for Hose Outlet: Required **OR** Not required **OR** Not applicable, **as directed**.
 - h. Supply Centers: Single hole **OR** **4 inches (102 mm) OR 6 inches (152 mm) OR 8 inches (203 mm) OR** Adjustable, **as directed**.
 - i. Mounting: Deck, exposed **OR** Deck, concealed **OR** Back/wall, exposed **OR** Back/wall, concealed, **as directed**.
 - j. Handle(s): Lever **OR** Knob **OR** Cross, four arm **OR** Wrist blade, **4 inches (102 mm) OR** Elbow, **6 inches (152 mm) OR** Not applicable, **as directed**.
 - k. Temperature Indicators: Color-coded for hot water on left and cold water on right.
 - l. Inlet(s): **NPS 3/8 (DN 10)** plain-end tubing **OR** **NPS 3/8 (DN 10)** tubing with **NPS 1/2 (DN 15)** male adapter **OR** **NPS 1/2 (DN 15)** male shank **OR** **NPS 1/2 (DN 15)** female shank, **as directed**.
 - m. Spout: Rigid, solid **OR** Swing tubular **OR** Rigid, gooseneck, solid **OR** Swivel, gooseneck, solid, **as directed**, brass with wall brace, **as directed**.
 - n. Spout Outlet: Aerator **OR** Swivel aerator/spray **OR** Spray **OR** Laminar flow **OR** Hose thread **OR** Plain end, **as directed**.
 - o. Vacuum Breaker: Required **OR** Not required, **as directed**.
 - p. Operation: Compression, manual **OR** Noncompression, manual **OR** Automatic, hard-wired electric sensor, **as directed**.

D. Laminar-Flow Faucet-Spout Outlets

1. Description: Chrome-plated-brass faucet-spout outlet that produces non-aerating laminar stream. Include male or female thread that mates with faucet outlet for attachment to faucets where indicated and flow-rate range that includes flow of faucet.

E. Flushometers

1. Description: Flushometer for clinical-sink-type **OR** water-closet-type, **as directed**, medical plumbing fixture. Include brass body with corrosion-resistant internal components, non-hold-open feature, **as directed**, control stop with check valve, vacuum breaker, and copper or brass tubing, and polished chrome-plated finish on exposed parts.
 - a. Internal Design: Diaphragm operation.
 - b. Style: Exposed **OR** Concealed, **as directed**.
 - c. Inlet Size: **NPS 1 (DN 25)**.
 - d. Trip Mechanism: Oscillating, lever-handle actuator **OR** Mechanical, push-button actuator with stainless-steel access plate **OR** Hydraulic, push-button actuator **OR** Foot-pedal

- actuator **OR** Hard-wired, electric-sensor actuator **OR** Battery-operated sensor actuator, **as directed**.
- e. Consumption: 1.6 gal./flush (6.0 L/flush) **OR** 3.5 gal./flush (13.3 L/flush), **as directed**.
 - f. Tailpiece Size: NPS 1-1/4 (DN 32) **OR** NPS 1-1/2 (DN 40), **as directed**, and standard length to top of bowl.
 - g. Integral Bedpan Washer: Not required **OR** Factory fabricated, attached to tailpiece, and with spray head, **as directed**.
- F. Toilet Seats
- 1. Description: Plastic toilet seat for water-closet-type medical plumbing fixture.
 - a. Material: Molded, solid plastic with antimicrobial agent, **as directed**.
 - b. Configuration: Closed **OR** Open, **as directed**, front with **OR** without, **as directed**, cover.
 - c. Size: Elongated, unless otherwise indicated.
 - d. Class: Standard **OR** Heavy-duty, **as directed**, commercial.
 - e. Hinge Type: Stainless-steel CK, check **OR** SC, self-sustaining check, **as directed**.
 - f. Color: White **OR** Black, **as directed**.
- G. Protective Shielding Guards
- 1. Protective Shielding Pipe Covers:
 - a. Description: Manufactured plastic wraps for covering medical plumbing fixture hot-water supply **OR** hot- and cold-water supplies, **as directed**, and trap and drain piping. Comply with Americans with Disabilities Act (ADA) requirements.
 - 2. Protective Shielding Piping Enclosures:
 - a. Description: Manufactured plastic enclosure for covering medical plumbing fixture hot- and cold-water supplies and trap and drain piping. Comply with ADA requirements.
- H. Fixture Supports
- 1. Water-Closet Supports:
 - a. Description: Combination carrier designed for accessible **OR** standard, **as directed**, mounting height of wall-mounting, water-closet-type medical plumbing fixture. Include single or double, vertical or horizontal, hub-and-spigot or hubless waste fitting as required for piping arrangement; faceplates; couplings with gaskets; feet; and fixture bolts and hardware matching fixture. Include additional extension coupling, faceplate, and feet for installation in wide pipe space.
 - 2. Lavatory Supports:
 - a. Description: Type I, lavatory carrier with exposed arms and tie rods **OR** Type II, lavatory carrier with concealed arms and tie rod **OR** Type III, lavatory carrier with hanger plate and tie rod, **as directed**, for wall-mounting, lavatory-type medical plumbing fixture. Include steel uprights with feet.
 - b. Accessible-Fixture Support: Include rectangular steel uprights.
 - 3. Sink Supports:
 - a. Description: Type I, sink carrier with exposed arms and tie rods **OR** Type II, sink carrier with hanger plate, bearing studs, and tie rod **OR** Type III, sink carrier with hanger plate and exposed arms, **as directed**, for sink-type medical plumbing fixture. Include steel uprights with feet.
 - 4. Bedpan Washers
 - a. Description: Wall-mounting, hand-held, hand-control **OR** single-pedal, foot-control **OR** double-pedal, hot- and cold-water control, **as directed**, medical plumbing fixture.
 - 1) Hose: 48-inch- (1220-mm-) long rubber or vinyl hose with spray nozzle, wall bracket, and hook.
 - 2) Self-closing valve.
 - 3) Loose-key supply stop.
 - 4) Vacuum Breaker: Wall mounting, atmospheric.
 - 5) Finish: Polished, chrome-plated finish on metal parts exposed after installation.
- I. Water Closets

1. Wall-Mounting Water Closets:
 - a. Description: Accessible, wall-mounting **OR** Wall-mounting, **as directed**, back-outlet, vitreous-china medical plumbing fixture designed for bedpan washing and flushometer valve operation.
 - 1) Style: Flushometer valve.
 - a) Bowl Type: Elongated with siphon-jet design and bedpan lugs or slots.
 - b) Design Consumption: **1.6 gal./flush (6 L/flush)**.
 - c) Color: White.
2. Floor-Mounting Water Closets:
 - a. Description: Accessible, floor-mounting **OR** Floor-mounting, **as directed**, floor-outlet, vitreous-china medical plumbing fixture designed for bedpan washing and flushometer valve operation.
 - 1) Style: Flushometer valve.
 - a) Bowl Type: Elongated with siphon-jet design and bedpan lugs or slots. Include bolt caps matching fixture.
 - b) Height: Standard **OR** Accessible, **as directed**.
 - c) Design Consumption: **1.6 gal./flush (6 L/flush)**.
 - d) Color: White.

J. Lavatories

1. Wall-Mounting Lavatories:
 - a. Description: Accessible, wall-mounting **OR** Wall-mounting, **as directed**, vitreous-china medical plumbing fixture.
 - 1) Type: With back **OR** Ledge back **OR** Shelf back **OR** Slab, **as directed**.
 - 2) Size: **18 by 15 inches (457 by 381 mm) OR 19 by 16 inches (483 by 406 mm) OR 20 by 18 inches (508 by 457 mm) OR 24 by 20 inches (610 by 508 mm), as directed**, rectangular.
 - 3) Faucet Hole Punching: One hole **OR** Three holes, **2-inch (51-mm) centers OR Three holes, 4-inch (102-mm) centers, as directed**.
 - 4) Faucet Hole Location: Top **OR** Front wall **OR** Inclined panel, **as directed**.
 - 5) Color: White.
 - 6) Faucet: Lavatory with pop-up waste **OR** for separate drain, **as directed**.
 - 7) Supplies: **NPS 3/8 (DN 10)** chrome-plated copper tubes or flexible connectors, **as directed**, with stops.
 - 8) Drain: See faucet **OR** Grid **OR** Grid with offset, **as directed**.
 - a) Location: Not applicable.
 - 9) Drain Piping: **NPS 1-1/4 (DN 32) OR NPS 1-1/4 by NPS 1-1/2 (DN 32 by DN 40), as directed**, chrome-plated, cast-brass P-trap; **NPS 1-1/4 (DN 32) OR NPS 1-1/2 (DN 40), as directed, 0.032-inch- (0.8-mm-) OR 0.045-inch- (1.1-mm-), as directed**, thick tubular brass waste to wall; and wall escutcheon.
 - 10) Protective Shielding Guard(s): Designation, as directed by the Owner.
 - 11) Fixture Support: Lavatory.
2. Counter-Mounting Lavatories:
 - a. Description: Accessible, **as directed**, Counter-mounting **OR** Undercounter-mounting, **as directed**, vitreous-china, medical plumbing fixture.
 - 1) Type: Flat rim with ledge **OR** Self-rimming, **as directed**.
 - 2) Rectangular Lavatory Size: **18 by 15 inches (457 by 381 mm) OR 19 by 16 inches (483 by 406 mm) OR 20 by 18 inches (508 by 457 mm) OR 24 by 20 inches (610 by 508 mm), as directed**.
 - 3) Oval Lavatory Size: **19 by 16 inches (483 by 406 mm) OR 20 by 17 inches (508 by 432 mm), as directed**.
 - 4) Round Lavatory Size: **18 inches (457 mm) OR 19 inches (483 mm), as directed**, in diameter.
 - 5) Faucet Hole Punching: One hole **OR** Three holes, **2-inch (51-mm) centers OR Three holes, 4-inch (102-mm) centers, as directed**.

- 6) Faucet Hole Location: Top **OR** Front wall **OR** Inclined panel, **as directed**.
- 7) Color: White.
- 8) Faucet: Lavatory with pop-up waste **OR** for separate drain, **as directed**.
- 9) Supplies: **NPS 3/8 (DN 10)** chrome-plated copper tubes or flexible connectors, **as directed**, with stops.
- 10) Drain: See faucet **OR** Grid **OR** Grid with offset, **as directed**.
 - a) Location: Not applicable.
- 11) Drain Piping: **NPS 1-1/4 (DN 32)** **OR** **NPS 1-1/4 by NPS 1-1/2 (DN 32 by DN 40)**, **as directed**, chrome-plated, cast-brass P-trap; **NPS 1-1/4 (DN 32)** **OR** **NPS 1-1/2 (DN 40)**, **as directed**, **0.032-inch- (0.8-mm-)** **OR** **0.045-inch- (1.1-mm-)**, **as directed**, thick tubular brass waste to wall; and wall escutcheon.
- 12) Protective Shielding Guard(s): Designation, as directed by the Owner.

K. Individual Showers:

1. Description: Accessible, **as directed**, FRP **OR** PMMA, **as directed**, shower enclosure medical plumbing fixture with slip-resistant bathing surface complying with ASTM F 462. Comply with ADA requirements for use by people with disabilities.
 - a. Size: 36 by 34 inches (915 by 865 mm) **OR** 42 by 36 inches (1065 by 915 mm) **OR** 43 by 39 inches (1090 by 990 mm) **OR** 48 by 34 inches (1220 by 865 mm) **OR** 52 by 36 inches (1320 by 915 mm) **OR** 60 by 36 inches (1525 by 915 mm) **OR** 72 by 36 inches (1830 by 915 mm), **as directed**.
 - b. Surround: One piece.
 - c. Color: White.
 - d. Faucet: Shower.
 - e. Drain: Grid, NPS 2 (DN 50).
 - 1) Location: Left side **OR** Center **OR** Right side, **as directed**.
 - f. Accessories: If not furnished as integral components of specified fixture. Accessories are specified in Division 10 Section "Toilet, Bath, And Laundry Accessories".
 - 1) Grab bar(s).
 - 2) Normal-duty **OR** Heavy-duty, **as directed**, shower-curtain rod.
 - 3) Vinyl **OR** Duck **OR** Antibacterial, **as directed**, shower curtain.
 - 4) Shower-curtain hooks.
 - 5) Folding seat, **as directed**.

L. Patients' Combination Toilets

1. Swing-Away, Patients' Combination Toilets:
 - a. Description: Factory-fabricated, combination water closet and lavatory medical plumbing fixture.
 - 1) Cabinet: Fixed installation with storage space and toilet paper holder.
 - a) Material: Stainless steel **OR** Stainless steel, plastic laminate, or fiberglass, **as directed**, with laminated-wood or -plastic **OR** solid-plastic **OR** stainless-steel, **as directed**, top surface.
 - b) Color: Not applicable.
 - c) Mounting: Wall bracket.
 - 2) Water Closet: Swivel, floor-mounting, back-outlet **OR** floor-outlet, **as directed**, flushometer valve design.
 - a) Material: Stainless steel.
 - b) Orientation: Left **OR** Right, **as directed**, hand.
 - c) Color: Not applicable.
 - d) Toilet Seat: White, solid plastic.
 - e) Flushometer: Concealed flushometer valve with push-button trip mechanism, check stop, and vacuum breaker on tailpiece.
 - f) Fixture Support: Floor plate.
 - g) Seal: For outlet.
 - 3) Lavatory: Counter mounting.
 - a) Material: Stainless steel.

- b) Color: Not applicable.
 - c) Faucet: Gooseneck type with wrist-blade handles **OR** Swing-spout type with single lever, **as directed**.
 - d) Drain: Grid, **NPS 1-1/4 (DN 32)**.
 - e) Drain Piping: **NPS 1-1/4 (DN 32)** chrome-plated, cast-brass P-trap; tubular-brass waste to wall; and wall flange.
 - 4) Bedpan Washer: On flushometer valve tailpiece or separate attachment affixed to unit.
 - 2. Static, Patients' Combination Toilets:
 - a. Description: Factory-fabricated, combination water closet and lavatory fixture.
 - 1) Cabinet: Fixed installation; swing-away cabinet or retractable, water-closet cover design with storage space and toilet paper holder.
 - a) Material: Stainless steel **OR** Stainless steel, plastic laminate, or fiberglass, **as directed**, with laminated-wood or -plastic **OR** solid-plastic **OR** stainless-steel, **as directed**, top surface.
 - b) Color: Not applicable.
 - c) Mounting: Wall bracket.
 - 2) Water Closet: Floor-mounting, floor-outlet, flushometer valve design.
 - a) Material: Stainless steel or vitreous china.
 - b) Orientation: Left **OR** Right, **as directed**, hand.
 - c) Color: Not applicable.
 - d) Toilet Seat: White, solid plastic.
 - e) Flushometer: Concealed flushometer valve with push-button trip mechanism, check stop, and vacuum breaker on tailpiece.
 - f) Seal: For outlet.
 - 3) Lavatory: Counter mounting.
 - a) Material: Stainless steel.
 - b) Color: Not applicable.
 - c) Faucet: Gooseneck type with wrist-blade handles **OR** Swing-spout type with single lever, **as directed**.
 - d) Drain: Grid, **NPS 1-1/4 (DN 32)**.
 - e) Drain Piping: **NPS 1-1/4 (DN 32)** chrome-plated, cast-brass P-trap; tubular-brass waste to wall; and wall flange.
 - 4) Bedpan Washer: On flushometer valve tailpiece or separate attachment affixed to unit.
- M. Clinical Sinks
- 1. Wall-Mounting Clinical Sinks:
 - a. Description: Wall-mounting, back-outlet, vitreous-china, flushing-rim, service-sink-type medical plumbing fixture.
 - 1) Size: Approximately **25 by 20 inches (635 by 510 mm)**.
 - 2) Color: White.
 - 3) Rim Guard: Stainless steel on front and also on sides if flat rim.
 - 4) Faucet: Sink, polished, chrome-plated, solid-brass, service-sink faucet type, including integral stops in shanks, vacuum breaker, hose-thread outlet, and pail hook.
 - 2. Floor-Mounting Clinical Sinks:
 - a. Description: Floor-mounting, bottom-outlet, vitreous-china, flushing-rim, service-sink-type medical plumbing fixture. Include bolt caps.
 - 1) Size: Approximately **27 by 20 inches (685 by 510 mm)**.
 - 2) Color: White.
 - 3) Rim Guards: Stainless steel on front and sides.
 - 4) Sink Base: **10-inch (25.4-mm)** -high, cast terrazzo if required.

- 5) Faucet: Sink, polished, chrome-plated, solid-brass, service-sink faucet type, including integral stops in shanks, vacuum breaker, hose-thread outlet, and pail hook.

N. Plaster Sinks:

1. Description: Wall-mounting, vitreous-china medical plumbing fixture.
 - a. Size: 24 by 22 inches (610 by 560 mm) **OR** 30 by 22 inches (760 by 560 mm), **as directed**, with back or ledge faucet holes.
 - b. Color: White.
 - c. Faucet Holes: One **OR** Two, **as directed**, in back or ledge.
 - d. Faucet: Sink.
 - e. Supplies: NPS 1/2 (DN 15) chrome-plated copper tubes or flexible connectors, **as directed**, with stops.
 - f. Drain: Grid, NPS 1-1/2 (DN 40) with NPS 1-1/2 (DN 40) to NPS 2 (DN 50) adaptor, **as directed**.
 - g. Drain Piping: NPS 1-1/2 (DN 40) **OR** NPS 2 (DN 50), **as directed**, chrome-plated brass; 0.045-inch- (1.1-mm-) thick waste to interceptor; interceptor to wall; and wall flange.
 - h. Plaster Interceptor:
 - 1) Description: Cast-iron or steel body and removable cover with acid-resistant-enameled interior lining and outside coating; removable, corrosion-resistant metal screens or strainer; and NPS 1-1/2 (DN 40) **OR** NPS 2 (DN 50), **as directed**, inlet and outlet.
2. Fixture Support: Sink with white-enameled-steel brackets.

O. Surgeons' Scrub Sinks

1. Stainless-Steel Surgeons' Scrub Sinks:
 - a. Description: Wall-mounting, sink-type medical plumbing fixture.
 - 1) Size: Approximately **31 by 20 inches (790 by 510 mm)** with back with 1 faucet hole.
 - 2) Faucet: Chrome-plated-brass, gooseneck type matching fixture.
 - 3) Operation: Foot-pedal **OR** Knee **OR** Automatic, hard-wired electric sensor, **as directed**, control.
 - 4) Supplies: **NPS 1/2 (DN 15)** chrome-plated copper tubes or flexible connectors, **as directed**, with stops.
 - 5) Drain: Grid, **NPS 1-1/2 (DN 40)**.
 - 6) Drain Piping: **NPS 1-1/2 (DN 40)** chrome-plated, cast-brass P-trap; **0.045-inch- (1.1-mm-)** thick tubular-brass waste to wall; and wall flange.
 - 7) Fixture Support: Sink.
2. Vitreous-China Surgeons' Scrub Sinks:
 - a. Description: Wall-mounting, sink-type medical plumbing fixture.
 - 1) Size: **28 by 22 inches (710 by 560 mm) OR 30 by 22 inches (760 by 560 mm)**, **as directed**, with back or ledge with 1 faucet hole.
 - 2) Color: White.
 - 3) Faucet: Chrome-plated-brass, gooseneck-type matching fixture.
 - 4) Operation: Foot-pedal **OR** Knee, **as directed**, control.
 - 5) Supplies: **NPS 1/2 (DN 15)** chrome-plated copper tubes or flexible connectors, **as directed**, with stops.
 - 6) Drain: Grid, **NPS 1-1/2 (DN 40)**.
 - 7) Drain Piping: **NPS 1-1/2 (DN 40)** chrome-plated, cast-brass P-trap; **0.045-inch- (1.1-mm-)** thick tubular-brass waste to wall; and wall flange.
 - 8) Fixture Support: Sink.

P. Surgeons' Instrument Sinks:

1. Description: Wall-mounting, stainless-steel, sink-type medical plumbing fixture. Include instrument tray on each side.
 - a. Size: 28 by 20 inches (710 by 510 mm) with 1 hole for deck-mounting faucet.

- b. Faucet: Chrome-plated-brass, gooseneck type matching fixture with knee **OR** foot-pedal, **as directed**, control for mixing hot- and cold-water supplies.
- c. Supplies: NPS 1/2 (DN 15) chrome-plated copper tubes or flexible connectors, **as directed**, with stops.
- d. Drain: Grid, NPS 1-1/2 (DN 40).
- e. Drain Piping: NPS 1-1/2 (DN 40) chrome-plated, cast-brass P-trap; 0.045-inch- (1.1-mm-) thick tubular-brass waste to wall; and wall flange.
- f. Fixture Support: Sink.

Q. Bathing Units

1. Institutional Bath Tubs:

- a. Description: Enameled, cast-iron, island medical plumbing fixture with separate wall-mounting faucet.
 - 1) Size: **66 by 30 by 18 inches (1680 by 765 by 455 mm)**.
 - 2) Base: Enameled, cast iron to raise rim of bathtub to **28 inches (710 mm)** above the floor.
 - 3) Faucet: Shower **OR** Sink, **as directed**, modified to include tub filler spout.
 - 4) Supplies: **NPS 1/2 (DN 15)** chrome-plated copper tubes or flexible connectors, **as directed**, with stops. Include atmospheric vacuum breaker.
 - 5) Drain: **NPS 1-1/2 (DN 40)**; chrome-plated exposed parts; brass pop-up waste and overflow.
 - 6) Drain Piping: **NPS 1-1/2 (DN 40)** chrome-plated, cast-brass P-trap; **0.045-inch- (1.1-mm-)** thick tubular-brass waste to wall; and wall flange.

2. Bathing Units:

- a. Description: Plastic-tub, institutional side-entry bath **OR** whirlpool-bath, **as directed**, fixture with integral controls.
 - 1) Tub Size: **60 by 30 inches (1525 by 765 mm)**.
 - 2) Controls: Vacuum breakers on supplies, thermostatic mixing valve, tub fill spout, and hand-held shower head.
 - 3) Supplies: **NPS 3/4 (DN 20) OR NPS 1 (DN 25)**, **as directed**, copper tubing with ball, gate, or globe valves.
 - 4) Drain: **NPS 1-1/2 (DN 40)** and **NPS 2 (DN 50)**.
 - 5) Drain Piping: **NPS 1-1/2 (DN 40) OR NPS 2 (DN 50)**, **as directed**, cast-brass P-trap, waste to wall, and wall flange. Include combined drain piping if two drains.

3. Bathing Units:

- a. Description: Plastic-tub, institutional side-entry **OR** transfer-lift-entry **OR** slide-on-entry, **as directed**, adjustable-height **OR** fixed-height, **as directed**, bath fixture with integral controls.
 - 1) Tub Size: **60 by 30 inches (1525 by 765 mm)**.
 - 2) Controls: Vacuum breakers on supplies, thermostatic mixing valve, tub fill spout, and hand-held shower head.
 - 3) Supplies: **NPS 3/4 (DN 20) OR NPS 1 (DN 25)**, **as directed**, copper tubing with ball, gate, or globe valves.
 - 4) Drain: **NPS 1-1/2 (DN 40)** and **NPS 2 (DN 50)**.
 - 5) Drain Piping: **NPS 1-1/2 (DN 40) OR NPS 2 (DN 50)**, **as directed**, cast-brass P-trap, waste to wall, and wall flange. Include combined drain piping if two drains.
 - 6) Lift System: Not required.

4. Bathing Units:

- a. Description: Plastic-tub, institutional front-entry shower fixture with integral controls.
 - 1) Cabinet Size: **35 by 41 inches (889 by 1041 mm)**.
 - 2) Controls: Vacuum breakers on supplies, thermostatic mixing valve, tub fill spout, and hand-held shower head.
 - 3) Supplies: **NPS 3/4 (DN 20) OR NPS 1 (DN 25)**, **as directed**, copper tubing with ball, gate, or globe valves.
 - 4) Drain: **NPS 2 (DN 50)**.
 - 5) Drain Piping: **NPS 2 (DN 50)** cast-brass P-trap, waste to wall, and wall flange.

5. Residential Bath Tubs:

- a. Description: Plastic island or against-wall-installation, **as directed**, medical plumbing fixture with side door, seat, and separate wall-mounting faucet.
 - 1) Size 1
 - a) Size: Approximately **60 by 32 by 21 inches** (1525 by 815 by 535 mm).
 - b) Seat: Integral.
 - c) Drain Location: Left **OR** Right, **as directed**, end.
 - 2) Size 2
 - a) Size: Approximately **60 by 42 by 24.5 inches** (1525 by 1070 by 620 mm).
 - b) Seat: Integral bench **OR** None, **as directed**.
 - c) Drain Location: Right end.
 - 3) Material: PMMA.
 - 4) Skirt: Front only **OR** Full, on three sides, **as directed**.
 - 5) Door: Side opening with rubber sealing gasket.
 - 6) Faucet: Shower **OR** Sink, **as directed**, modified to include tub filler spout.
 - 7) Supplies: **NPS 1/2 (DN 15)** chrome-plated copper tubes or flexible connectors, **as directed**, with stops. Include atmospheric vacuum breaker.
 - 8) Drain: **NPS 1-1/2 (DN 40)**; chrome-plated exposed parts; brass pop-up waste and overflow.
 - 9) Drain Piping: **NPS 1-1/2 (DN 40)** cast-brass P-trap and **0.045-inch- (1.1-mm-)** thick, tubular-brass waste to wall.

R. Sitz Baths:

1. Description: Pedestal-mounting **OR** Wall-mounting, **as directed**, vitreous-china, perineal bath medical plumbing fixture.
 - a. Color: White.
 - b. Drain: **NPS 1-1/2 (DN 40)** with removable overflow attachment.
 - c. Drain Piping: **NPS 1-1/2 (DN 40)** chrome-plated, cast-brass P-trap; waste to wall; and wall flange.
 - d. Fixture Support: Sink.
 - e. Faucet:
 - 1) Description: Wall-mounting, single-lever-handle, thermostatic-mixing-valve faucet with concealed supplies and wall-mounting thermometer.
 - a) Material: Brass body and escutcheon.
 - b) Flow Rate: Modified to **1.5 gpm (5.7 L/min.)** maximum, unless otherwise indicated.
 - c) Finish: Polished chrome plate.
 - d) Temperature Indicators: Color-coded for hot and cold water.
 - f. Exposed Piping: Chrome-plated; brass pipe or copper tube.

S. Bedpan Washing Equipment

1. Bedpan Washers/Sanitizers:

- a. Description: Recessed-mounting **OR** On-wall-mounting **OR** Pedestal-mounting, **as directed**, medical plumbing fixture for cleaning bedpans and urinals having cast-iron chamber and waste assembly with spray nozzles and enameled-steel **OR** stainless-steel, **as directed**, front panel and cover box.
 - 1) Controls: Electric, 120-V ac, automatic operation with timer, solenoid valves, and circuit breaker.
 - 2) Door Mechanism: Foot-pedal operation.
 - 3) Supplies: **NPS 1 (DN 25)** cold water and **NPS 3/8 (DN 10)** hot water **OR** steam, **as directed**.
 - 4) Drain: **NPS 3 (DN 80)** P-trap and soil pipe.
 - 5) Atmospheric Vent: **NPS 2 (DN 50)**.
 - 6) Mounting Hardware: Matching fixture mounting arrangement.
 - 7) Accessories:
 - a) Bedpan Rack(s): One **OR** Two, **as directed**.

- b) Urinal Rack(s): One **OR** Two, **as directed**.
 - c) Drain Tray(s): One **OR** Two, **as directed**.
 - 2. Bedpan Washers/Disinfectors:
 - a. Description: Freestanding-mounting **OR** On-wall-mounting **OR** Undercounter-mounting, **as directed**, medical plumbing fixture for cleaning bedpans and urinals; with steam generator, pump, and spray nozzle.
 - 1) Controls: Electric, automatic operation.
 - 2) Cabinet: Stainless steel.
 - 3) Wash Chamber: Stainless steel.
 - 4) Supplies: **NPS 1/2 (DN 15)** cold water and **NPS 1/2 (DN 15)** hot water.
 - 5) Drain: **NPS 4 (DN 100)** P-trap and soil pipe.
 - 6) Mounting Hardware: Matching fixture mounting arrangement.

T. Hydrotherapy Whirlpools

- 1. Podiatry Whirlpools:
 - a. Description: Stationary, stainless-steel tank for feet and ankles.
 - 1) Water Capacity: **15 gal. (57 L)**.
 - 2) Drain: Waste connection.
 - 3) Controls.
 - 4) Thermometer: Control panel or tank mounted.
 - 5) One electric turbine ejector.
- 2. Upper-Extremity Whirlpools:
 - a. Description: Stationary, pedestal-mounted, stainless-steel tank for arms, hands, and elbows.
 - 1) Water Capacity: **25 gal. (95 L)**.
 - 2) Drain: Waste connection.
 - 3) One arm support.
 - 4) Controls.
 - 5) Thermometer: Control panel or tank mounted.
 - 6) One electric turbine ejector.
- 3. High-Tank Body Whirlpools:
 - a. Description: Stationary, stainless-steel tank for legs, hip, and back.
 - 1) Water Capacity: **105 gal. (397 L)**.
 - 2) Drain: Waste connection.
 - 3) Controls.
 - 4) Thermometer: Control panel or tank mounted.
 - 5) One electric turbine ejector.
- 4. Low-Tank Body Whirlpools:
 - a. Description: Stationary, extended-length stainless-steel tank for legs, hip, and lower back.
 - 1) Water Capacity: **105 gal. (397 L)**.
 - 2) Drain: Waste connection.
 - 3) Controls.
 - 4) Thermometer: Control panel or tank mounted.
 - 5) Head rest.
 - 6) One electric turbine ejector.
- 5. Small, Hubbard Immersion Tanks:
 - a. Description: Stationary, butterfly-shaped tank, for full-body massage
 - 1) Tank Dimensions: **93 by 64 by 22 inches (2362 by 1626 by 560 mm)**.
 - 2) Overall Height: **34 to 38 inches (864 to 965 mm)**.
 - 3) Water Capacity: **268 gal. (1014 L)**.
 - 4) Material: Stainless steel.
 - 5) Supports: Legs or base.
 - 6) Controls.
 - 7) Thermometer: Control panel or tank rim mounted.
 - 8) Supply: Over-the-rim fill spout.

- 9) Drains: Two waste connections.
 - 10) Electric Turbine Ejectors: Two; one rail mounted on each side.
 - 11) Thermostatic, mixing-valve assembly.
 - 12) Hose and hand-held shower.
 - 13) Wash-out-hose assembly.
 - 14) Stretcher lift.
 - 15) Overhead electric, **as directed**, hoist.
6. Medium, Hubbard Immersion Tanks:
- a. Description: Stationary, butterfly-shaped tank, for full-body massage.
 - 1) Tank Dimensions: 100 by 73 by 24 inches (2540 by 1854 by 610 mm).
 - 2) Overall Height: 34 to 38 inches (864 to 965 mm).
 - 3) Water Capacity: 377 gal. (1468 L).
 - 4) Material: Stainless steel.
 - 5) Supports: Legs or base.
 - 6) Controls.
 - 7) Thermometer: Control panel or tank rim mounted.
 - 8) Supply: Over-the-rim fill spout.
 - 9) Drain: One waste connection.
 - 10) Electric Turbine Ejector: One, panel mounted.
 - 11) Thermostatic, mixing-valve assembly.
 - 12) Hose and hand-held shower.
 - 13) Wash-out-hose assembly.
 - 14) Stretcher lift.
 - 15) Overhead electric, **as directed**, hoist.
7. Large, Hubbard Immersion Tanks:
- a. Description: Stationary, butterfly-shaped tank, for full-body massage.
 - 1) Tank Dimensions: 106 by 77 by 22 inches (2692 by 1956 by 560 mm).
 - 2) Overall Height: 34 inches (864 mm).
 - 3) Water Capacity: 425 gal. (1609 L).
 - 4) Material: Stainless steel.
 - 5) Supports: Legs or base.
 - 6) Controls.
 - 7) Thermometer: Control panel or tank rim mounted.
 - 8) Supply: Over-the-rim fill spout.
 - 9) Drain(s): One or two waste connections.
 - 10) Electric Turbine Ejectors: Two; one rail mounted on each side.
 - 11) Thermostatic, mixing-valve assembly.
 - 12) Hose and hand-held shower.
 - 13) Wash-out-hose assembly.
 - 14) Stretcher lift.
 - 15) Overhead electric, **as directed**, hoist.
8. Full-Body Immersion Tanks:
- a. Description: Stationary, rectangular tank, for full-body massage
 - 1) Tank Dimensions: 90 by 32 by 19 inches (2286 by 813 by 483 mm) OR 95 by 41 by 22 inches (2413 by 1041 by 560 mm), **as directed**.
 - 2) Overall Height: 32 or 34 inches (813 or 860 mm).
 - 3) Water Capacity: 195 gal. (738 L) OR 260 gal. (984 L), **as directed**.
 - 4) Material: Stainless steel.
 - 5) Supports: Legs or base.
 - 6) Controls.
 - 7) Thermometer: Control panel or tank rim mounted.
 - 8) Supply: Over-the-rim fill spout.
 - 9) Drain(s): One or two waste connections.
 - 10) Electric Turbine Ejector: One, tank mounted at end **OR** on rail **OR** on side, **as directed**.
 - 11) Thermostatic, mixing-valve assembly.

- 12) Hose and hand-held shower.
- 13) Wash-out-hose assembly.
- 14) Stretcher lift.
- 15) Overhead electric, **as directed**, hoist.

U. Outlet Boxes

1. Dialysis Equipment Outlet Boxes:

- a. Description: Recessed-mounting outlet box with water supply and drain connections.
 - 1) Box and Faceplate: Stainless steel.
 - 2) Supply Fitting(s): 1 **OR** 2, **as directed**, NPS 1/2 (DN 15) PVC ball valve(s) and adapter with male hose-thread outlet.
 - 3) Drain: NPS 2 (DN 50) standpipe, P-trap, and direct waste connection to drainage piping.
- b. Reinforcement: 2-by-4-inch (50-by-100-mm) fire-retardant-treated-wood blocking between studs. Fire-retardant-treated wood blocking is specified in Division 06 Section "Rough Carpentry".

V. Morgue Equipment

1. Autopsy Tables:

- a. Description: Pedestal stainless-steel table with sink; designed for downdraft ventilation.
 - 1) Material: Stainless steel.
 - 2) Overall Size: Approximately 88 by 30 inches (2250 by 760 mm) with deck faucet holes.
 - 3) Faucet: Deck mounted with wrist- or elbow-blade handles.
 - 4) Aspirator: Deck mounted.
 - 5) Removable body supports.
 - 6) Rinse Assembly: Deck-mounted faucet with hose.
 - 7) Disposer: Not required **OR** Required, **as directed**.
 - 8) Fixture Support: Sink.
 - 9) Receptacle: Duplex, hospital grade with ground-fault interruption.
 - 10) Supplies: Chrome-plated copper tubes or flexible connectors, **as directed**, with atmospheric vacuum breakers and stops.
 - 11) Drain: Chrome-plated, cast-brass P-trap and waste to wall.

2. Dissecting Sinks:

- a. Description: Wall-mounting sink with backsplash.
 - 1) Material: Stainless steel.
 - 2) Overall Size: 84 by 28 inches (2134 by 711 mm) with back faucet holes.
 - 3) Sink Size: Approximately 30 inches (763 mm) wide.
 - 4) Equipment drawer.
 - 5) Faucet: Back mounted with wrist- or elbow-blade handles.
 - 6) Aspirator: Back mounted.
 - 7) Rinse Assembly: One back-mounted faucet with hose.
 - 8) Disposer: Not required **OR** Required, **as directed**.
 - 9) Fixture Support: Sink.
 - 10) Supplies: Chrome-plated copper tubes or flexible connectors, **as directed**, with atmospheric vacuum breakers and stops.
 - 11) Drain: Chrome-plated, cast-brass P-trap and waste to wall.
 - 12) Back-mounted, hand-held-type eye wash.

1.3 EXECUTION

A. Installation

1. Assemble medical plumbing fixtures, trim, fittings, and other components according to manufacturers' written instructions.

2. Install off-floor supports, affixed to building substrate, for wall-mounting fixtures.
 - a. Use carrier supports with waste fitting and seal for back-outlet fixtures.
 - b. Use carrier supports without waste fitting for fixtures with tubular waste piping.
 - c. Use chair-type carrier supports with rectangular steel uprights for accessible fixtures.
 3. Install back-outlet, wall-mounting fixtures onto waste fitting seals and attach to supports.
 4. Install floor-mounting fixtures on closet flanges or other attachments to piping or building substrate.
 5. Install wall-mounting fixtures with tubular waste piping attached to supports.
 6. Install counter-mounting fixtures in and attached to casework.
 7. Install fixtures level and plumb according to roughing-in drawings.
 8. Install water-supply piping with stop on each supply to each fixture to be connected to domestic water piping. Attach supplies to supports or substrate within pipe spaces behind fixtures. Install stops in locations where they can be easily reached for operation.
 - a. Exception: Use ball, gate, or globe valve if stops are not specified with fixture. Valves are specified in Division 22 Section "General-duty Valves For Plumbing Piping".
 9. Install trap and tubular waste piping on drain outlet of each fixture to be directly connected to sanitary drainage system.
 10. Install flushometer valves for accessible water closets with handle mounted on wide side of compartment. Install other actuators in locations that are easy for people with disabilities to reach.
 11. Install toilet seats on water closets.
 12. Install faucet-spout fittings with specified flow rates and patterns in faucet spouts if faucets are not available with required rates and patterns. Include adapters if required.
 13. Install shower flow-control fittings with specified maximum flow rates in shower arms.
 14. Install traps on fixture outlets.
 - a. Exception: Omit trap on fixtures with integral traps.
 15. Install escutcheons at piping wall penetrations in exposed, finished locations and within cabinets and millwork. Use deep-pattern escutcheons if required to conceal protruding fittings. Escutcheons are specified in Division 22 Section "Common Work Results For Plumbing".
 16. Set showers in leveling bed of cement grout. Grout is specified in Division 22 Section "Common Work Results For Plumbing".
 17. Seal joints between fixtures and walls, floors, and counters using sanitary-type, one-part, mildew-resistant silicone sealant. Match sealant color to fixture color. Sealants are specified in Division 07 Section "Joint Sealants".
- B. Connections
1. Piping installation requirements are specified in other Division 14.. Drawings indicate general arrangement of piping, fittings, and specialties.
 2. Connect water supplies from domestic water piping to medical plumbing fixtures.
 3. Connect drain piping from medical plumbing fixtures to sanitary waste and vent piping.
 4. Ground equipment according to Division 26 Section "Grounding And Bonding For Electrical Systems".
 5. Connect wiring according to Division 26 Section "Low-voltage Electrical Power Conductors And Cables".
- C. Field Quality Control
1. Verify that installed medical plumbing fixtures are categories and types specified for locations where installed.
 2. Check that medical plumbing fixtures are complete with trim, faucets, fittings, and other specified components.
 3. Inspect installed medical plumbing fixtures for damage. Replace damaged fixtures and components.
 4. Test installed fixtures after water systems are pressurized for proper operation. Replace malfunctioning fixtures and components, then retest. Repeat procedure until units operate properly.
 5. Install fresh batteries in sensor-operated mechanisms.

- D. Adjusting
 - 1. Operate and adjust faucets and controls. Replace damaged and malfunctioning medical plumbing fixtures, fittings, and controls.
 - 2. Adjust water pressure at faucets, shower valves, and flushometer valves to produce proper flow and stream.
 - 3. Replace washers and seals of leaking and dripping faucets and stops.
- E. Cleaning
 - 1. Clean medical plumbing fixtures, faucets, and other fittings with manufacturers' recommended cleaning methods and materials. Do the following:
 - a. Remove faucet spouts and strainers, remove sediment and debris, and reinstall strainers and spouts.
 - b. Remove sediment and debris from drains.
 - 2. After completing installation of exposed, factory-finished fixtures, faucets, and fittings, inspect exposed finishes and repair damaged finishes.
- F. Protection
 - 1. Provide protective covering for installed fixtures and fittings.
 - 2. Do not allow use of medical plumbing fixtures for temporary facilities unless approved in writing by the Owner.

END OF SECTION 22 43 00 00

Task	Specification	Specification Description
22 43 13 00	10 28 19 16	Plumbing Fixtures
22 43 13 00	22 01 40 81	Emergency Plumbing Fixtures
22 43 16 00	10 28 19 16	Plumbing Fixtures
22 43 16 00	22 01 40 81	Emergency Plumbing Fixtures
22 43 39 00	10 28 19 16	Plumbing Fixtures
22 43 39 00	22 43 00 00	Medical Plumbing Fixtures
22 43 39 00	22 01 40 81	Emergency Plumbing Fixtures
22 43 43 00	10 28 19 16	Plumbing Fixtures
22 45 00 00	22 01 40 81	Emergency Plumbing Fixtures
22 45 13 00	10 28 19 16	Plumbing Fixtures
22 45 13 00	22 01 40 81	Emergency Plumbing Fixtures
22 45 16 00	22 01 40 81	Emergency Plumbing Fixtures
22 45 23 00	10 28 19 16	Plumbing Fixtures
22 45 23 00	22 01 40 81	Emergency Plumbing Fixtures
22 45 26 00	10 28 19 16	Plumbing Fixtures
22 45 26 00	22 01 40 81	Emergency Plumbing Fixtures
22 45 29 00	22 01 40 81	Emergency Plumbing Fixtures
22 45 33 00	10 28 19 16	Plumbing Fixtures
22 45 33 00	22 01 40 81	Emergency Plumbing Fixtures
22 45 36 00	22 01 40 81	Emergency Plumbing Fixtures
22 45 39 00	22 01 40 81	Emergency Plumbing Fixtures

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SECTION 22 46 13 13 - SECURITY PLUMBING FIXTURES

1.1 GENERAL

A. Description Of Work

1. This specification covers the furnishing and installation of materials for security plumbing fixtures. Products shall be as follows or as directed by the Owner. Installation procedures shall be in accordance with the products manufacturer's recommendations. Demolition and removal of materials shall be as required to support the work.

B. Summary

1. This Section includes the following security plumbing fixtures and related components:
 - a. Combination units.
 - b. Drinking fountains.
 - c. Lavatories.
 - d. Service sinks.
 - e. Shampoo bowls.
 - f. Showers.
 - g. Urinals.
 - h. Water closets.
 - i. Flushometer valves for vitreous-china water closets.
 - j. Fixture supports for front-mounting, stainless-steel fixtures and vitreous-china, wall-mounting fixtures.

C. Related Requirements:

1. Section 224213.13 "Commercial Water Closets."
2. Section 224213.16 "Commercial Urinals."
3. Section 224216.13 "Commercial Lavatories."
4. Section 224216.16 "Commercial Sinks."
5. Section 224223 "Commercial Showers."
6. Section 224233 "Wash Fountains."
7. Section 224300 "Healthcare Plumbing Fixtures."
8. Section 224500 "Emergency Plumbing Fixtures."
9. Section 224713 "Drinking Fountains."

D. Definitions

1. Accessible Fixture: Security plumbing fixture that can be approached and used by people with disabilities.
2. Back-Mounting-Type Fixture: Security plumbing fixture designed to mount on wall sleeve built into wall so installation and removal of fixture and piping and other components are only accessible from service space behind wall.
3. Front-Mounting-Type Fixture: Security plumbing fixture designed to mount on fixture support with installation and removal from fixture side of wall, and piping and other components are accessible from access panels in fixture or wall.

E. Submittals

1. Product Data: For each type of product indicated.
2. LEED Submittal:
 - a. Product Data for Credit WE 2, 3.1, and 3.2: Documentation indicating flow and water consumption requirements.
3. Shop Drawings: Diagram power, signal, and control wiring.
4. Field quality-control test reports.
5. Operation and maintenance data.



F. Quality Assurance

1. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
2. Regulatory Requirements: Comply with requirements in ICC A117.1, "Accessible and Usable Buildings and Facilities"; Public Law 90-480, "Architectural Barriers Act"; and Public Law 101-336, "Americans with Disabilities Act", **as directed**; about security plumbing fixtures for people with disabilities. Comply with requirements in "Energy Policy Act" about water flow and consumption rates for plumbing fixtures.
3. NSF Standard: Comply with NSF 61, "Drinking Water System Components - Health Effects," for fixture materials that will be in contact with potable water.
4. Select combinations of fixtures and trim, faucets, fittings, and other components that are compatible.

1.2 PRODUCTS

1.3 SOURCE LIMITATIONS

- A. Obtain each product type from single manufacturer.

1.4 PERFORMANCE REQUIREMENTS

- A. Comply with ASME A112.19.2/CSA B45.1 for vitreous-china plumbing fixtures.
- B. Comply with ASME A112.19.3/CSA B45.4 for stainless steel plumbing fixtures.
- C. Comply with ASSE 1037/ASME A112.1037/CSA B125.37 for flush valves.
- D. Comply with ASME A112.19.5/CSA B45.15 for flush valves and spuds for water closets.
- E. Comply with ASME A112.18.1/CSA B125.1 for plumbing supply fittings.
- F. Comply with ASME A112.18.2/CSA B125.2 for plumbing waste fittings.
- G. Comply with IAPMO Z124.5 for water-closet (toilet) seats.
- H. Comply with ASME A112.6.1M for plumbing fixture supports.
- I. Comply with ICC A117.1 for ADA-compliant, accessible plumbing fixtures and installation.
- J. Comply with ASTM A1045 for flexible PVC gaskets used in connection of vitreous-china water closets to sanitary drainage systems.
- K. Comply with ASME A112.4.3 for plastic fittings used in connection of vitreous-china water closets to sanitary drainage systems.
- L. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by an NRTL, and marked for intended location and application.
- M. Faucets and bubblers intended to convey or dispense water for human consumption are to comply with the U.S. Safe Drinking Water Act (SDWA), with requirements of the Authority Having Jurisdiction (AHJ),

and with NSF 61/NSF 372; or are certified in compliance with NSF 61/NSF 372 by an ANSI-accredited third-party certification body, that the weighted average lead content at wetted surfaces is less than or equal to 0.25 percent.

N. Combination Units

1. Security Combination Units:

a. Description: Back-mounting, cabinet, security plumbing fixture with integral water closet and lavatory; fabricated from **0.078-inch (2.0-mm)** minimum **OR 0.109-inch (2.8-mm)**, **as directed**, thickness, ASTM A 666, Type 304 stainless steel. Include SSINA No. 4 polished finish on exposed surfaces, and corrosion-resistant metal for internal piping and bracing.

1) Water Closet: Comply with IAPMO PS 61 for water-closet component.

a) Bowl: Elongated, with back inlet, integral trap, blowout design with back **OR** siphon-jet design with back **OR** siphon-jet design with floor, **as directed**, outlet and contoured seat.

i. Seat Surface: SSINA No. 7 polished finish.

ii. Punching: Provide two holes for installation of separate toilet seat.

iii. Drain: NPS 4 (DN 100) **OR** NPS 3 (DN 80), **as directed**, horizontal with cleanout and slip joint **OR** vertical, **as directed**.

b) Toilet Seat: ANSI Z124.5, white, **OR** black, **as directed**, commercial, heavy-duty, elongated, open front with cover, **as directed**, with check **OR** self-sustaining **OR** self-sustaining, check, **as directed**, hinges.

c) Flushing Device: Concealed flushometer valve with stainless-steel access panel, push-button mechanism, and **3.5-gal./flush (13.3-L/flush)** **OR 1.6-gal./flush (6.0-L/flush)**, **as directed**, consumption. Refer to "Flushometer Valves" Article.

2) Lavatory: In top of cabinet.

a) Receptor: Oval **OR** Rectangular, **as directed**, bowl with integral soap depression.

b) Hot- and Cold-Water and Bubbler, **as directed**, Supply Valves: Pneumatic **OR** Mechanical-metering **OR** Electric-solenoid, **as directed**, type with push-button actuation and individual check stop.

c) Filler Spout: Backsplash **OR** Deck, **as directed**, mounted.

d) Drain: Integral punched grid with **NPS 1-1/4 (DN 32)** minimum horizontal waste and trap complying with ASME A112.18.2 **OR** concealed waste piping to spill into water-closet bowl, **as directed**.

e) Toothbrush Holders: One on each **OR** left **OR** right, **as directed**, side of backsplash.

f) Towel Hooks: One **OR** Two, **as directed**, on each **OR** left **OR** right, **as directed**, side of fixture.

g) Bubbler Location: On backsplash **OR** deck, **as directed**.

3) Cabinet Configuration: Rectangular apron **OR** Five-sided apron with two angled sides **OR** Four-sided apron with angled left side **OR** Four-sided apron with angled right side, **as directed**, made for above-floor **OR** on-floor, **as directed**, installation and with backsplash.

a) Water-Closet Bowl Location: Centered on front **OR** Left of center on front **OR** Right of center on front **OR** On angled left side **OR** On angled right side, **as directed**, of apron.

b) Toilet Paper Holder: Recessed, **0.063-inch (1.6-mm)** minimum thickness, stainless steel complying with ASTM A 666, Type 304 and located above water closet and centered in front **OR** in front **OR** right of center in front **OR** left of center in front **OR** in angled right side **OR** in angled left side **OR** in right side **OR** in left side, **as directed**, of apron.

4) Wall Sleeve: Galvanized-steel frame of dimensions required to match and support entire fixture. Include steel bars or other design that will prevent escape if fixture is removed.

O. Drinking Fountains

1. Security Drinking Fountains, Back-Mounting:

- a. Description: Back-mounting, accessible, **as directed**, security plumbing fixture; fabricated from **0.078-inch (2.0-mm)** minimum **OR 0.109-inch (2.8-mm)**, **as directed**, thickness, ASTM A 666, Type 304 stainless steel. Include SSINA No. 4 polished finish on exposed surfaces, and corrosion-resistant metal for internal piping and bracing.
- 1) Receptor: Bowl or depression in top and with backsplash.
 - 2) Bubbler Location: On backsplash **OR** deck, **as directed**.
 - 3) Bubbler Water-Supply Valve: Pneumatic type with push-button actuation.
 - 4) Drain: Integral punched grid with **NPS 1-1/4 (DN 32)** minimum horizontal waste and trap complying with ASME A112.18.2.
 - 5) Wall Sleeve: Galvanized-steel frame of dimensions required to match and support fixture.

2. Security Drinking Fountains, Front-Mounting:

- a. Description: Front-mounting, accessible, **as directed**, security plumbing fixture; fabricated from **0.078-inch (2.0-mm)** minimum **OR 0.109-inch (2.8-mm)**, **as directed**, thickness, ASTM A 666, Type 304 stainless steel. Include SSINA No. 4 polished finish on exposed surfaces, and corrosion-resistant metal for internal piping and bracing.
- 1) Receptor: Bowl or depression in top and with backsplash.
 - 2) Bubbler Location: On backsplash **OR** deck, **as directed**.
 - 3) Bubbler Water-Supply Valve: Pneumatic type with push-button actuation.
 - 4) Drain: Integral punched grid with **NPS 1-1/4 (DN 32)** minimum tailpiece, trap, and waste, and complying with ASME A112.18.2.
 - 5) Access to Internal Components: Vandal-resistant access panels.
 - 6) Mounting Device: Wall bracket.
 - 7) Support: Chair carrier. Refer to "Fixture Supports" Article.

P. Lavatories

1. Security Lavatories, Back-Mounting:

- a. Description: Back-mounting, accessible, **as directed**, security plumbing fixture; fabricated from **0.078-inch (2.0-mm)** minimum **OR 0.109-inch (2.8-mm)**, **as directed**, thickness, ASTM A 666, Type 304 stainless steel. Include SSINA No. 4 polished finish on exposed surfaces, and corrosion-resistant metal for internal piping and bracing.
- 1) Receptor: Oval **OR** Rectangular, **as directed**, bowl with integral soap depression and backsplash.
 - 2) Hot- and Cold-Water and Bubbler, **as directed**, Supply Valves: Pneumatic **OR** Mechanical-metering **OR** Electric-solenoid, **as directed**, type with push-button actuation and individual check stop.
 - 3) Filler Spout: Backsplash **OR** Deck, **as directed**, mounted.
 - 4) Drain: Integral punched grid with **NPS 1-1/4 (DN 32)** minimum horizontal waste and trap complying with ASME A112.18.2.
 - 5) Toothbrush Holders: One on each **OR** left **OR** right, **as directed**, side of backsplash.
 - 6) Towel Hooks: One **OR** Two, **as directed**, on each **OR** left **OR** right, **as directed**, side of fixture.
 - 7) Bubbler Location: On backsplash **OR** deck, **as directed**.
 - 8) Wall Sleeve: Galvanized-steel frame of dimensions required to match and support fixture.

2. Security Lavatories, Front-Mounting:

- a. Description: Front-mounting, accessible, **as directed**, security plumbing fixture; fabricated from **0.078-inch (2.0-mm)** minimum **OR 0.109-inch (2.8-mm)**, **as directed**, thickness, ASTM A 666, Type 304, stainless steel. Include SSINA No. 4 polished finish on exposed surfaces, and corrosion-resistant metal for internal piping and bracing.
- 1) Receptor: Oval **OR** Rectangular, **as directed**, bowl with integral soap depression and backsplash.

- 2) Hot- and Cold-Water and Bubbler, **as directed**, Supply Valves: Pneumatic **OR** Mechanical-metering **OR** Electric-solenoid, **as directed**, type with push-button actuation and individual check stop.
 - 3) Filler Spout: Backsplash **OR** Deck, **as directed**, mounted.
 - 4) Drain: Integral punched grid with **NPS 1-1/4 (DN 32)** minimum tailpiece, trap, and waste complying with ASME A112.18.2.
 - 5) Toothbrush Holders: One on each **OR** left **OR** right, **as directed**, side of backsplash.
 - 6) Towel Hooks: One **OR** Two, **as directed**, on each **OR** left **OR** right, **as directed**, side of fixture.
 - 7) Bubbler Location: On backsplash **OR** deck, **as directed**.
 - 8) Access to Internal Components: Vandal-resistant access panels.
 - 9) Mounting Device: Wall bracket.
 - 10) Support: Chair carrier. Refer to "Fixture Supports" Article.
3. Security Lavatories, Vitreous-China:
- a. Description: ASME A112.19.2M, vitreous-china security plumbing fixture made for institutional applications, with integral soap depression and **NPS 1-1/4 (DN 32)** waste outlet and with factory-installed, push-button, self-closing, chrome-plated brass faucets complying with ASME A112.18.1.
 - 1) Waste: **NPS 1-1/4 (DN 32)** minimum piping and trap complying with ASME A112.18.2.
 - 2) Mounting Device: Wall bracket.
 - 3) Support: Chair carrier. Refer to "Fixture Supports" Article.
- Q. Service Sinks
1. Security Service Sinks:
 - a. Description: Back-mounting security plumbing fixture made for above-floor **OR** on-floor, **as directed**, installation; fabricated from **0.078-inch (2.0-mm)** minimum **OR** **0.109-inch (2.8-mm)**, **as directed**, thickness, ASTM A 666, Type 304 stainless steel. Include SSINA No. 4 polished finish on exposed surfaces, and corrosion-resistant metal for internal piping and bracing.
 - 1) Receptor: Rectangular bowl with high backsplash.
 - 2) Hot- and Cold-Water-Supply Valves: Pneumatic type with push-button actuation and individual check stop.
 - 3) Filler Spout: Backsplash mounted.
 - 4) Drain: Grid with **NPS 2 (DN 50)** waste and trap complying with ASME A112.18.2.
 - 5) Wall Sleeve: Galvanized-steel frame of dimensions required to match and support fixture.
- R. Shampoo Bowls
1. Security Shampoo Bowls:
 - a. Description: Front-mounting security plumbing fixture made for above-floor **OR** counter-mounting, **as directed**, installation; fabricated from **0.078-inch (2.0-mm)** thickness, ASTM A 666, Type 304 stainless steel and corrosion-resistant metal internal piping and bracing.
 - 1) Receptor: Bowl with contoured neck rest.
 - 2) Finish: White **OR** Black, **as directed**, enamel.
 - 3) Exposed Surfaces without Enamel Finish: SSINA No. 4 polished finish.
 - 4) Faucet: Dial single-lever control with vacuum breaker, hose, and spray.
 - 5) Drain: Basket strainer with **NPS 1-1/2 (DN 40)** tailpiece, trap, and waste to wall complying with ASME A112.18.2.
 - 6) Access to Internal Components: Vandal-resistant access panels.
 - 7) Mounting Device: Wall bracket.
 - 8) Support: Chair carrier. Refer to "Fixture Supports" Article.

S. Showers

1. Security Showers, Back-Mounting, Recessed:
 - a. Description: Back-mounting, accessible, **as directed**, recessed security plumbing fixture made with wall plate for flush installation; fabricated from **0.078-inch (2.0-mm)** minimum **OR 0.109-inch (2.8-mm)**, **as directed**, thickness, ASTM A 666, Type 304 stainless steel. Include SSINA No. 4 polished finish on exposed surfaces, and corrosion-resistant metal for internal piping and bracing.
 - 1) Configuration: Wall type with shower head and soap dish.
 - 2) Tempered-Water-Supply **OR** Hot- and Cold-Water-Supply, **as directed**, Valves: Pneumatic **OR** Mechanical-metering **OR** Electric-solenoid, **as directed**, type with individual check stop.
 - 3) Shower: Hose with vandal-resistant, hand-held **OR** Vandal-resistant, fixed-type **OR** Vandal-resistant, swivel-type, **as directed**, head.
 - 4) Soap Dish: Recessed, stainless steel.
 - 5) Wall Sleeve: Galvanized-steel frame of dimensions required to match and support fixture.
2. Security Showers, Front-Mounting, Recessed:
 - a. Description: Front-mounting, accessible, **as directed**, recessed security plumbing fixture made with wall plate for flush installation; fabricated from **0.078-inch (2.0-mm)** minimum **OR 0.109-inch (2.8-mm)**, **as directed**, thickness, ASTM A 666, Type 304 stainless steel. Include SSINA No. 4 polished finish on exposed surfaces, and corrosion-resistant metal for internal piping and bracing.
 - 1) Configuration: Wall type with shower head and soap dish.
 - 2) Tempered-Water-Supply **OR** Hot- and Cold-Water-Supply, **as directed**, Valves: Pneumatic **OR** Mechanical-metering **OR** Electric-solenoid, **as directed**, type with individual check stop.
 - 3) Shower: Hose with vandal-resistant, hand-held **OR** Vandal-resistant, fixed-type **OR** Vandal-resistant, swivel-type, **as directed**, head.
 - 4) Soap Dish: Recessed, stainless steel.
 - 5) Access to Internal Components: Vandal-resistant access panels.
 - 6) Mounting Device: Wall-mounting frame.
3. Security Showers, Front-Mounting, Surface Installation:
 - a. Description: Front-mounting, accessible, **as directed**, security plumbing fixture made for surface installation; fabricated from **0.078-inch (2.0-mm)** minimum **OR 0.109-inch (2.8-mm)**, **as directed**, thickness, ASTM A 666, Type 304 stainless steel. Include SSINA No. 4 polished finish on exposed surfaces, and corrosion-resistant metal for internal piping and bracing.
 - 1) Configuration: Wall type with shower head and soap dish.
 - 2) Tempered-Water-Supply **OR** Hot- and Cold-Water-Supply, **as directed**, Valves: Pneumatic **OR** Mechanical-metering **OR** Electric-solenoid, **as directed**, type with individual check stops.
 - 3) Soap Dish: Recessed, stainless steel.
 - 4) Access to Internal Components: Vandal-resistant access panels.
 - 5) Mounting Device: Wall-mounting frame.
4. Security Showers, Back-Mounting, Accessible:
 - a. Description: Back-mounting, accessible, cabinet, security plumbing fixture; fabricated from **0.078-inch (2.0-mm)** minimum **OR 0.109-inch (2.8-mm)**, **as directed**, thickness, ASTM A 666, Type 304 stainless steel. Include SSINA No. 4 polished finish on exposed surfaces, and corrosion-resistant metal for internal piping and bracing.
 - 1) Configuration: Cabinet **42 or 44 by 36 inches (1065 or 1120 by 915 mm)** **OR 48 by 36 inches (1220 by 915 mm)**, **as directed**, with floor and top, **as directed**, with stainless-steel soap dish, towel hook, drain, seat, and grab bar.
 - 2) Tempered-Water-Supply **OR** Hot- and Cold-Water-Supply, **as directed**, Valves: Pneumatic **OR** Mechanical-metering **OR** Electric-solenoid, **as directed**, type with individual check stops.
 - 3) Shower: Hose with vandal-resistant, hand-held head.

- 4) Drain: **NPS 2 (DN 50)** strainer, waste to wall, and trap complying with ASME A112.18.2.
 - 5) Wall Sleeve: Galvanized-steel frame of dimensions required to match and support fixture.
5. Security Showers, Back-Mounting:
- a. Description: Back-mounting, cabinet, security plumbing fixture; fabricated from **0.078-inch (2.0-mm)** minimum **OR 0.109-inch (2.8-mm)**, **as directed**, thickness, ASTM A 666, Type 304 stainless steel. Include SSINA No. 4 polished finish on exposed surfaces, and corrosion-resistant metal for internal piping and bracing.
 - 1) Configuration: Cabinet **30 by 30 inches (760 by 760 mm)** **OR 32 by 32 inches (815 by 815 mm)** **OR 36 by 36 inches (915 by 915 mm)**, **as directed**, with floor and top, **as directed**, and with stainless-steel soap dish, towel hook, and drain.
 - 2) Tempered-Water-Supply **OR** Hot- and Cold-Water-Supply, **as directed**, Valves: Pneumatic **OR** Mechanical-metering **OR** Electric-solenoid, **as directed**, type with individual check stops.
 - 3) Shower: Vandal-resistant, fixed **OR** Fixed **OR** Swivel, **as directed**, type head.
 - 4) Drain: **NPS 2 (DN 50)** strainer, waste to wall, and trap complying with ASME A112.18.2.
 - 5) Wall Sleeve: Galvanized-steel frame of dimensions required to match and support fixture.
- T. Urinals
1. Security Urinals, Back-Mounting:
 - a. Description: Back-mounting security plumbing fixture; fabricated from **0.078-inch (2.0-mm)** minimum **OR 0.109-inch (2.8-mm)**, **as directed**, thickness, ASTM A 666, Type 304 stainless steel. Include SSINA No. 4 polished finish on exposed surfaces, and corrosion-resistant metal for internal piping and bracing.
 - 1) Type and Configuration: Blowout **OR** Washout, **as directed**, type with back inlet and extended shields.
OR
Type and Configuration: Washout, trough type, and **36 inches (915 mm)** **OR 48 inches (1220 mm)**, **as directed**, wide.
 - 2) Drain: Strainer with **NPS 2 (DN 50)** tailpiece, trap under fixture, and drain piping.
 - 3) Flushing Device: Concealed flushometer valve with stainless-steel access panel, push-button mechanism, and **3.5-gal./flush (13.3-L/flush)** **OR 1.5-gal./flush (5.7-L/flush)** **OR 1.0-gal./flush (3.78-L/flush)**, **as directed**, consumption. Refer to "Flushometer Valves" Article.
 - 4) Wall Sleeve: Galvanized-steel frame of dimensions required to match and support fixture.
 2. Security Urinals, Front-Mounting:
 - a. Description: Front-mounting security plumbing fixture; fabricated from **0.078-inch (2.0-mm)** minimum **OR 0.109-inch (2.8-mm)**, **as directed**, thickness, ASTM A 666, Type 304 stainless steel. Include SSINA No. 4 polished finish on exposed surfaces, and corrosion-resistant metal for internal piping and bracing.
 - 1) Type and Configuration: Blowout **OR** Washout, **as directed**, type with back **OR** top, **as directed**, inlet and extended shields.
OR
Type and Configuration: Washout, trough type, and **36 inches (915 mm)** **OR 48 inches (1220 mm)**, **as directed**, wide.
 - 2) Drain: Strainer with **NPS 2 (DN 50)** tailpiece, trap under fixture, and drain piping complying with ASME A112.18.2.
 - 3) Flushing Device: Concealed flushometer valve with stainless-steel access panel, push-button **OR** Exposed flushometer valve with oscillating lever-handle, **as directed**, mechanism, and **3.5-gal./flush (13.3-L/flush)** **OR 1.5-gal./flush (5.7-L/flush)** **OR 1.0-gal./flush (3.78-L/flush)**, **as directed** consumption. Refer to "Flushometer Valves" Article.

- 4) Support: Chair carrier. Refer to "Fixture Supports" Article.
3. Security Urinals, Back-Mounting, Wall-And-Floor Installation:
 - a. Description: Back-mounting security plumbing fixture made for wall-and-floor installation; fabricated from **0.078-inch (2.0-mm)** minimum **OR 0.109-inch (2.8-mm)**, **as directed**, thickness, ASTM A 666, Type 304 stainless steel. Include SSINA No. 4 polished finish on exposed surfaces, and corrosion-resistant metal for internal piping and bracing.
 - 1) Type and Configuration: Washout, stall type with back inlet.
 - 2) Drain: Strainer with **NPS 2 (DN 50)** outlet.
 - 3) Flushing Device: Concealed flushometer valve with stainless-steel access panel, push-button mechanism, and **1.5-gal./flush (5.7-L/flush)** **OR 1.0-gal./flush (3.78-L/flush)**, **as directed**, consumption. Refer to "Flushometer Valves" Article.
4. Security Urinals, Front-Mounting, Wall-And-Floor Installation:
 - a. Description: Front-mounting security plumbing fixture made for wall-and-floor installation; fabricated from **0.078-inch (2.0-mm)** minimum **OR 0.109-inch (2.8-mm)**, **as directed**, thickness, ASTM A 666, Type 304 stainless steel. Include SSINA No. 4 polished finish on exposed surfaces, and corrosion-resistant metal for internal piping and bracing.
 - 1) Type and Configuration: Washout, stall type with back **OR top**, **as directed**, inlet.
 - 2) Drain: Strainer with **NPS 2 (DN 50)** outlet.
 - 3) Flushing Device: Concealed flushometer valve with stainless-steel access panel, push-button **OR** Exposed flushometer valve with oscillating lever-handle, **as directed**, mechanism, and **1.5-gal./flush (5.7-L/flush)** **OR 1.0-gal./flush (3.78-L/flush)**, **as directed**, consumption. Refer to "Flushometer Valves" Article.
 - 4) Support: Chair carrier. Refer to "Fixture Supports" Article.

U. Water Closets

1. Security Water Closets, Back-Mounting, Above Floor Installation:
 - a. Description: IAPMO PS 61, back-mounting, accessible, **as directed**, security plumbing fixture made for above-floor installation; fabricated from **0.078-inch (2.0-mm)** minimum **OR 0.109-inch (2.8-mm)**, **as directed**, thickness, ASTM A 666, Type 304 stainless steel. Include SSINA No. 4 polished finish on exposed surfaces, and corrosion-resistant metal for internal piping and bracing.
 - 1) Configuration: Compact design, with bowl on wall flange.
 - 2) Bowl: Elongated, with back inlet, integral trap, blowout design with back outlet and contoured seat.
 - a) Seat Surface: SSINA No. 7 polished finish.
 - b) Punching: Provide two holes for installation of separate toilet seat.
 - c) Drain: **NPS 4 (DN 100)** **OR NPS 3 (DN 80)**, **as directed**, horizontal with cleanout and slip joint.
 - 3) Flushing Device: Concealed flushometer valve with stainless-steel access panel, push-button **OR** Exposed flushometer valve with oscillating lever-handle, **as directed**, mechanism, and **3.5-gal./flush (13.3-L/flush)** **OR 1.6-gal./flush (6.0-L/flush)**, **as directed**, consumption. Refer to "Flushometer Valves" Article.
 - 4) Toilet Seat, **as directed**: ANSI Z124.5, white, **OR** black, **as directed**, commercial, heavy-duty, elongated, open front with cover, **as directed**, with check **OR** self-sustaining **OR** self-sustaining, check, **as directed**, hinges.
 - 5) Wall Sleeve: Galvanized-steel frame of dimensions required to match and support fixture. Include steel bars or other design that will prevent escape if fixture is removed.
2. Security Water Closets, Back-Mounting, Off Floor Installation:
 - a. Description: IAPMO PS 61, back-mounting, accessible, **as directed**, security plumbing fixture made for off-floor installation; fabricated from **0.078-inch (2.0-mm)** minimum **OR 0.109-inch (2.8-mm)**, **as directed**, thickness, ASTM A 666, Type 304 stainless steel. Include SSINA No. 4 polished finish on exposed surfaces, and corrosion-resistant metal for internal piping and bracing.
 - 1) Configuration: Standard design.

- 2) Bowl: Elongated, with back **OR** top, **as directed**, inlet, integral trap, blowout **OR** siphon-jet, **as directed**, design with back outlet and contoured seat.
 - a) Seat Surface: SSINA No. 7 polished finish.
 - b) Punching: Provide two holes for installation of separate toilet seat.
 - c) Drain: **NPS 4 (DN 100) OR NPS 3 (DN 80)**, **as directed**, horizontal with cleanout and slip joint.
 - 3) Flushing Device: Concealed flushometer valve with stainless-steel access panel, push-button **OR** Exposed flushometer valve with oscillating lever-handle, **as directed**, mechanism, and **3.5-gal./flush (13.3-L/flush) OR 1.6-gal./flush (6.0-L/flush)**, **as directed**, consumption. Refer to "Flushometer Valves" Article.
 - 4) Toilet Seat, **as directed**: ANSI Z124.5, white, **OR** black, **as directed**, commercial, heavy-duty, elongated, open front with cover, **as directed**, with check **OR** self-sustaining **OR** self-sustaining, check, **as directed**, hinges.
 - 5) Wall Sleeve: Galvanized-steel frame of dimensions required to match and support fixture. Include steel bars or other design that will prevent escape if fixture is removed.
3. Security Water Closets, Front-Mounting, Off-Floor Installation:
- a. Description: IAPMO PS 61, front-mounting, accessible, **as directed**, security plumbing fixture made for off-floor installation; fabricated from **0.078-inch (2.0-mm) minimum OR 0.109-inch (2.8-mm)**, **as directed**, thickness, ASTM A 666, Type 304 stainless steel. Include SSINA No. 4 polished finish on exposed surfaces, and corrosion-resistant metal for internal piping and bracing.
 - 1) Configuration: Standard design.
 - 2) Bowl: Elongated, with back **OR** top, **as directed**, inlet, integral trap, blowout **OR** siphon-jet, **as directed**, design with back outlet and contoured seat.
 - a) Seat Surface: SSINA No. 7 polished finish.
 - b) Punching: Provide two holes for installation of separate toilet seat.
 - 3) Access to Internal Components: Vandal-resistant access panels.
 - 4) Flushing Device: Concealed flushometer valve with stainless-steel access panel, push-button **OR** Exposed flushometer valve with oscillating lever-handle, **as directed**, mechanism, and **3.5-gal./flush (13.3-L/flush) OR 1.6-gal./flush (6.0-L/flush)**, **as directed**, consumption. Refer to "Flushometer Valves" Article.
 - 5) Toilet Seat, **as directed**: ANSI Z124.5, white, **OR** black, **as directed**, commercial, heavy-duty, elongated, open front with cover, **as directed**, with check **OR** self-sustaining **OR** self-sustaining, check, **as directed**, hinges.
 - 6) Support: Combination support and waste fitting assembly. Refer to "Fixture Supports" Article.
4. Security Water Closets, Back-Mounting, On-Floor Installation:
- a. Description: IAPMO PS 61, back-mounting security plumbing fixture made for on-floor installation; fabricated from **0.078-inch (2.0-mm) minimum OR 0.109-inch (2.8-mm)**, **as directed**, thickness, ASTM A 666, Type 304 stainless steel. Include SSINA No. 4, polished finish on exposed surfaces, and corrosion-resistant metal for internal piping and bracing.
 - 1) Configuration: Standard design.
 - 2) Bowl: Elongated, with back **OR** top, **as directed**, inlet, integral trap, blowout **OR** siphon-jet, **as directed**, design with back outlet and contoured seat.
 - a) Seat Surface: SSINA No. 7 polished finish.
 - b) Punching: Provide two holes for installation of separate toilet seat.
 - c) Drain: **NPS 4 (DN 100) OR NPS 3 (DN 80)**, **as directed**, horizontal with cleanout and slip joint.
 - 3) Flushing Device: Concealed flushometer valve with stainless-steel access panel, push-button **OR** Exposed flushometer valve with oscillating lever-handle, **as directed**, mechanism, and **3.5-gal./flush (13.3-L/flush) OR 1.6-gal./flush (6.0-L/flush)**, **as directed**, consumption. Refer to "Flushometer Valves" Article.

- 4) Toilet Seat, **as directed**: ANSI Z124.5, white, **OR** black, **as directed**, commercial, heavy-duty, elongated, open front with cover, **as directed**, with check **OR** self-sustaining **OR** self-sustaining, check, **as directed**, hinges.
5. Security Water Closets, Front-Mounting, On-Floor Installation:
 - a. Description: IAPMO PS 61, front-mounting security plumbing fixture made for on-floor installation; fabricated from **0.078-inch (2.0-mm)** minimum **OR 0.109-inch (2.8-mm)**, **as directed**, thickness, ASTM A 666, Type 304 stainless steel. Include SSINA No. 4 polished finish on exposed surfaces, and corrosion-resistant metal for internal piping and bracing.
 - 1) Configuration: Standard design.
 - 2) Bowl: Elongated, with back **OR** top, **as directed**, inlet, integral trap, siphon-jet design with back **OR** floor, **as directed**, outlet and contoured seat.
 - a) Seat Surface: SSINA No. 7 polished finish.
 - b) Punching: Provide two holes for installation of separate toilet seat.
 - 3) Access to Internal Components: Vandal-resistant access panels.
 - 4) Flushing Device: Concealed flushometer valve with stainless-steel access panel, push-button **OR** Exposed flushometer valve with oscillating lever-handle, **as directed**, mechanism, and **3.5-gal./flush (13.3-L/flush) OR 1.6-gal./flush (6.0-L/flush)**, **as directed**, consumption. Refer to "Flushometer Valves" Article.
 - 5) Toilet Seat, **as directed**: ANSI Z124.5, white, **OR** black, **as directed**, commercial, heavy-duty, elongated, open front with cover, **as directed**, with check **OR** self-sustaining **OR** self-sustaining, check, **as directed**, hinges.
 - 6) Support: Combination support and waste fitting assembly. Refer to "Fixture Supports" Article.
 6. Security Water Closets, Vitreous-China, Wall-Mounting, On-Floor Installation
 - a. Description: ASME A112.19.2M, vitreous-china, wall-mounting and on-floor installation, back-inlet, blowout **OR** siphon-jet, **as directed**, fixture with integral contoured seat and made for institutional applications.
 - 1) Flushing Device: Concealed flushometer valve with stainless-steel access panel, push-button mechanism, and **3.5-gal./flush (13.3-L/flush) OR 1.6-gal./flush (6.0-L/flush)**, **as directed**, consumption. Refer to "Flushometer Valves" Article.
 - 2) Support: Combination support and waste fitting assembly. Refer to "Fixture Supports" Article.
 7. Security Water Closets, Vitreous-China, Wall-Mounting:
 - a. Description: ASME A112.19.2M, vitreous-china, accessible, **as directed**, wall-mounting, back-inlet, blowout fixture with integral contoured seat and made for institutional applications.
 - 1) Flushing Device: Concealed flushometer valve with stainless-steel access panel, push-button mechanism, and **3.5-gal./flush (13.3-L/flush)** consumption. Refer to "Flushometer Valves" Article.
 - 2) Support: Combination support and waste fitting assembly. Refer to "Fixture Supports" Article.

V. Flushometer Valves

1. Flushing Devices for Vitreous-China Water Closets:
 - a. Description: Flushometer valves, trim, and components complying with ASSE 1037. Include brass body, check-stop inlet, diaphragm operation, vacuum breaker, tailpiece, chrome-plated finish on exposed components, and non-hold-open feature on oscillating lever-handle trip mechanism. See fixture type for consumption.

W. Fixture Supports

1. Back-mounting fixtures are installed on wall sleeves. Front-mounting and wall-mounting fixtures are installed on supports specified herein.
2. Off-Floor, Plumbing Fixture Supports:
 - a. Description: ASME A112.6.1M carriers with dimensions and trim matching fixture.
 - 1) Stainless-Steel, Front-Mounting Fixtures: With modifications.

- a) Drinking Fountains: Type I drinking fountain carrier.
- b) Lavatories: Type III lavatory carrier.
- c) Shampoo Bowls: Type II sink carrier.
- d) Urinals: Type I urinal carrier with inlet seal unless Type II is required.
- e) Water Closets: Combination support and waste fitting assembly.
- 2) Vitreous-China, Wall-Mounting Fixtures:
 - a) Lavatories: Type III lavatory carrier.
 - b) Water Closets: Combination support and waste fitting assembly.
- 3) Carriers: With vertical steel uprights with feet. Include tie rods, bearing plates, and mounting studs matching fixture to be supported.
- 4) Combination Support and Waste Fitting Assemblies: With feet and inlet seal.
- 5) Carriers for Accessible Fixtures: Include rectangular, vertical steel uprights instead of steel pipe uprights.

1.5 EXECUTION

A. Security Plumbing Fixture Installation

1. Install back-mounting-type, stainless-steel security plumbing fixtures as follows:
 - a. Install wall sleeve in wall.
 - b. Install fixture on wall sleeve; mount components on or attached to wall sleeve with access from accessible service space.
 - c. Extend supply piping from service space to fixture.
 - d. Install soil and waste piping from fixture and extend into service space.
 - e. Install fixture trap in service space instead of below fixture drain.
2. Install front-mounting-type, stainless-steel security plumbing fixtures as follows:
 - a. Install fixture support or mounting bracket.
 - b. Install fixture on support; mount components inside of or attached to fixture.
 - c. Extend supply piping from pipe space to fixture.
 - d. Install trap below fixture and extend soil and waste piping into pipe space.
3. Install vitreous-china security plumbing fixtures onto accessible service space as follows:
 - a. Install fixture support in service space.
 - 1) Use combination support and waste fitting assembly for water closet.
 - 2) Use chair carriers for lavatory.
 - b. Install fixture on support.
 - c. Install components in service space.
4. Install vitreous-china security plumbing fixtures onto accessible pipe space as follows:
 - a. Install fixture support in pipe space.
 - 1) Use combination support and waste fitting assembly for water closet.
 - 2) Use carrier support for lavatory.
 - b. Install fixture on support.
 - c. Install components in pipe space with access panels. See Division 08 Section "Access Doors And Frames" for access panels not in this Section.
5. Install security plumbing fixture outlets with gasket seals.
6. Install fixtures designated "accessible" according to ICC A117.1 for heights, dimensions, and clearances.
7. Install fixtures level and plumb.
8. Install shutoff valves in water-supply piping to fixtures. Use ball, gate, or globe valve if specific type valve is not indicated. Install valves in locations where they can be easily reached for operation. Valves are specified in Division 22 Section "General-duty Valves For Plumbing Piping".
9. Install dielectric fittings in water-supply piping to fixtures if piping and fixture connections are made of different metals. See Division 22 Section "Common Work Results For Plumbing" for dielectric fittings.
10. Install toilet seats on water closets and combination units if seats are indicated.

- B. Connections
1. Piping installation requirements are specified in other Division 14. Drawings indicate general arrangement of piping, fittings, and specialties.
 2. Connect hot- and cold-water supply piping to security plumbing fixtures. Include supply stops, if specified, or ball valve on each supply. Ball valves are specified in Division 22 Section "General-duty Valves For Plumbing Piping".
 3. Connect soil and waste piping to security plumbing fixtures.
 4. Ground equipment according to Division 26 Section "Grounding And Bonding For Electrical Systems".
 5. Connect wiring according to Division 26 Section "Low-voltage Electrical Power Conductors And Cables".
- C. Field Quality Control
1. Perform the following field tests and inspections and prepare test reports:
 - a. Testing: After installing security plumbing fixtures and after electrical circuitry has been energized, test for compliance with requirements.
 - b. Remove and replace malfunctioning security plumbing fixtures. Retest as specified above after repairs or replacements are made.
- D. Adjusting
1. Operate and adjust water-supply flushometers and flow-control valves on security plumbing fixtures.
- E. Cleaning
1. Clean security plumbing fixtures, faucets, and other fittings with manufacturers' recommended cleaning methods and materials. Do the following:
 - a. Remove faucet spouts and strainers, remove sediment and debris, and reinstall spouts and strainers.
 - b. Remove sediment and debris from drains.
 2. After completing installation of exposed, factory-finished fixtures, faucets, and fittings, inspect exposed finishes and repair damaged finishes.
- F. Protection
1. Provide protective covering for installed security plumbing fixtures and fittings.
 2. Do not allow use of security plumbing fixtures for temporary facilities unless approved in writing by the Owner.

END OF SECTION 22 46 13 13



Task	Specification	Specification Description
22 46 13 16	22 46 13 13	Security Plumbing Fixtures
22 46 13 19	22 46 13 13	Security Plumbing Fixtures
22 46 16 13	22 46 13 13	Security Plumbing Fixtures
22 46 16 16	22 46 13 13	Security Plumbing Fixtures
22 46 19 00	22 46 13 13	Security Plumbing Fixtures
22 46 56 00	22 46 13 13	Security Plumbing Fixtures

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SECTION 22 47 13 00 - DRINKING FOUNTAINS AND WATER COOLERS

1.1 GENERAL

A. Description Of Work

1. This specification covers the furnishing and installation of materials for drinking fountains and water coolers. Products shall be as follows or as directed by the Owner. Installation procedures shall be in accordance with the products manufacturer's recommendations. Demolition and removal of materials shall be as required to support the work.

B. Summary

1. This Section includes the following:
 - a. Style F, freestanding drinking fountains.
 - b. Style W, wall-mounting drinking fountains.
 - c. Type PB, pressure with bubbler, Style F, freestanding water coolers.
 - d. Type PB, pressure with bubbler, Style W, wall-mounting water coolers.
 - e. Fixture supports.

C. Definitions

1. Accessible Drinking Fountain or Water Cooler: Fixture that can be approached and used by people with disabilities.
2. Cast Polymer: Dense, cast-filled-polymer plastic.
3. Drinking Fountain: Fixture with nozzle for delivering stream of water for drinking.
4. Fitting: Device that controls flow of water into or out of fixture.
5. Fixture: Drinking fountain or water cooler unless one is specifically indicated.
6. Remote Water Cooler: Electrically powered equipment for generating cooled drinking water.
7. Water Cooler: Electrically powered fixture for generating and delivering cooled drinking water.

D. Submittals

1. Product Data: For each type of product indicated.
2. Shop Drawings: Diagram power, signal, and control wiring.
3. Operation and maintenance data.

E. Quality Assurance

1. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
2. Regulatory Requirements: Comply with requirements in ICC A117.1, "Accessible and Usable Buildings and Facilities"; Public Law 90-480, "Architectural Barriers Act"; and Public Law 101-336, "Americans with Disabilities Act"; for fixtures for people with disabilities.
3. NSF Standard: Comply with NSF 61, "Drinking Water System Components--Health Effects," for fixture materials that will be in contact with potable water.
4. ARI Standard: Comply with ARI's "Directory of Certified Drinking Water Coolers" for style classifications.
5. ARI Standard: Comply with ARI 1010, "Self-Contained, Mechanically Refrigerated Drinking-Water Coolers," for water coolers and with ARI's "Directory of Certified Drinking Water Coolers" for type and style classifications.
6. ASHRAE Standard: Comply with ASHRAE 34, "Designation and Safety Classification of Refrigerants" for water coolers. Provide HFC 134a (tetrafluoroethane) refrigerant unless otherwise indicated.

1.2 PRODUCTS

A. Drinking Fountains

1. Description: Accessible, Style F, freestanding drinking fountain.
 - a. Pedestal:
 - 1) Material: Concrete **OR** Painted cast iron or steel, **as directed**.
 - 2) Shape: Rectangular **OR** Round, **as directed**, with offset to receptor **OR** with side receptor(s), **as directed**.
 - b. Receptor(s):
 - 1) Number: One **OR** Two **OR** Three, **as directed**.
 - 2) Material: Bronze **OR** Chrome-plated brass or stainless steel, **as directed**.
 - 3) Shape: Rectangular **OR** Round **OR** Rounded front, **as directed**.
 - 4) Bubbler: One for each receptor, with adjustable stream regulator, located on deck.
 - c. Controls: Foot pedal **OR** Push bar **OR** Push button, **as directed**, with adjustable stream regulator.
 - d. Access to Internal Components: Panel in pedestal.
 - e. Supply: **NPS 3/8 (DN 10) OR NPS 1/2 (DN 15)**, **as directed**, with ball, gate, or globe valve.
 - f. Drain: Grid with **NPS 1-1/4 (DN 32)** minimum horizontal waste and trap complying with ASME A112.18.2 **OR** waste to drainage system, **as directed**.
2. Description: Accessible, Style F, antifreeze, freestanding drinking fountain designed to operate without draining into ground.
 - a. Pedestal: Rectangular, painted cast iron or steel.
 - b. Receptor: Rectangular, chrome-plated brass or stainless steel with bubbler.
 - c. Control: Foot pedal with control valve assembly.
 - d. Supply: **NPS 1/2 (DN 15)** with underground shutoff and flow-control valve assembly.
 - e. Drain: Grid with **NPS 1 (DN 25) OR NPS 1-1/4 (DN 32) OR NPS 1-1/2 (DN 40)**, **as directed**, minimum waste to drainage system.
 - f. Bury Depth, Grade to Valve Components: **36 inches (915 mm) OR 48 inches (1220 mm) OR 60 inches (1525 mm)**, **as directed**.
3. Description: Accessible, Style W, wall-mounting drinking fountain.
 - a. Material: Bronze **OR** Metal **OR** Cast polymer **OR** Stainless steel **OR** Vitreous china complying with ASME 112.19.2M for drinking fountains with backsplash, **as directed**.
 - b. Receptor Shape: Rectangular **OR** Round **OR** Rounded front, **as directed**.
 - c. Back Panel: Stainless-steel wall plate behind drinking fountain.
 - d. Bubblers: One **OR** Two **OR** Three, **as directed**, with adjustable stream regulator, located on deck.
 - e. Control: Push button **OR** Push bar, **as directed**.
 - f. Supply: **NPS 3/8 (DN 10)** with ball, gate, or globe valve.
 - g. Drain: Grid with **NPS 1-1/4 (DN 32)** minimum horizontal waste and trap complying with ASME A112.18.2.
 - h. Support: Type I, water cooler carrier. Refer to "Fixture Supports" Article.
4. Description: Accessible, Style WS, wall-mounting, semirecessed drinking fountain.
 - a. Material: Stainless steel **OR** Bronze **OR** Vitreous china complying with ASME A112.19.2M for semirecessed drinking fountains, **as directed**.
 - b. Receptor Shape: Concave with projecting bowl.
 - c. Bubbler: One, with adjustable stream regulator, located on deck.
 - d. Control: Push button **OR** Push bar, **as directed**.
 - e. Supply: **NPS 3/8 (DN 10)** with ball, gate, or globe valve.
 - f. Drain: Integral punched grid with **NPS 1-1/4 (DN 32)** minimum horizontal waste and trap complying with ASME A112.18.2.
 - g. Support: Mounting frame or brackets for attaching to substrate.
5. Description: Style RE, stainless-steel, recessed drinking fountain.
 - a. Receptor Shape: Concave with flush wall flange.
 - b. Bubbler: One, with adjustable stream regulator, located on deck.

- c. Control: Push button **OR** bar, **as directed**.
 - d. Supply: **NPS 3/8 (DN 10)** with ball, gate, or globe valve.
 - e. Drain: Grid with **NPS 1-1/4 (DN 32)** minimum horizontal waste and trap complying with ASME A112.18.2.
 - f. Support: Mounting frame or brackets for attaching to substrate.
- B. Water Coolers
1. Description: ARI 1010, Type PB, pressure with bubbler, Style F, freestanding or Style FW, flush-to-wall water cooler.
 - a. Cabinet: All stainless steel **OR** Steel with powder-coat-finish **OR** Vinyl-covered steel with stainless-steel top, **as directed**.
 - b. Bubbler: One, with adjustable stream regulator, located on deck.
 - c. Control: Push button **OR** Foot pedal, **as directed**.
 - d. Supply: **NPS 3/8 (DN 10)** with ball, gate, or globe valve.
 - e. Filter: One or more water filters complying with NSF 42 and NSF 53 for cyst and lead reduction to below EPA standards; with capacity sized for unit peak flow rate.
 - f. Drain: Grid with **NPS 1-1/4 (DN 32)** minimum horizontal waste and trap complying with ASME A112.18.2.
 - g. Cooling System: Electric, with precooler, hermetically sealed compressor, cooling coil, air-cooled condensing unit, corrosion-resistant tubing, refrigerant, corrosion-resistant-metal storage tank, and adjustable thermostat.
 - 1) Capacity: **5 gph (0.0053 L/s) OR 8 gph (0.0084 L/s) OR 10 gph (0.0105 L/s) OR 14 gph (0.0147 L/s), as directed**, of **50 deg F (10 deg C)** cooled water from **80 deg F (27 deg C)** inlet water and **90 deg F (32 deg C)** ambient air temperature.
 - 2) Electrical Characteristics: **1/6 OR 1/5 OR 1/4, as directed**, hp; 120-V ac; single phase; 60 Hz.
 2. Description: ARI 1010, Type PBC, pressure with bubbler and compartment, Style F, freestanding water cooler.
 - a. Cabinet: All stainless steel **OR** Vinyl-covered steel with stainless-steel top, **as directed**, with refrigerated compartment in front panel.
 - b. Bubbler: One, with adjustable stream regulator, located on deck.
 - c. Control: Push button.
 - d. Supply: **NPS 3/8 (DN 10)** with ball, gate, or globe valve.
 - e. Filter: One or more water filters complying with NSF 42 and NSF 53 for cyst and lead reduction to below EPA standards; with capacity sized for unit peak flow rate.
 - f. Drain: Grid with **NPS 1-1/4 (DN 32)** minimum horizontal waste and trap complying with ASME A112.18.2.
 - g. Cooling System: Electric, with hermetically sealed compressor, cooling coil, air-cooled condensing unit, corrosion-resistant tubing, refrigerant, corrosion-resistant-metal storage tank, and adjustable thermostat.
 - 1) Capacity: **3 gph (0.0032 L/s) of 50 deg F (10 deg C)** cooled water from **80 deg F (27 deg C)** inlet water and **90 deg F (32 deg C)** ambient air temperature.
 - 2) Electrical Characteristics: **1/8 hp; 120-V ac; single phase; 60 Hz.**
 3. Description: Accessible, ARI 1010, Type PB, pressure with bubbler, Style W, wall-mounting water cooler for adult **OR** child, **as directed**, -mounting height.
 - a. Cabinet: Single **OR** Bilevel with two attached cabinets **OR** Bilevel with two attached cabinets and with bilevel skirt kit, **as directed**, all stainless steel **OR** vinyl-covered steel with stainless-steel top, **as directed**.
 - b. Bubbler: One, with adjustable stream regulator, located on each cabinet deck.
 - c. Control: Push button **OR** Push bar, **as directed**.
 - d. Supply: **NPS 3/8 (DN 10)** with ball, gate, or globe valve.
 - e. Filter: One or more water filters complying with NSF 42 and NSF 53 for cyst and lead reduction to below EPA standards; with capacity sized for unit peak flow rate.
 - f. Drain(s): Grid with **NPS 1-1/4 (DN 32)** minimum horizontal waste and trap complying with ASME A112.18.1.

- g. Cooling System: Electric, with hermetically sealed compressor, cooling coil, air-cooled condensing unit, corrosion-resistant tubing, refrigerant, corrosion-resistant-metal storage tank, and adjustable thermostat.
 - 1) Capacity: **5 gph (0.0053 L/s)** **OR 8 gph (0.0084 L/s)**, **as directed**, of **50 deg F (10 deg C)** cooled water from **80 deg F (27 deg C)** inlet water and **90 deg F (32 deg C)** ambient air temperature.
 - 2) Electrical Characteristics: **1/6 OR 1/5 OR 1/4 OR 1/3**, **as directed**, hp; 120-V ac; single phase; 60 Hz.
- h. Support: Type I **OR** II, **as directed**, water cooler carrier. Refer to "Fixture Supports" Article.
- 4. Description: Accessible, ARI 1010, Type PB, pressure with bubbler, Style WS, semirecessed water cooler.
 - a. Cabinet: All stainless steel **OR** Vinyl-covered steel with stainless-steel top, **as directed**.
 - b. Bubbler: One, with adjustable stream regulator, located on deck.
 - c. Control: Push button **OR** Push bar, **as directed**.
 - d. Supply: **NPS 3/8 (DN 10)** with ball, gate, or globe valve.
 - e. Filter: One or more water filters complying with NSF 42 and NSF 53 for cyst and lead reduction to below EPA standards; with capacity sized for unit peak flow rate.
 - f. Drain: Grid with **NPS 1-1/4 (DN 32)** minimum horizontal waste and trap complying with ASME A112.18.2.
 - g. Cooling System: Electric, with precooler, hermetically sealed compressor, cooling coil, air-cooled condensing unit, corrosion-resistant tubing, refrigerant, corrosion-resistant-metal storage tank, and adjustable thermostat.
 - 1) Capacity: **8 gph (0.0084 L/s)** **OR 12 gph (0.0126 L/s)**, **as directed**, of **50 deg F (10 deg C)** cooled water from **80 deg F (27 deg C)** inlet water and **90 deg F (32 deg C)** ambient air temperature.
 - 2) Electrical Characteristics: **1/6 OR 1/5**, **as directed**, hp; 120-V ac; single phase; 60 Hz.
 - h. Support: Mounting frame or brackets for attaching to substrate.
- 5. Description: ARI 1010, Type PB, pressure with bubbler, Style RE, recessed water cooler.
 - a. Cabinet: All stainless steel.
 - b. Bubbler: One, with adjustable stream regulator, located on deck.
 - c. Control: Push button **OR** bar, **as directed**.
 - d. Supply: **NPS 3/8 (DN 10)** with ball, gate, or globe valve.
 - e. Filter: One or more water filters complying with NSF 42 and NSF 53 for cyst and lead reduction to below EPA standards; with capacity sized for unit peak flow rate.
 - f. Drain: Grid with **NPS 1-1/4 (DN 32)** minimum horizontal waste and trap complying with ASME A112.18.2.
 - g. Cooling System: Electric, with precooler, hermetically sealed compressor, cooling coil, air-cooled condensing unit, corrosion-resistant tubing, refrigerant, corrosion-resistant-metal storage tank, and adjustable thermostat.
 - 1) Capacity: **8 gph (0.0084 L/s)** **OR 12 gph (0.0126 L/s)**, **as directed**, of **50 deg F (10 deg C)** cooled water from **80 deg F (27 deg C)** inlet water and **90 deg F (32 deg C)** ambient air temperature.
 - 2) Electrical Characteristics: **1/6 OR 1/5**, **as directed**, hp; 120-V ac; single phase; 60 Hz.
 - h. Ventilation Grille: Stainless steel, located above **OR** below, **as directed**, fountain.
 - i. Support: Mounting frame for attaching to substrate.

C. Water Station Water Coolers

- 1. Description: Water-station configuration, freestanding, cabinet water cooler with top-mounting glass fillers.
 - a. Cabinet: All stainless steel **OR** Enameled-steel panels with stainless-steel top, **as directed**, **0.05 inch (1.3 mm)** thick; and **32 inches (813 mm)** **OR 36 inches (915 mm)**, **as directed**, high.

- b. Receptors: Two **OR** Four, **as directed**, stainless-steel bowls, with grid drain and bottom outlet in top; with two facing front and two facing back.
 - c. Glass Fillers: Two **OR** Four, **as directed**, push-back type **OR** pedestal type, **as directed**, on top, over receptors.
 - d. Tray Slides: One on front and one on back, stainless steel.
 - e. Supply: **NPS 1/2 (DN 15)** with ball, gate, or globe valve, and connected to filter, chiller, and each glass filler.
 - f. Filter: One or more water filters complying with NSF 42 and NSF 53 for cyst and lead reduction to below EPA standards; with capacity sized for unit peak flow rate.
 - g. Drain: Waste piping from each receptor connected to **NPS 1-1/4 (DN 32) OR NPS 1-1/2 (DN 40)**, **as directed**, trap and waste to wall **OR** indirect waste to floor receptor, **as directed**, complying with ASME A112.18.2.
 - h. Cooling System: Electric, complying with ARI 1010, for Type R remote water coolers.
 - 1) Chassis: Galvanized or corrosion-resistant-coated steel.
 - 2) Chiller: Hermetically sealed compressor, cooling coil, air-cooled condensing unit, corrosion-resistant tubing, and refrigerant.
 - 3) Storage Tank: **2 gal. (7.6 L) OR 4 gal. (15.1 L) OR 6 gal. (22.7 L) OR 14 gal. (53 L) OR 25 gal. (95 L)**, **as directed**, stainless steel.
 - 4) Controls: Adjustable thermostat.
 - 5) One-Hour Peak Capacity Rate: **8 gph (0.0084 L/s) OR 12 gph (0.0126 L/s) OR 18 gph (0.0189 L/s) OR 29 gph (0.0305 L/s) OR 50 gph (0.0526 L/s)**, **as directed**, of **50 deg F (10 deg C)** cooled water from **80 deg F (27 deg C)** inlet water and **90 deg F (32 deg C)** ambient air temperature.
 - 6) Electrical Characteristics: **1/5 OR 1/4 OR 1/3 OR 1/2 OR 3/4, as directed**, hp; **120 OR 240 OR 277 OR 480, as directed**, -V ac; single phase; 60 Hz.
2. Description: Water-station configuration, freestanding, cabinet water cooler with front-mounting glass fillers.
- a. Cabinet: All stainless steel **OR** Enameled-steel panels with stainless-steel top, **as directed**, **0.05 inch (1.3 mm)** thick; and **42 inches (1067 mm) OR 48 inches (1219 mm)**, **as directed**, high.
 - b. Receptors: One **OR** Two, **as directed**, stainless-steel tray(s), with antisplash design, drain, and bottom outlet, in vertical panel(s), with one facing front and one facing back.
 - c. Glass Fillers: Two **OR** Four, **as directed**, push-back type, on vertical panel(s), over receptor(s).
 - d. Shelves: One **OR** Two, **as directed**, stainless steel, on each side panel.
 - e. Supply: **NPS 1/2 (DN 15)** with ball, gate, or globe valve, and connected to filter, chiller, and each glass filler.
 - f. Filter: One or more water filters complying with NSF 42 and NSF 53 for cyst and lead reduction to below EPA standards; with capacity sized for unit peak flow rate.
 - g. Drain: **NPS 1-1/4 (DN 32) OR NPS 1-1/2 (DN 40)**, **as directed**, trap and waste to wall **OR** indirect waste to floor receptor, **as directed**, complying with ASME A112.18.2.
 - h. Cooling System: Electric, complying with ARI 1010, for Type R remote water coolers.
 - 1) Chassis: Galvanized or corrosion-resistant-coated steel.
 - 2) Chiller: Hermetically sealed compressor, cooling coil, air-cooled condensing unit, corrosion-resistant tubing, and refrigerant.
 - 3) Storage Tank: **6 gal. (22.7 L) OR 14 gal. (53 L) OR 25 gal. (95 L) OR 30 gal. (113.6 L) OR 40 gal. (151.4 L)**, **as directed**, stainless steel.
 - 4) Controls: Adjustable thermostat.
 - 5) One-Hour Peak Capacity Rate: **18 gph (0.0189 L/s) OR 29 gph (0.0305 L/s) OR 50 gph (0.0526 L/s) OR 65 gph (0.0684 L/s) OR 85 gph (0.0894 L/s)**, **as directed**, of **50 deg F (10 deg C)** cooled water from **80 deg F (27 deg C)** inlet water and **90 deg F (32 deg C)** ambient air temperature.
 - 6) Electrical Characteristics: **1/3 OR 1/2 OR 3/4 OR 1 OR 1-1/2, as directed**, hp; **120 OR 240 OR 277 OR 480, as directed**, -V ac; single phase; 60 Hz.

D. Remote Water Coolers

1. Description: ARI 1010, Style R, remote chiller equipment for installation separate from drinking fountains. Include filter, reverse-osmosis system and ultra-violet-disinfection equipment, **as directed**.
 - a. Cooling System: Electric.
 - 1) Chassis: Galvanized or corrosion-resistant-coated steel.
 - 2) Chiller: Hermetically sealed compressor, cooling coil, air-cooled condensing unit, corrosion-resistant tubing, and refrigerant.
 - 3) Storage Tank: **0.5 gal. (1.9 L) OR 4 gal. (15.1 L), as directed**, stainless steel.
 - 4) Controls: Adjustable thermostat.
 - 5) Capacity: **5 gph (0.0053 L/s) OR 8 gph (0.0084 L/s) OR 14 gph (0.0147 L/s), as directed**, of **50 deg F (10 deg C)** cooled water from **80 deg F (27 deg C)** inlet water and **90 deg F (32 deg C)** ambient air temperature.
 - 6) Electrical Characteristics: **1/5 OR 1/4 OR 1/3, as directed**, hp; **120 OR 240 OR 277 OR 480, as directed**, -V ac; single phase; 60 Hz.
 - b. Ventilation Grille: Stainless steel.
 - c. Filter: One or more water filters complying with NSF 42 and NSF 53 for cyst and lead reduction to below EPA standards; with capacity sized for unit peak flow rate.

E. Fixture Supports

1. Description: ASME A112.6.1M, water cooler carriers. Include vertical, steel uprights with feet and tie rods and bearing plates with mounting studs matching fixture to be supported.
 - a. Type I: Hanger-type carrier with two vertical uprights.
 - b. Type II: Bilevel, hanger-type carrier with three vertical uprights.
 - c. Supports for Accessible Fixtures: Include rectangular, vertical, steel uprights instead of steel pipe uprights.

1.3 EXECUTION

A. Applications

1. Use carrier off-floor supports for wall-mounting fixtures, unless otherwise indicated.
2. Use mounting frames for recessed water coolers, unless otherwise indicated.
3. Set freestanding and pedestal drinking fountains on floor.
4. Set remote water coolers on floor, unless otherwise indicated.
5. Use chrome-plated brass or copper tube, fittings, and valves in locations exposed to view. Plain copper tube, fittings, and valves may be used in concealed locations.

B. Installation

1. Install off-floor supports affixed to building substrate and attach wall-mounting fixtures, unless otherwise indicated.
2. Install mounting frames affixed to building construction and attach recessed water coolers to mounting frames, unless otherwise indicated.
3. Install fixtures level and plumb. For fixtures indicated for children, install at height required by authorities having jurisdiction.
4. Install water-supply piping with shutoff valve on supply to each fixture to be connected to water distribution piping. Use ball, gate, or globe valve. Install valves in locations where they can be easily reached for operation. Valves are specified in Division 22 Section "General-duty Valves For Plumbing Piping".
5. Install trap and waste piping on drain outlet of each fixture to be connected to sanitary drainage system.
6. Install pipe escutcheons at wall penetrations in exposed, finished locations. Use deep-pattern escutcheons where required to conceal protruding pipe fittings. Escutcheons are specified in Division 22 Section "Common Work Results For Plumbing".

7. Seal joints between fixtures and walls and floors using sanitary-type, one-part, mildew-resistant, silicone sealant. Match sealant color to fixture color. Sealants are specified in Division 07 Section "Joint Sealants".
- C. Connections
 1. Connect fixtures with water supplies, traps, and risers, and with soil, waste, and vent piping. Use size fittings required to match fixtures.
 2. Ground equipment according to Division 26 Section "Grounding And Bonding For Electrical Systems".
 3. Connect wiring according to Division 26 Section "Low-voltage Electrical Power Conductors And Cables".
- D. Field Quality Control
 1. Water Cooler Testing: After electrical circuitry has been energized, test for compliance with requirements. Test and adjust controls and safeties.
 - a. Remove and replace malfunctioning units and retest as specified above.
 - b. Report test results in writing.
- E. Adjusting
 1. Adjust fixture flow regulators for proper flow and stream height.
 2. Adjust water cooler temperature settings.

END OF SECTION 22 47 13 00

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Task	Specification	Specification Description
22 47 16 00	01 22 16 00	No Specification Required
22 47 16 00	10 28 19 16	Plumbing Fixtures
22 47 16 00	22 01 40 81	Emergency Plumbing Fixtures
22 47 16 00	22 47 13 00	Drinking Fountains And Water Coolers
22 47 23 00	22 47 13 00	Drinking Fountains And Water Coolers
22 47 26 00	10 28 19 16	Plumbing Fixtures
22 51 13 00	01 22 16 00	No Specification Required
22 51 16 00	01 22 16 00	No Specification Required
22 51 19 00	01 22 16 00	No Specification Required
22 66 53 00	07 63 00 00	Common Work Results for Fire Suppression
22 66 53 00	07 63 00 00a	Common Work Results for Plumbing
22 66 53 00	07 63 00 00b	Common Work Results for HVAC
22 66 53 00	22 11 16 00a	Sanitary Waste And Vent Piping
22 66 53 00	22 11 16 00f	General-Service Compressed-Air Piping

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SECTION 22 66 83 16 - CHEMICAL-WASTE SYSTEMS FOR LABORATORY AND HEALTHCARE FACILITIES

1.1 GENERAL

A. Description Of Work

1. This specification covers the furnishing and installation of materials for chemical-waste systems for laboratory and healthcare facilities. Products shall be as follows or as directed by the Owner. Installation procedures shall be in accordance with the products manufacturer's recommendations. Demolition and removal of materials shall be as required to support the work.

C. Summary

1. Section Includes:
 - a. Single-wall piping.
 - b. Double-containment piping.
 - c. Field-fabrication containment piping.
 - d. Piping specialties.
 - e. Neutralization tanks.
 - f. Neutralization systems.
 - g. Manholes.
 - h. Leak-detection systems.

D. Definitions

1. CR: Chlorosulfonated polyethylene synthetic rubber.
2. FPM: Vinylidene fluoride-hexafluoro propylene copolymer rubber.

E. Performance Requirements

1. Single-Wall Piping Pressure Rating: 10 feet head of water (30 kPa).
2. Double-Containment Piping Pressure Rating:
 - a. Carrier Piping: 5-psig (34.5-kPa) air test pressure.
 - b. Containment Piping: 5-psig (34.5-kPa) air test pressure.
3. Field-Fabrication Containment-Piping Pressure Rating: 5-psig (34.5-kPa) air test pressure.
4. Delegated Design: Design seismic restraints for aboveground piping, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

F. Submittals

1. Product Data: For each type of product indicated.
2. LEED Submittal:
 - a. Product Data for Credit EQ 4.1: For solvent cements and adhesive primers, including printed statement of VOC content.
3. Shop Drawings: For neutralization system and leak-detection system. Include plans, elevations, sections, details, and attachments to other work.
 - a. Detail neutralization-system assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
 - b. Detail leak-detection-system assemblies and indicate required clearances, method of field assembly, components, and location and size of each field connection.
 - c. Wiring Diagrams: For power, signal, and control wiring.
4. Delegated-Design Submittal: For seismic restraints of aboveground piping, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
5. Profile Drawings for Outdoor Underground Piping: Show system piping in elevation. Draw profiles at horizontal scale of not less than 1 inch equals 50 feet (1:500) and vertical scale of not

less than **1 inch equals 5 feet (1:50)**. Indicate underground structures and pipes. Show types, sizes, materials, and elevations of other utilities crossing system piping.

6. Field quality-control test reports.
7. Operation and Maintenance Data: For chemical-waste specialties and neutralization tanks, neutralization systems, and leak-detection systems to include in emergency, operation, and maintenance manuals.

G. Quality Assurance

1. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
2. NFPA Compliance: Comply with NFPA 70, "National Electrical Code."

H. Delivery, Storage, And Handling

1. Deliver and store piping and specialties with sealing plugs in ends or with end protection.
2. Do not store plastic pipe or fittings in direct sunlight.
3. Protect pipe, fittings, and seals from dirt and damage.

I. Project Conditions

1. Interruption of Existing Chemical-Waste Service: Do not interrupt chemical-waste service to facilities occupied by the Owner or others unless permitted under the following conditions and then only after arranging to provide temporary chemical-waste service according to requirements indicated:
 - a. Notify the Owner no fewer than two days in advance of proposed interruption of chemical-waste service.
 - b. Do not proceed with interruption of chemical-waste service without the Owner's written permission.

1.2 PRODUCTS

A. Single-Wall Pipe And Fittings

1. PE Drainage Pipe and Fittings: Made of ASTM D 4976, PE resin.
 - a. Pipe: ASTM F 1412, Schedule 40.
 - b. Fittings: ASTM F 1412, Schedule 40, socket-fusion, drainage pattern complying with ASTM D 3311.
2. PP Drainage Pipe and Fittings: ASTM F 1412, pipe extruded and drainage-pattern fittings molded, with Schedule 40 dimensions, from PP resin with fire-retardant additive complying with ASTM D 4101; with fusion **OR** fusion- and mechanical **OR** mechanical, **as directed**, joint ends.
 - a. Exception: Pipe and fittings made from PP resin without fire-retardant additive may be used for underground installation.
3. PVC Drainage Pipe and Fittings: ASTM D 2665, pipe and drainage-pattern fittings.
4. PVDF Drainage Pipe and Fittings: ASTM F 1673, Schedule 40, pipe and drainage-pattern fittings. Include fittings with fusion **OR** fusion- and mechanical **OR** mechanical, **as directed**, joint ends.
5. Fiberglass Pipe and Fittings, Centrifugally Cast: ASTM D 2997, Type II, Grade 1 **OR** Grade 2, **as directed**, Class A **OR** Class B **OR** Class C, **as directed**, RTRP pipe; with ASTM D 5685, Type 4, RTRF fittings matching pipe; and adhesive-bonding **OR** butt-and-wrap-joint, **as directed**, materials. Include wall thickness that will provide **160-psig (1105-kPa)** minimum, sustained water test pressure rating.
6. Fiberglass Pipe and Fittings, Filament Wound: ASTM D 2996, Type I, Grade 1 **OR** Grade 2, **as directed**, Class A **OR** Class B **OR** Class C **OR** Class E **OR** Class F, **as directed**, RTRP pipe; ASTM D 5685, Type 1, RTRF fittings matching pipe; and adhesive-bonding **OR** butt-and-wrap-joint, **as directed**, materials. Include wall thickness that will provide **160-psig (1105-kPa)** minimum, sustained water test pressure rating.